ATTACHMENT G1
Exhibits to Comment Letter I9

NOTE: This is a public document, Comment Letter I9, Exhibits E, G, K, L, N, O, P, Q, T, U, and V are available online.

EXHIBIT F

Comment Letter I9

MAMMOTH PACIFIC I REPLACEMENT PROJECT

REVISED DRAFT ENVIRONMENTAL IMPACT REPORT

California Clearinghouse Number 2011022020

February 2012

CEQA Lead Agency:

Mono County
P.O. Box 2415
Mammoth Lakes, California 93546

1 INTRODUCTION

This assessment is a Revised Draft Environmental Impact Report (Revised Draft EIR) of the proposed Mammoth Pacific I (MP-I) Replacement Project that was prepared to meet the requirements of the California Environmental Quality Act (CEQA; Public Resources Code 21000-21178.1). This Revised Draft EIR describes the existing environment that would be affected by, and the environmental impacts which could result from the proposed MP–I Replacement Project and the alternatives described in Chapter 2 of this Revised Draft EIR.

1.1 PROJECT DESCRIPTION

The Mammoth Pacific I Replacement Project (Project) has been proposed by Mammoth Pacific L.P. (MPLP) to replace the aging Mammoth Pacific Unit I (MP–I) power plant with a modern and more efficient binary power plant (M–1) while maintaining the existing geothermal wellfield, pipeline system and ancillary facilities. The existing MP–I project is a commercial geothermal project located near Casa Diablo Hot Springs in Mono County, California that has been in operation since 1984 (see Figure 1). The existing MP–I Project is one of three existing binary geothermal power plants (MP-I, MP-II and PLES-I) co-located in what is known as the Casa Diablo geothermal development complex (see Figure 2). The MP-I Project consists of a binary power plant with a design capacity of about 14 megawatts (MW), a geothermal wellfield, production and injection fluid pipelines, and ancillary facilities located approximately 1,200 feet northeast of the intersection of U.S. Highway 395 and California State Route 203 on 90 acres of private (fee) land owned by Ormat Nevada, Inc. (Ormat), the parent company of MPLP.

The M-1 replacement plant site would be located entirely on private land about 500 feet northeast of the existing MP-I power generation facilities and immediately adjacent to the existing MP-II power plant. The proposed M–1 replacement power plant would be capable of generating, on average, approximately 18.8 MW (net) of electricity. The Project would replace the existing MP-I power generation facilities. The Project would not change the existing geothermal wellfield or wellfield operations, and it would not change the amount of geothermal resource utilized by the existing Casa Diablo geothermal development complex; therefore, no adverse impact on the geothermal reservoir would occur as a result of the Project (see Appendix B).

During M–1 plant startup operations, the existing MP–I plant would continue to operate until the new M-1 replacement plant becomes commercial, after which time MPLP would close and dismantle the old MP–I plant. The transition period during which both the existing MP–I and the replacement M–1 plant startup operations would overlap would be a period of up to two years from the date the M–1 plant begins startup operations. The net amount of geothermal resource utilized by the existing Casa Diablo geothermal development complex would not change as a result of any aspect of the Project either during the MP-I/M-1 transition overlap or after the MP-I plant operations are discontinued entirely and the M-1 plant is operating commercially.

After the existing MP-I plant is dismantled, the plant facilities would be removed from the site, the site would be re-graded, covered with gravel and converted to a fenced equipment storage yard that would also be used periodically for overflow parking. This interim restoration of the MP-I plant site is described in the Reclamation Plan submitted to Mono County (see Appendix L). In addition, site reclamation at the that could potentially result from changes to groundwater production, long–term geothermal fluid production or other factors in the Long Valley Caldera (Thomas 2005).

The existing geothermal development at Casa Diablo is operating under a stipulated Owens tui chub monitoring and remedial action program intended to protect the Owens tui chub critical habitat supported by the Hot Creek headsprings. The program was initially adopted in 1990 as set forth in Stipulation No. 1 of the Bureau of Land Management approval of the Plans of Operation for Development, Injection and Utilization for the then proposed PLES-I Geothermal Project, but the program also considered the MP–I and MP–II projects.

The monitoring program is coordinated by the Long Valley Hydrologic Advisory Committee (LVHAC). The monitoring data is routinely evaluated by the Mono County Economic Development Department (MCEDD), the LVHAC and CDFG (Mono County General Plan, Energy Resources, Goal 1, Objectives C and D). Small changes have been observed in some of the Long Valley caldera springs since the Casa Diablo geothermal operation began in 1984 (see Section 4.8), but, to date, there have been no substantive impacts on the Hot Creek headsprings supporting the Owens tui chub that have been attributed to geothermal development in the Long Valley caldera. The LVHAC will continue to conduct the hydrologic and biologic monitoring activities (Personal Communication – Dan Lyster, Director, MCEDD; June 22, 2011).

The proposed MP-I Replacement Project would not change the existing MP-I wellfield or rate of geothermal production or injection. As such, there would be no change on the effects of the existing geothermal utilization on springs that are connected to the geothermal production or injection reservoirs. Specific concern has been expressed that a decrease in geothermal injection fluid temperature could occur as a possible result of additional heat extraction from the geothermal fluid by the new technology proposed for the M-1 replacement plant. A substantial change in injection fluid temperature could lead to changes in the geothermal reservoir with possible adverse effects on hydrogeologically connected springs. The Applicant has provided evidence that the increased efficiency of the new technology and other operational changes would result in both a higher rate of electrical energy production from the M-1 replacement plant as well as the return of slightly warmer (3-4˚F) rather than cooler geothermal fluid injection temperatures (see Appendix B). The return of slightly warmer injection fluid would diminish whatever adverse effect on the injection reservoir that may be occurring from the existing return of slightly cooler injection fluid to the injection reservoir. As such, there would be no new potential for adverse impact on the Hot Creek headsprings habitat of the Owens tui chub as a result of the Project.

Based on this assessment there would be no potential for significant adverse impacts on the Owens tui chub critical habitat as a result of the proposed Project. In addition, a mitigation measure is provided to require that the existing MP-I Project, as modernized by the proposed MP-I Replacement Project facilities, must adopt the same monitoring and remedial action plan requirements for protecting the Owens tui chub critical habitat as required for new projects pursuant to Mono County General Plan (Mono County General Plan, Conservation/Open Space Element, Energy Resources, Goal 1, Objectives C and D), and as is currently required for the existing MP-II Project (see Table 17). This requirement would ensure that the monitoring and remedial action program requirements currently in place to protect the headsprings supporting the Owens tui chub critical habitat would continue even if the existing MP-II and PLES-I projects should be abandoned. The following mitigation measure is required.[2, 3]

[2] The referenced Goal 1, Objectives C and D, of the Conservation/Open Space Element are provided above in Table 17, and the referenced MP-II Geothermal Power Plant CUP conditions are provided as Appendix K of this Revised Draft EIR. See specifically MP-II Project CUP conditions D.5, and D.9 through D.18, as applicable.

MAMMOTH PACIFIC I REPLACEMENT PROJECT

DRAFT ENVIRONMENTAL IMPACT REPORT

California Clearinghouse Number 2011022020

July 2011

CEQA Lead Agency:

Mono County
P.O. Box 2415
Mammoth Lakes, California 93546

COUNTY OF MONO
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CALIFORNIA

Comment Letter I9

MAMMOTH PACIFIC I REPLACEMENT PROJECT

DRAFT ENVIRONMENTAL IMPACT REPORT

California Clearinghouse Number 2011022020

July 2011

CEQA Lead Agency:

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1 INTRODUCTION

This assessment is a Draft Environmental Impact Report (Draft EIR) that was prepared to meet the requirements of the California Environmental Quality Act (CEQA; Public Resources Code 21000–21178.1). This Draft EIR describes the existing environment that would be affected by, and the environmental impacts which could result from the proposed Mammoth Pacific I (MP–I) Replacement Project and the alternatives described in Chapter 2 of this Draft EIR.

1.1 OVERVIEW OF THE PROPOSED PROJECT

The existing Mammoth Pacific Unit I (MP–I) project is a commercial geothermal development project operated by Mammoth Pacific L.P. (MPLP) and located near Casa Diablo Hot Springs in Mono County, California (see Figure 1). The existing MP–I project consists of a binary power plant with a design capacity of about 14 megawatts (MW), a geothermal wellfield, production and injection fluid pipelines, and ancillary facilities that have been operating since 1984. The existing MP–I power plant site is located approximately 1,200 feet northeast of the intersection of U.S. Highway 395 and California State Route 203 on 90 acres of private (fee) land owned by Ormat Nevada, Inc. (Ormat), the parent company of MPLP (see Figure 2).

The proposed Mammoth Pacific I Replacement Project (Project) has been proposed by MPLP (Applicant) to replace the aging MP–I power plant with a new, more modern and efficient binary power plant (M–1) while maintaining the existing geothermal wellfield, pipeline system and ancillary facilities. The proposed M–1 replacement power plant would be capable of generating, on average, approximately 18.8 MW (net) of electricity from the same geothermal resources currently supplying the existing MP–I plant. This represents about a 34 percent increase in the net electricity generation from the same geothermal resources currently being utilized for the existing MP–I facility. During M–1 plant startup operations, the existing MP–I plant would continue to operate until the new M–1 plant becomes commercial, after which time MPLP would close and dismantle the old MP–I plant. The transition period during which both the MP–I and M–1 operations would overlap would be a period of up to two years from the date the M–1 plant begins startup operations.

1.2 OBJECTIVES OF THE PROPOSED PROJECT AND THE EIR

The Project is a proposal by MPLP to decommission the existing MP–I power plant and to construct, operate, maintain and eventually decommission the M–1 replacement plant. The following describes the key participants and their roles in the development, analysis, and decisions related to the Project.

1.2.1 Mammoth Pacific, L.P.

MPLP's objectives for the Project are to continue to generate electricity within the MP–I project area from the production and commercial utilization of the geothermal resources currently utilized by the aging MP–I plant. MPLP's specific objectives for the Project are (a) to optimize the amount of electrical energy that can be generated from the available geothermal resources; (b) to replace the existing MP–I plant with a new, more modern and efficient binary power plant; and (c) to ensure continuous power generation and maximize utilization of the geothermal resource. MPLP has filed the required applications for a

Conditional Use Permit (CUP) and needed variances with Mono County for the Project. Approval of the CUP and variances would grant MPLP the right to construct and operate the new M–1 plant; to temporarily continue to operate the existing MP–I plant with the M–1 plant during the commissioning period; and to decommission the MP–I plant after the replacement M–1 plant is fully operational. In addition, MPLP has submitted a Reclamation Plan for the Project which must be approved by Mono County; and to actually commence construction of the new M–1 replacement plant, MPLP would also need to submit applications for and obtain approval, as necessary, from other responsible agencies for discretionary permit(s) and from Mono County for approval of grading and building permits required for construction.

1.2.2 Mono County

Mono County is the lead agency for compliance with CEQA for the Project. MPLP has filed the required permit application with Mono County to obtain approval for the construction and operation of the proposed M–1 replacement plant within the Project area. The objectives of Mono County for preparing this EIR are to comply with the requirements of CEQA and to evaluate the potential environmental impacts of the *Proposed Project* consistent with the requirements of CEQA and the County General Plan. Policy 8 of the Land Use Element of the General Plan provides the following direction:

> *Regulate geothermal development and other energy development projects in a manner consistent with the Energy Resources Policies in the Conservation/Open Space Element.* [Action 8.5]

The following relevant goals, objectives, and policies for Energy Resources are set forth in the Conservation/Open Space Element of the General Plan.

> *Goal 1: Establish a regulatory process with respect to both geothermal exploration and development that ensures that permitted projects are carried out with minimal or no adverse environmental impacts.*
>
> *Goal 2: Permit the productive and beneficial development of alternative energy resources, including geothermal resources, consistent with the objectives of Goal I and national and local interests.*
>
> *Objective A*
> *Provided that the environment is protected in the manner required by the policies and actions of Goal I of this section of the Conservation/Open Space Element, County policy shall ensure the orderly and sound economic development of geothermal resources under the appropriate circumstances.*
>
> > *Policy 1: Decisions on applications for geothermal development permits may take into account evidence of national needs for alternative energy development.*
> >
> > *Policy 2: Decisions on applications for geothermal development permits should be relatively more favorable during times of scarcities of other energy sources.*
> >
> > > *Action 2.1: Applicants for permits for geothermal exploration and development may be required to submit information showing the benefits of geothermal energy during the proposed period of geothermal*

Table 11: Projected M-1 Plant Site Mitigated Annual Construction Air Emissions

Source	ROG[b] (tons/year)	NO_x (tons/year)	CO (tons/year)	SO_2 (tons/year)	PM_{10} Total (tons/year)
Site Construction 2011[a]	0.42	3.15	1.88	0.00	0.81
Site Construction 2012[a]	4.11	7.53	5.34	0.01	2.04

Model: CalEEMod (ENVIRON 2011)
[a] Assumes power plant construction begins September 2011and ends October 2012 and assumes the maximum number of construction workers on site at any time is 80 workers.
[b] Reactive organic gases (ROG) are non-methane organic compound emissions that are assumed to be precursors to the formation of secondary photochemical oxidant air pollutants in the atmosphere, including ozone. The more current federal term is volatile organic compounds (VOC).

The plant site construction air emissions would be short term and temporary and the mitigated construction emissions would not result in a significant CEQA impact.

Replacement Plant Operations:

The proposed MP-I replacement plant would be an air-cooled, binary power plant in which both the geothermal fluid and the motive fluid (n-pentane) would be contained in closed systems with no operational emission sources. The project design eliminates emissions of noncondensible gases (carbon dioxide, hydrogen sulfide, etc.) from the geothermal fluid and cooling tower emissions typical of geothermal flash power plants. Geothermal power plants do not burn fossil fuels so there would be no combustion emissions typical of coal, oil or natural gas fired power plants.

There would be no change in the existing MP-I wellfield operations and no new geothermal well drilling or testing operations would be associated with MP-I Replacement Project. As such, there would be no increased potential for the release of noncondensible gases, including hydrogen sulfide gas, from the geothermal fluid to the atmosphere, and there would be no increase in the potential for objectionable odors that could affect a substantial number of people from the Project.

Motive Fluid Emissions: The existing MP-I power plant uses isobutane as the motive fluid. Both isobutane and n-pentane are VOC and both are considered to be air contaminants. Based on motive fluid inventory records at similar facilities to those proposed by the Project, the Applicant has estimated that up to 205 pounds per day of fugitive n-pentane emissions would occur from very tiny leaks of n-pentane through valves, flanges, seals, and other connections which would be released to the atmosphere. Air leaked into the n-pentane condensers would be captured in the proposed OEC Unit vapor recovery units (VRU). Some n-pentane vapors would be discharged to the atmosphere from the OEC Unit VRU and from maintenance VRU during OEC Unit maintenance activities. After abatement the annual potential fugitive emissions of n-pentane from the Project would be about 37.4 tons based on the estimated daily losses. This would represent about a 60 percent decrease in fugitive VOC emissions from the MP-I Project as the aging MP-I plant has fugitive losses of up to 500 pounds per day (91.3 tons per year) of isobutane.

According to GBUACD regulations, new stationary sources of emissions which would result in a net increase in emissions of 250 or more pounds per day of any air pollutant or precursor (excepting carbon monoxide or particulate matter) must meet Best Available Control Technology (BACT) and Mitigation Requirements (GBUAPCD Rule 209-A Section D). The fugitive losses of n-pentane would not exceed the regulatory threshold requiring BACT.

EXHIBIT H

DRAFT
Project Management Indicator Species Report

Casa Diablo IV Geothermal Development Project

Mammoth Lakes Ranger District
Inyo National Forest

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10/12/2010

1. Introduction

The purpose of this report is to evaluate and disclose the impacts of the Casa Diablo IV Geothermal Development (CD-4) Project on the habitat of the thirteen (13) Management Indicator Species (MIS) identified in the Forest (NF) Land and Resource Management Plan (LRMP) (USDA 1988) as amended by the Sierra Nevada Forests Management Indicator Species Amendment (SNF MIS Amendment) Record of Decision (USDA Forest Service 2007a). This report documents the effects of the proposed action and alternatives on the habitat of selected project-level MIS. This report also addresses habitat of the mule deer (*Odocoileus hemionus*), an Inyo National Forest Species of Special Interest (SSI).

MIS are animal species identified in the SNF MIS Amendment Record of Decision (ROD) signed December 14, 2007, which was developed under the 1982 National Forest System Land and Resource Management Planning Rule (1982 Planning Rule) (36 CFR 219). Guidance regarding MIS set forth in the LRMP as amended by the 2007 SNF MIS Amendment ROD directs Forest Service resource managers to (1) at project scale, analyze the effects of proposed projects on the habitat of each MIS affected by such projects, and (2) at the bioregional scale, monitor populations and/or habitat trends of MIS, as identified in the LRMP as amended.

1.a. Direction Regarding the Analysis of Project-Level Effects on MIS Habitat

Project-level effects on MIS habitat are analyzed and disclosed as part of environmental analysis under the National Environmental Policy Act (NEPA). This involves examining the impacts of the proposed project alternatives on MIS habitat by discussing how direct, indirect, and cumulative effects will change the habitat in the analysis area.

These project-level impacts to habitat are then related to broader scale (bioregional) population and/or habitat trends. The appropriate approach for relating project-level impacts to broader scale trends depends on the type of monitoring identified for MIS in the LRMP as amended by the SNF MIS Amendment ROD. Hence, where the NF LRMP as amended by the SNF MIS Amendment ROD identifies distribution population monitoring for an MIS, the project-level habitat effects analysis for that MIS is informed by available distribution population monitoring data, which are gathered at the bioregional scale. For greater sage-grouse, the Inyo NF LRMP as amended by the SNF MIS Amendment ROD, does not identify population monitoring or surveys, and project-level MIS habitat effects analysis is informed by available bioregional scale habitat monitoring data. The bioregional scale monitoring identified in the NF LRMP, as amended, for MIS analyzed for the CD-4 Project is summarized in Section 3 of this report.

Adequately analyzing project effects to MIS generally involves the following steps:

- Identifying which habitat and associated MIS would be either directly or indirectly affected by the project alternatives; these MIS are potentially affected by the project.
- Summarizing the bioregional-level monitoring identified in the LRMP, as amended, for this subset of MIS.
- Analyzing project-level effects on MIS habitat for this subset of MIS.

- Discussing bioregional scale habitat and/or population trends for this subset of MIS.
- Relating project-level impacts on MIS habitat to habitat and/or population trends at the bioregional scale for this subset of MIS.

These steps are described in detail in the Pacific Southwest Region's draft document "MIS Analysis and Documentation in Project-Level NEPA, R5 Environmental Coordination" (May 25, 2006). This Management Indicator Species (MIS) Report documents application of the above steps to select project-level MIS and analyze project effects on MIS habitat for the CD-4 Project.

1.b. Direction Regarding Monitoring of MIS Population and Habitat Trends at the Bioregional Scale.

The bioregional scale monitoring strategy for the Inyo NF's MIS is found in the Sierra Nevada Forests Management Indicator Species Amendment (SNF MIS Amendment) Record of Decision (ROD) of 2007. Bioregional scale habitat monitoring is identified for all twelve of the terrestrial MIS. In addition, bioregional scale population monitoring, in the form of distribution population monitoring, is identified for all of the terrestrial MIS except for the greater sage-grouse. For aquatic macroinvertebrates, the bioregional scale monitoring identified is Index of Biological Integrity and Habitat. The current bioregional status and trend of populations and/or habitat for each of the MIS is discussed in the Sierra Nevada Forests Bioregional Management Indicator Species (SNF Bioregional MIS) Report (USDA Forest Service 2008).

- **MIS Habitat Status and Trend.**

  All habitat monitoring data are collected and/or compiled at the bioregional scale, consistent with the LRMP as amended by the 2007 SNF MIS Amendment ROD (USDA Forest Service 2007a).

  Habitats are the vegetation types (for example, early seral coniferous forest) or ecosystem components (for example, snags in green forest) required by an MIS for breeding, cover, and/or feeding. MIS for the Sierra Nevada National Forests represent 10 major habitats and 2 ecosystem components (USDA Forest Service 2007a), as listed in Table 1. These habitats are defined using the California Wildlife Habitat Relationship (CWHR) System (CDFG 2005). The CWHR System provides the most widely used habitat relationship models for California's terrestrial vertebrate species (ibid). It is described in detail in the SNF Bioregional MIS Report (USDA Forest Service 2008).

  Habitat status is the current amount of habitat on the Sierra Nevada Forests. Habitat trend is the direction of change in the amount or quality of habitat over time. The methodology for assessing habitat status and trend is described in detail in the SNF Bioregional MIS Report (USDA Forest Service 2008).

- **MIS Population Status and Trend.**
  All population monitoring data are collected and/or compiled at the bioregional scale, consistent with the LRMP as amended by the 2007 SNF MIS Amendment ROD (USDA Forest Service 2007a). The information is presented in detail in the 2008 SNF Bioregional MIS Report (USDA Forest Service 2008).

Population monitoring strategies for MIS of the Inyo NF are identified in the 2007 Sierra Nevada Forests Management Indicator Species (SNF MIS) Amendment ROD (USDA Forest Service 2007a). Population status is the current condition of the MIS related to the population monitoring data required in the 2007 SNF MIS Amendment ROD for that MIS. Population trend is the direction of change in that population measure over time.

There are a myriad of approaches for monitoring populations of MIS, from simply detecting presence to detailed tracking of population structure (USDA Forest Service 2001, Appendix E, page E-19). A distribution population monitoring approach is identified for all of the terrestrial MIS in the 2007 SNF MIS Amendment, except for the greater sage-grouse (USDA Forest Service 2007a). Distribution population monitoring consists of collecting presence data for the MIS across a number of sample locations over time. Presence data are collected using a number of direct and indirect methods, such as surveys (population surveys), bird point counts, tracking number of hunter kills, counts of species sign (such as deer pellets), and so forth. The specifics regarding how these presence data are assessed to track changes in distribution over time vary by species and the type of presence data collected, as described in the SNF Bioregional MIS Report (USDA Forest Service 2008).

- **Aquatic Macroinvertebrate Status and Trend.**
  For aquatic macroinvertebrates, condition and trend is determined by analyzing macroinvertebrate data using the predictive, multivariate River Invertebrate Prediction And Classification System (RIVPACS) (Hawkins 2003) to determine whether the macroinvertebrate community has been impaired relative to reference condition within perennial water bodies. This monitoring consists of collecting aquatic macroinvertebrates and measuring stream habitat features according to the Stream Condition Inventory (SCI) manual (Frasier et al. 2005). Evaluation of the condition of the biological community is based upon the "observed to expected" (O/E) ratio, which is a reflection of the number of species observed at a site versus the number expected to occur there in the absence of impairment. Sites with a low O/E scores have lost many species predicted to occur there, which is an indication that the site has a lower than expected richness of sensitive species and is therefore impaired.

2. Selection of Project level MIS

Management Indicator Species (MIS) for the Inyo NF are identified in the 2007 Sierra Nevada Forests Management Indicator Species (SNF MIS) Amendment (USDA Forest Service 2007a). The habitats and ecosystem components and associated MIS analyzed for the project were selected from this list of MIS, as indicated in Table 1. In addition to identifying the habitat or ecosystem components (1st column), the CWHR type(s) defining each habitat/ecosystem component (2nd column), and the associated MIS (3rd column), the Table discloses whether or not the habitat of the MIS is potentially affected by the Inyo Project (4th column).

Table 1. Selection of MIS for Project-Level Habitat Analysis for the CD-4 Project.

Habitat or Ecosystem Component	CWHR Type(s) defining the habitat or ecosystem component[1]	Sierra Nevada Forests Management Indicator Species *Scientific Name*	Category for Project Analysis [2]
Riverine & Lacustrine	lacustrine (LAC) and riverine (RIV)	aquatic macroinvertebrates	2
Shrubland (west-slope chaparral types)	montane chaparral (MCP), mixed chaparral (MCH), chamise-redshank chaparral (CRC)	fox sparrow *Passerella iliaca*	1
Sagebrush	Sagebrush (SGB)	greater sage-grouse *Centrocercus urophasianus*	3
Riparian	montane riparian (MRI), valley foothill riparian (VRI)	yellow warbler *Dendroica petechia*	2
Wet Meadow	Wet meadow (WTM), freshwater emergent wetland (FEW)	Pacific tree frog *Pseudacris regilla*	2
Early Seral Coniferous Forest	ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree sizes 1, 2, and 3, all canopy closures	Mountain quail *Oreortyx pictus*	2
Mid Seral Coniferous Forest	ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree size 4, all canopy closures	Mountain quail *Oreortyx pictus*	
Late Seral Open Canopy Coniferous Forest	ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree size 5, canopy closures S and P	Sooty (blue) grouse *Dendragapus obscurus*	1
Late Seral Closed Canopy Coniferous Forest	ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), tree size 5 (canopy closures M and D), and tree size 6.	California spotted owl *Strix occidentalis occidentalis*	2
		American marten *Martes americana*	3
		northern flying squirrel *Glaucomys sabrinus*	2

Snags in Green Forest	Medium and large snags in green forest	hairy woodpecker *Picoides villosus*	2
Snags in Burned Forest	Medium and large snags in burned forest (stand-replacing fire)	black-backed woodpecker *Picoides arcticus*	1
Sagebrush	Sagebrush (SGB)	Mule deer* *Odocoileus hemionus*	3

[1] All CWHR size classes and canopy closures are included unless otherwise specified; **dbh** = diameter at breast height; **Canopy Closure classifications:** S=Sparse Cover (10-24% canopy closure); P= Open cover (25-39% canopy closure); M= Moderate cover (40-59% canopy closure); D= Dense cover (60-100% canopy closure); **Tree size classes:** 1 (Seedling)(<1" dbh); 2 (Sapling)(1"-5.9" dbh); 3 (Pole)(6"-10.9" dbh); 4 (Small tree)(11"-23.9" dbh); 5 (Medium/Large tree)(≥24" dbh); 6 (Multi-layered Tree) [In PPN and SMC] (Mayer and Laudenslayer 1988).

[2] **Category 1:** MIS whose habitat is not in or adjacent to the project area and would not be affected by the project.
Category 2: MIS whose habitat is in or adjacent to project area, but would not be either directly or indirectly affected by the project.
Category 3: MIS whose habitat would be either directly or indirectly affected by the project.

The category 1 MIS whose habitat is not in or adjacent to the project area and will not be affected by the project includes the fox sparrow, sooty blue grouse and the black-backed woodpecker. These species will therefore not be discussed further in this analysis.

The MIS whose habitat would be either directly or indirectly affected by the CD-4 Project, identified as Category 3 and 2 in Table 1 above, are carried forward in this analysis, which will evaluate the direct, indirect, and cumulative effects of the proposed action and alternatives on the habitat of these MIS. The MIS selected for project-level MIS analysis for the CD-4 Project are: aquatic invertebrates, greater sage-grouse, yellow warbler, pacific tree frog, mountain quail, California spotted owl, American marten, northern flying squirrel and hairy woodpecker. The mule deer was selected for analysis as a SSI.

3. Bioregional Monitoring Requirements for MIS Selected for Project-Level Analysis

3.a. MIS Monitoring Requirements.

The Sierra Nevada Forests Management Indicator Species (SNF MIS) Amendment (USDA Forest Service 2007a) identifies bioregional scale habitat and/or population monitoring for the Management Indicator Species for ten National Forests, including the Inyo NF (USDA Forest Service 2007a). The habitat and/or population monitoring requirements for Inyo NF's MIS are described in the Sierra Nevada Forests Bioregional Management Indicator Species (SNF Bioregional MIS) Report (USDA Forest Service 2008) and are summarized below for the MIS being analyzed for the CD-4 Project. The applicable habitat and/or population monitoring results are described in the SNF Bioregional MIS Report (USDA Forest Service 2008) and are summarized in Section 5 below for the MIS being analyzed for the CD-4 Project.

Habitat monitoring at the bioregional scale is identified for all the habitats and ecosystem components, including the following analyzed for the CD-4 Project: sagebrush and late seral closed canopy coniferous forest.

Population monitoring at the bioregional scale for mule deer, yellow warbler, Pacific tree frog, mountain quail, California spotted owl, American marten, northern flying squirrel, and hairy woodpecker. Distribution population monitoring. Distribution population monitoring consists of collecting presence data for the MIS across a number of sample locations over time (also see USDA Forest Service 2001, Appendix E).

3.b. How MIS Monitoring Requirements are Being Met.

Habitat and/or distribution population monitoring for all MIS is conducted at the Sierra Nevada scale. Refer to the SNF Bioregional MIS Report (USDA Forest Service 2008) for details by habitat and MIS.

4. Description of Proposed Project.

The project includes the construction, operation, and maintenance of the proposed CD-4 Project to process and transport geothermal fluid in leases CA11672, CA 11667, and CA 14408 located within the Inyo National Forest in Section 32, of Township 3 south and Range 27 East, MDB&M. The Project (location/vicinity Map Figure 1 / Project Map Figure 2) would consist of the following facilities:

- Geothermal power plant consisting of (2) OEC binary generating units (21.2 MW gross each) with vaporizers, turbines, generators, air-cooled condensers, preheaters, pumps and piping, motive fluid (isopentane) storage, a motive fluid vapor recovery system (VRU), and related ancillary equipment. The gross power generation of the plant would be 42.4 MW from the CD-4 plant. The estimated auxiliary and parasitic loads (power used within the project for the circulation pumps, fan, well pumps, loss in transformers and cables) is about 9.4, this providing a net power output of 33 MW.
- Up to 16 wells over the life of the project. Approximately half of the wells would be production wells and the other half injection wells. The final number of wells would be determined by modeling and actual drilling results. Two of these wells, 57-25 and 66-25 are already being used by the existing plants. Each production well would range in depth from 1,600 to 2,000 feet, and new injection wells would be approximately 2,500 feet in depth. Production wells would be equipped with a downhole pump powered by a surface electric motor.
- Geothermal piping from production wells to the power plant and from the power plant to the injection wells. Water piping from the Mammoth Lakes water facility to the geothermal piping near wells 12-31, 12A-31 and 23-31.
- Main pipeline will parallel MPLPs existing Basalt Canyon pipeline through Basalt Canyon and would cross U.S. 395 either at the same place as the existing pipeline, or farther north across Los Angeles Department of Water and Power land to access the CD-4 power plant site.
- Pumps, tanks, valves, controls, flow monitoring and other necessary equipment to the wells and pipelines. Power and control cables for the wells would either be installed in above-ground cable trays placed on the pipeline supporters or buried along and adjacent to the pipeline.
- New Substation connected to the Southern California Edison Casa Diablo Substation at Substation Road with a half mile long 33 kilovolt (kV) transmission line either above

ground with 66 foot high poles, on the ground, or buried below ground.

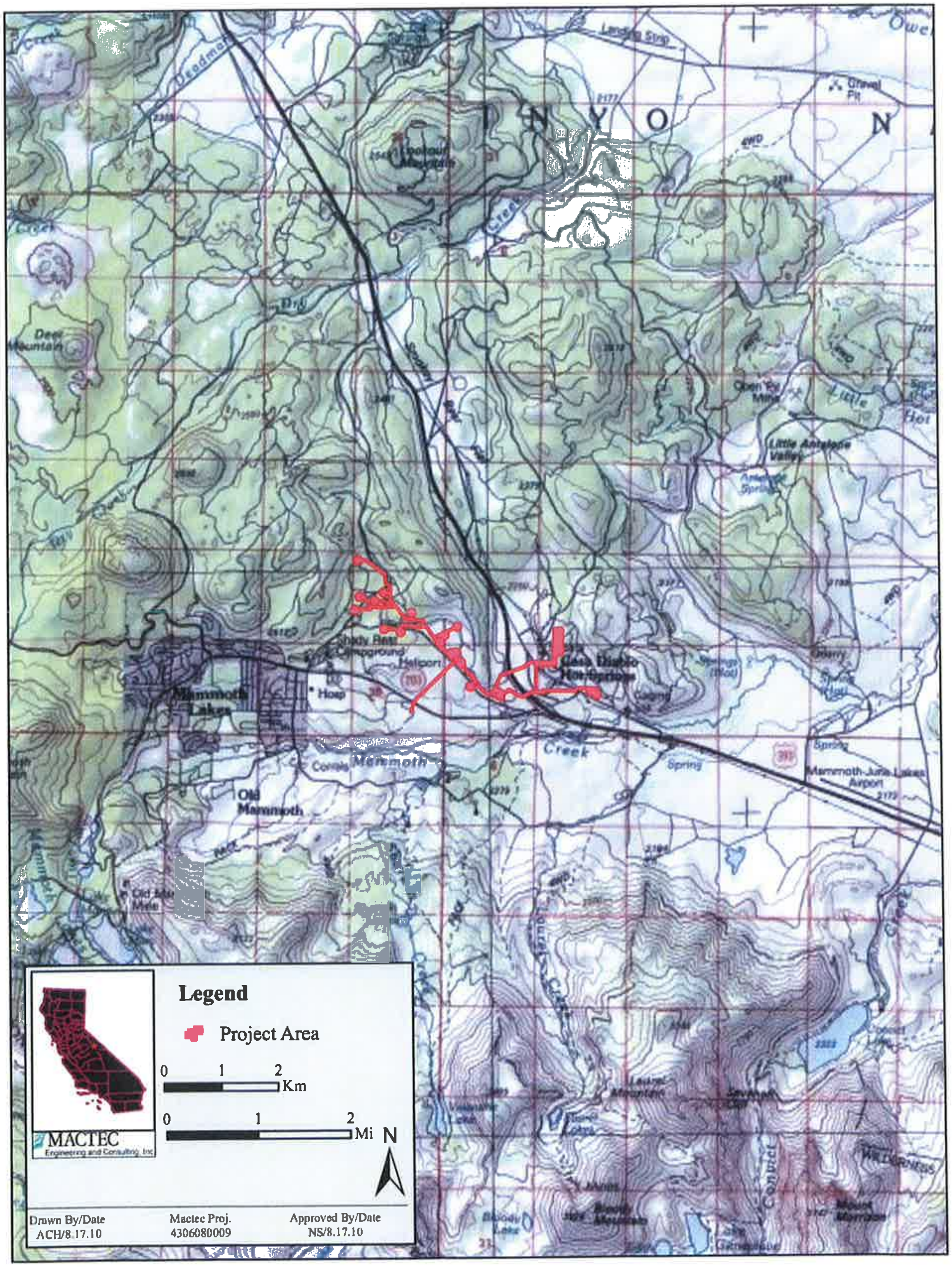

Figure 1. Vicinity Map.

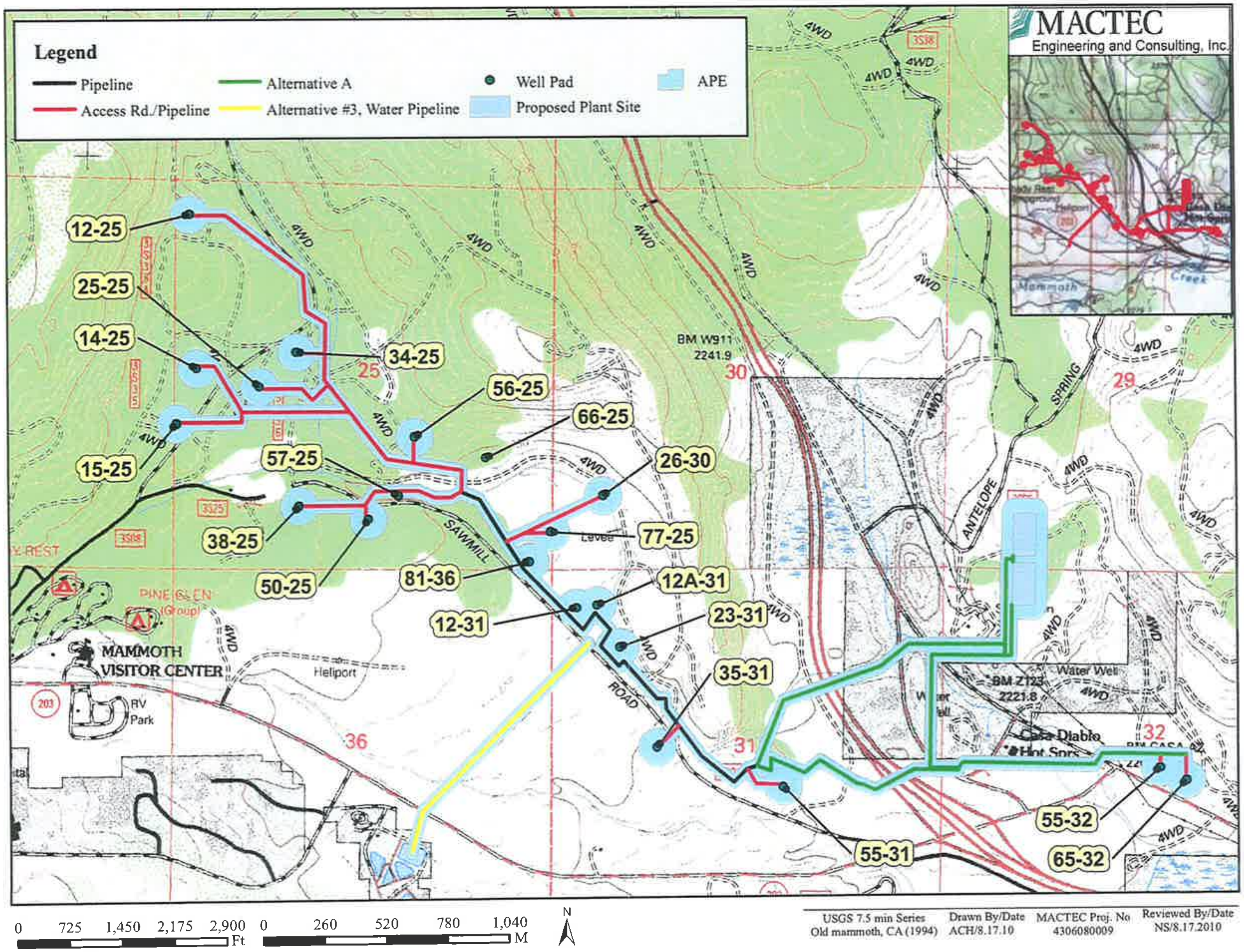

Figure 2. Project Area with Project Components.

- Air/water hybrid cooling system for the power plant using either recycled water from the Mammoth Community Water District (MCWD) wastewater treatment plant, or using treated brine (geothermal fluid). The first alternative would include installing a water supply pipeline from the MCWD treatment plant to the CD-4 plant. The second alternative would include installing an onsite reverse osmosis system to clean geothermal fluid. It is possible that Ormat may not proceed with either option and use a dry cooling system only; this would be decided during the engineering design of the Project.

5. Effects of Proposed Project on the Habitat for the Selected Project-Level MIS.

The following section documents the analysis for the following 'Category 3' species greater sage-grouse and American marten. The analysis of the effects of the CD-4 Project on the MIS habitat for the selected project-level MIS is conducted at the project scale. The analysis used the following habitat data: Detailed information on the MIS is documented in the SNF Bioregional MIS Report (USDA Forest Service 2008), which is hereby incorporated by reference.

Cumulative effects at the bioregional scale are tracked via the SNF MIS Bioregional monitoring, and detailed in the SNF Bioregional MIS Report (USDA Forest Service 2008).

Table 2. Plant Communities at Proposed CD-4 IV Geothermal Development Project Site, 2010.

Plant Community	Community Number[1]	Alliance[2]	Acreage in Project Area[3]	Project Component	Approximate Acres of Disturbance
Big Sagebrush	35.110.07	*Artemisia tridentata-Purshia tridentate*	137.7	Geothermal Pipeline	8.5
				Well pads / injection sites	20.0
				Access Roads	2.0
				Water Pipeline	0.17
Total Area Big Sagebrush (acres)			**137.7**		**30.67**
Jeffrey Pine Forest	87.020.26	*Pinus Jeffreyi*	118	Power Plant	2.2
				Substation	0.25
				Pipeline	3.6
				Transmission Line	12.1
				Well pads / injection sites	15.0
Total Area Jeffrey Pine (acres)			**118**		**33.15**
Total Area of Plant Communities (acres)			**255.7**		
Total Disturbed Area of Plant Communities (acres)					**63.82**

1. CDFG 2003; 2. Classification proposed by CDFD 2007; 3. Project Area = Cultural Resources Area of Potential Effect

Sagebrush Habitat (Greater Sage-Grouse)

Habitat/Species Relationship.

The greater sage-grouse was selected as the MIS for sagebrush habitat on the Inyo and Modoc National Forests. Sage-grouse is dependent on sagebrush (*Artemisia* spp.) for both food and cover (Connelly et al. 2004, USFWS 2005). As vegetation in upland sagebrush habitats desiccate, hens move to more mesic sites, such as riparian, wet meadows, and sagebrush grasslands, to summer and rear broods (Connelly et al. 2000). Productive nesting habitat includes sagebrush with horizontal and vertical structural diversity, including sagebrush generally 30-80cm tall with a canopy of 15-25% and an understory composed of native grasses and forbs (Connelly et al. 2000). Sage-grouse surveys were conducted within appropriate habitat (sagebrush) in the proposed project area, summer 2010 and no signs of the species were observed.

Project-level Effects Analysis – Sagebrush Habitat

Habitat Factor(s) for the Analysis: (1) Acres of sagebrush habitat (CWHR types SGB and SLG). (2) Acres with changes in shrub ground cover class (Sparse=10-24%; Open=25-39%; Moderate=40-59%; Dense=60-100 (3) Acres with changes in CWHR shrub size class [Seedling shrub (seedlings or sprouts <3years); Young shrub (no crown decadence); Mature Shrub (crown decadence 1-25%); Decadent shrub (>25%)]. (4) Changes in perennial herbaceous understory.

Current Condition of the Habitat Factor(s) in the Project Area: The sagebrush community is dominated by big sagebrush (*Artemisia tridentata*) and bitterbrush (*Purshia tridentata*) which provide an average cover of approximately 30%. The total vegetative cover is approximately 40-50%. Perennial grasses (approximately 10%) such as *Achnatherum occidentalis*, *A. Hymenoides*, and *Leymus cinereus* are also present and sometimes comprise a significant portion of the total cover (Paulus, 2003, 2008). Jeffrey pine (*Pinus jeffreyi*) stands occur primarily at the edges of the sagebrush but do encroach into the sagebrush providing a scattered overstory in some areas.

Alternative A (Proposed Action)

Direct and Indirect Effects to Habitat. Effects to the greater sage-grouse habitat would include the loss or disturbance of habitat (vegetation) as a result of trenching, drilling activities and accessing these activity sites. Approximately 137.7 acres of sagebrush habitat available for forage and cover is expected to be disturbed as a result of the proposed construction of four boreholes.

Cumulative Effects to Habitat in the Analysis Area. Cumulative impacts from past, present and reasonably foreseeable future actions would have impacts on the sagebrush plant community within the project area. Continued use of the area for geothermal projects including testing, pumping and plant expansion and development, and recreational use by forest visitors would expand the impacts to vegetation loss and soil compaction and erosion. The impacts will reduce the amount of available cover and forage for the sage grouse and other native plants and wildlife utilizing the project area.

Cumulative Effects Conclusion: Impacts to greater sage-grouse habitat in or adjacent to the CD-4 area would be minimal. Sage-grouse utilization of habitat in the vicinity of the existing power plant is expected to be minimal, thereby limiting the potential for conflicts when the geotechnical surveys are conducted in that area. Approximately 137.7 acres of sagebrush habitat would be impacted as a result of the proposed project.

Summary of Greater Sage-grouse Status and Trend at the Bioregional Scale

The Inyo NF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale habitat monitoring for the greater sage-grouse; hence, the sagebrush effects analysis for the CD-4 Project must be informed by habitat monitoring data. The sections below summarize the habitat status and trend data for the greater sage-grouse. This information is drawn from the detailed information on habitat and population trends in the Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2008), which is hereby incorporated by reference.

Habitat Status and Trend. There are currently 998,000 acres of sagebrush habitat on National Forest System lands in the Sierra Nevada. The quality and quantity of sagebrush habitat have declined for at least the last 50 years throughout the range of the greater sage-grouse, (Connelly et al. 2000). Within the last decade in the Sierra Nevada, the habitat quantity trend is essentially stable (within the last decade, only changing from 8% to 9% of the acres on National Forest System lands). Current data from California and the Sierra Nevada indicate that, although habitat quantity and quality has decreased historically, the current habitat trend for greater sage-grouse in the Sierra Nevada is stable.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Greater Sage-grouse Habitat Trend. In conclusion, the CD-4 Project is not expected to have a significant direct, indirect or cumulative effect on greater sage-grouse habitat in the project area. The loss of approximately 137.7 acres of sagebrush habitat will not alter the existing bioregional trend for sagebrush habitat in the project area nor will it lead to a change in the distribution of greater sage-grouse across the Sierra Nevada bioregion.

Late Seral Closed Canopy Coniferous Forest Habitat (California spotted owl, American marten, and northern flying squirrel)

Habitat/Species Relationship.

California spotted owl. The California spotted owl was selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat in the Sierra Nevada. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. The California spotted owl is strongly associated with forests that have a complex multi-layered structure, large-diameter trees, and high canopy closure (CDFG 2005, USFWS 2006). It uses dense, multi-layered canopy cover for roost seclusion; roost selection appears to be related closely to thermoregulatory needs, and the species appears to be intolerant of high temperatures (CDFG 2005). Mature, multi-layered forest stands are required for breeding (Ibid). The mixed-conifer forest type is the predominant type used by spotted owls in the Sierra Nevada: about 80 percent of known sites are found in mixed-conifer forest, with 10 percent in red fir forest (USDA Forest Service 2001).

American Marten. The American marten was selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat in the Sierra Nevada. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. Martens prefer coniferous forest habitat with large diameter trees and snags, large down logs, moderate-to-high canopy closure, and an interspersion of riparian areas and meadows. Important habitat attributes are: vegetative diversity, with predominately mature forest; snags; dispersal cover; and large woody debris (Allen 1987). Key components for westside and eastside marten habitat can be found in the Sierra Nevada Forest Plan Amendment FEIS (USDA Forest Service 2001), Volume 3, Chapter 3, part 4.4, pages 20-21.

Northern flying squirrel. The northern flying squirrel was selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat in the Sierra Nevada. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. The northern flying squirrel occurs primarily in mature, dense conifer habitats intermixed with various riparian habitats, using cavities in mature trees, snags, or logs for cover (CDFG 2005).

Project-level Effects Analysis – Late Seral Closed Canopy Coniferous Forest Habitat.

Habitat Factor(s) for the Analysis: (1) Acres of late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat [CWHR ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), tree size 5 (canopy closures M and D), and tree size 6]. (2) Acres with changes in canopy closure (D to M). (3) Acres with changes in large down logs per acre or large snags per acre.

Current Condition of the Habitat Factor(s) in the Project Area: There are currently 994,000 acres of late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat on National Forest System lands in the Sierra Nevada.

Alternative A (Proposed Action)

Direct and Indirect Effects to Habitat. Effects to the late-seral closed canopy coniferous forest habitat would include the loss or disturbance of habitat (vegetation) as a result of tree removal along pipeline route and at well pad sites. Approximately 33.15 acres of late-seral closed canopy habitat available for cover, dening and nesting is expected to be disturbed as a result of the proposed construction of the pipeline and well pads.

Cumulative Effects to Habitat in the Analysis Area. Impacts to late-seral closed canopy coniferous forest habitat in or adjacent to the CD-4 area would be minimal. Spotted owl marten and flying squirrel in the vicinity of the pipeline and well pads is expected to be minimal, thereby limiting the potential for conflicts during construction, operation, and maintenance of the wells and pipeline. Approximately 33.15 acres of late-seral closed canopy coniferous forest would be impacted as a result of the proposed project.

Cumulative Effects Conclusion: Impacts to late-seral closed canopy coniferous forest habitat in or adjacent to the CD-4 project area would be minimal. Spotted owl marten and flying squirrel utilization of habitat in the vicinity of the proposed well pads and pipeline is expected to be minimal, thereby limiting the potential for conflicts during construction, operation and maintenance of the wells and pipeline. Approximately 33.15 acres of slate-seral closed canopy coniferous forest habitat would be impacted as a result of the proposed project.

Summary of Status and Trend at the Bioregional Scale

California spotted owl, American marten, and Northern flying squirrel. The Inyo NF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale habitat and distribution population monitoring for the California spotted owl, American marten, and northern flying squirrel; hence, the late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat effects analysis for the CD-4 Project must be informed by both habitat and distribution population monitoring data. The sections below summarize the habitat and distribution population status and trend data. This information is drawn from the detailed information on habitat and population trends in the SNF Bioregional MIS Report (USDA Forest Service 2008), which is hereby incorporated by reference.

Habitat Status and Trend. There are currently 994,000 acres of late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat on National Forest System lands in the Sierra Nevada. The trend is slightly increasing (from 7% to 9% within the last decade on National Forest System lands).

Population Status and Trend - California spotted owl. California spotted owl has been monitored in California and throughout the Sierra Nevada through general surveys, monitoring of nests and territorial birds, and demography studies (Verner et al. 1992; USDA Forest Service 2001, 2004, 2006; USFWS 2006; Sierra Nevada Research Center 2007). Current data at the rangewide, California, and Sierra Nevada scales indicate that, although there may be localized declines in population trend [e.g., localized decreases in "lambda" (estimated annual rate of population change)], the distribution of California spotted owl populations in the Sierra Nevada is stable.

Population Status and Trend – American marten. American marten has been monitored throughout the Sierra Nevada as part of general surveys and studies from 1996-2002 (Zielinski et al. 2005). Since 2002, the American marten has been monitored on the Sierra Nevada forests as part of the Sierra Nevada Forest Plan Amendment (SNFPA) monitoring plan (USDA Forest Service 2005, 2006, 2007b). Current data at the rangewide, California, and Sierra Nevada scales indicate that, although marten appear to be distributed throughout their historic range, their distribution has become fragmented in the southern Cascades and northern Sierra Nevada, particularly in Plumas County. The distribution appears to be continuous across high-elevation forests from Placer County south through the southern end of the Sierra Nevada.

Population Status and Trend – northern flying squirrel. The northern flying squirrel has been monitored in the Sierra Nevada at various sample locations by live-trapping, ear-tagging, camera surveys, snap-trapping, and radiotelemetry: 2002-present on the Plumas and Lassen National Forests (Sierra Nevada Research Center 2007), and 1958-2004 throughout the Sierra Nevada in various monitoring efforts and studies (see USDA Forest Service 2008, Table NOFLS-IV-1). These data indicate that northern flying squirrels continue to be present at these sample sites, and current data at the rangewide, California, and Sierra Nevada scales indicate that the distribution of northern flying squirrel populations in the Sierra Nevada is stable.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Trends.

California spotted owl. In conclusion the CD-4 Project is not expected to have a significant direct, indirect or cumulative effect on spotted owl habitat in the project area. The loss of approximately 33.15 acres of late-seral closed canopy coniferous forest habitat will not alter the existing bioregional trend in the project area nor will it lead to a change in the distribution of spotted owl across the Sierra Nevada bioregion.

American marten. In conclusion the CD-4 Project is not expected to have a significant direct, indirect or cumulative effect on American marten habitat in the project area. The loss of approximately 33.15 acres of late-seral closed canopy coniferous forest habitat will not alter the existing bioregional trend in the project area nor will it lead to a change in the distribution of American marten across the Sierra Nevada bioregion.

Northern flying squirrel. In conclusion the CD-4 Project is not expected to have a significant direct, indirect or cumulative effect on Northern flying squirrel habitat in the project area. The loss of approximately 33.15 acres of late-seral closed canopy coniferous forest habitat will not alter the existing bioregional trend in the project area nor will it lead to a change in the distribution of Northern flying squirrel across the Sierra Nevada bioregion.

Species of Special Interest
<u>Sagebrush Habitat (Mule Deer)</u>

Habitat/Species Relationship.

The mule deer was selected for sagebrush habitat as a SSI. Mule deer range and habitat includes coniferous forest, foothill woodland, shrubland, grassland, agricultural fields, and suburban environments (CDFG 2005). Many mule deer migrate seasonally between higher elevation summer range and low elevation winter range (Ibid). Mule deer surveys were conducted in the summer, 2010, throughout the proposed project area and mule deer tracks and other sign were uncommonly observed.

Project-level Effects Analysis - Sagebrush Habitat

Habitat Factor(s) for the Analysis: (1) Acres of sagebrush habitat (CWHR types SGB and SLG). (2) Acres with changes in shrub ground cover class (Sparse=10-24%; Open=25-39%;

Moderate=40-59%; Dense=60-100%) (3) Acres with changes in CWHR shrub size class [Seedling shrub (seedlings or sprouts <3years); Young shrub (no crown decadence); Mature Shrub (crown decadence 1-25%); Decadent shrub (>25%)]. (4) Changes in perennial herbaceous understory.

Current Condition of the Habitat Factor(s) in the Project Area: The mule deer is no longer identified as a MIS by the Inyo National Forest but is still recognized as a SSI and so is considered here for sagebrush habitat on the Inyo National Forest.

The Jeffrey Pine (*pinus jeffreyi*) forest accounts for approximately 80 percent of the tree canopy in the project area and individual trees average 30 feet in height and 14 inches in diameter-at-breast-height (dbh). Singleleaf pinyon (*Pinus monophylla*) and mountain juniper (*Juniperus grandis*) are minor canopy components with an average of 20%, within the project area. Jeffrey pine is common and widespread in the landscape surrounding the project area. (Paulus 2009)

The forest contains a shrubby understory of primarily big sagebrush (*Artemisia tridentata*) and antelope bitterbrush (*Purshia tridentata*), that rarely comprises more than 10 percent of total cover. Grass is sparse in the understory and consists of western needlegrass (*Achnatherum occidentale*) and squirreltail grass (*Elymus elymoides*). In areas of disturbed soil the non-native annual cheat grass (*Bromus tectorum*) is dominant.

Alternative A (Proposed Action)

Direct and Indirect Effects to Habitat. Trenching, drilling and site access activities may affect mule deer habitat with the disturbance of 976 square feet of sagebrush habitat. Invasive, non-native and noxious weeds that established populations in previously undisturbed sites, within the project area, would impact the quality of the sagebrush habitat.

Cumulative Effects to Habitat in the Analysis Area. Cumulative impacts from past, present and reasonably foreseeable future actions would have impacts on the sagebrush plant community within the project area. Continued use of the area for geothermal projects including testing, pumping and plant expansion and development, and recreational use by forest visitors would expand the impacts to vegetation loss and soil compaction and erosion. The impacts will reduce the amount of available cover and forage to the sage grouse and other native plants and wildlife utilizing the project area.

Cumulative Effects Conclusion: The disturbance of approximately 976 square feet of sagebrush habitat, as a result of this project) relative to the tens of thousands of acres available on a landscape scale would not change the existing trend in the habitat.

Summary of Mule Deer Status and Trend at the Bioregional Scale

Habitat Status and Trend. There are currently 998,000 acres of sagebrush habitat on National Forest System lands in the Sierra Nevada. The quality and quantity of sagebrush habitat have declined for at least the last 50 years. Within the last decade in the Sierra Nevada, the habitat quantity trend is essentially stable (within the last decade, only changing from 8% to 9% of the acres on National Forest System lands). Current data from California and the Sierra Nevada indicate that, although habitat quantity and quality has decreased historically, the current habitat trend for mule deer in the Sierra Nevada is stable.

Population Status and Trend. The mule deer has been monitored in the Sierra Nevada at various sample locations by herd monitoring (spring and fall) and hunter survey and associated modeling (CDFG 2007). California Department of Fish and Game (CDFG) conducts surveys of deer herds in early spring to determine the proportion of fawns that have survived the winter, and conducts fall counts to determine herd composition (CDFG 2007). This information, along with prior year harvest information, is used to estimate overall herd size, sex and age rations, and the predicted number of bucks available to hunt (ibid). These data indicate that mule deer continue to be present across the Sierra Nevada, and current data at the rangewide, California, and Sierra Nevada scales indicate that, although there may be localized declines in some herds or Deer Assessment Units, the distribution of mule deer populations in the Sierra Nevada is stable.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Mule Deer Trend. In conclusion the CD-4 Project is not expected to have a significant direct, indirect or cumulative effect on mule deer habitat in the project area. The disturbance to approximately 976 square feet of sagebrush habitat will not alter the existing bioregional trend for sagebrush habitat nor will it lead to a change in the distribution of mule deer across the Sierra Nevada bioregion.

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EXHIBIT I

Comment Letter I9

To: Steven Kerns
Wildlands Resource Managers
P.O. Box 102
Round Mountain, CA 96084

June 18, 2001

From: Jim Paulus
Consulting Botanist, EMA Associates
PO Box 244
Bishop, CA 93515

RE: Plant communities found at the Basalt Canyon Geothermal Exploration Survey Area

Dear Mr. Kerns,

I am writing to inform you of results of botanical survey work I have recently completed within the approximately 800 acre Basalt Canyon geothermal exploration area of the proposed Mammoth Pacific Geothermal Project. The botanical survey was performed to determine the presence or absence of sensitive plant species. All of the land surveyed is located west of Highway 395 north of the Highway 203 exit, near the Town of Mammoth Lakes, Mono County, California and is administered by the Inyo National Forest.

Great Basin Mixed Scrub and Jeffrey Pine Forest plant communities were found on currently undeveloped, rolling hills and steep slopes, crossed by many dirt roads and bicycle trails. "Murphy Gulch", an ephemeral stream channel, parallels Highway 203 near the southern edge of the survey area (Figure 1). No other hydrologic features (streams, seeps, wet meadows) were encountered. My survey strategy was floristic, striving to identify every species occurring along the transects. I have attached a list of the species found.

Typical dominants of the Great Basin Mixed Scrub were found at high frequencies at lower elevations, especially big sagebrush (*Artemisia tridentata*), antelope bush (*Purshia tridentata*), while tobacco brush (*Ceanothus velutinus*) and manzanita (*Arctostaphylos nevadensis* and *A. patula*) were restricted to patches on the steep slopes of the ridge west of Highway 395. Dominance by *A. tridentata* was usually 60-80%, and scrub height averaged 1 m. Perennial grasses (*Achnatherum hymenoides, A. occidentalis, A. nevadensis,* and *Leymus cinereus*) make up a significant percentage of the Mixed Scrub cover. Riparian vegetation was not found where Murphy Gulch (a conduit for runoff from impervious surfaces in Mammoth Lakes, upstream) bisected rolling hills dominated by Great Basin Mixed Scrub. However, a few patches of pine, and thick but small stands of shrubs such as bitter cherry (*Prunus emarginata*), were present to provide cover for animals. Deer sign was relatively profuse along the length of the Gulch.

Forest canopy cover is nearly monospecific Jeffrey pine (*Pinus jeffreyi*) at lower elevations. On steeper slopes near the ridge line west of Highway 395, white fir (*Abies concolor*), pinyon pine (*Pinus monophylla*), and juniper (*Juniperus occidentalis*) are mixed into the Forest canopy. Forest floor cover consisting of sometimes dense perennial grasses (mostly *Poa* *wheeleri*) and snowberry (*Symphoricarpos rotundifolia*) was found to be widespread. Habitat quality for deer in otherwise dense Forest near the eastern edge of the survey area is probably further enhanced by the high frequency of small, shrubby forest gaps.

Larger openings in the Forest canopy occur on the steeper slopes of higher elevations in the study area. Great Basin Mixed Scrub of higher diversity, ranging from nearly impassable inclusions of Tobacco Brush Chaparral to more open, herb-dominated inclusions of low Buckwheat Scrub, was found on these dry steep slopes. The frequency of the browse species *P. tridentata* occasionally increases to > 90%, and these areas were associated with high use by mule deer. Patches of desert peach (*Prunus andersonii*) showed similar relatively high usage by deer.

I did not see a lot of sign of deer use in Scrub-covered lower slopes central to the Basalt Canyon study area. I saw about 15 deer during the 8 days I have spent on site, all in Murphy Gulch, at the forest/scrub interfaces on lower slopes, and in heavy scrub cover on higher slopes. I did not find any water sources on the study area at the time of the survey. I believe the nearest surface water is Sherwin Creek south of Highway 203. Ground squirrels are common in Murphy Gulch. I observed a pair of red-tailed hawks on several consecutive days near the rocky outcrop on the ridgeline west of Highway 395. Smaller migratory birds were the only other wildlife observed during this work.

I hope this helps with your wildlife assessment. Call me at (760) 873-8516 if you have any questions.

Yours truly,

James R. Paulus

James R. Paulus, Ph.D.

cc. Dwight Carey

Plant Families and Species	Habit	Scrub	Forest	Disturbed
Boraginaceae				
Cryptantha circumscissa	NAH	x		x
Cryptantha confertifolia	NPH	x		
Cryptantha echinella	NAH	x		
Cryptantha micrantha	NAH	x		
Brassicaceae				
Arabis holboellii var. *retrofracta*	NPH	x	x	
Arabis inyoensis	NPH	x		x
Arabis platysperma var. *platysperma*	NPH	XMG		
Arabis puberula	NPH	x		
Arabis pulchra var. *pulchra*	NPH	x		
Arabis sparsiflora var. *sparsiflora*	NPH	x		
Descurainia californica	NAH	x		x
Descurainia sophia	IAH	x		x
Erysimum capitatum ssp. *capitatum*	NBH	x		
Lepidium desiflorum var. *macrocarpum*	NBH	XMG		
Thelypodium milleflorum	NBH	x		
Caprifoliaceae				
Symphoricarpos rotundifolius var. *parishii*	NS		x	
Symphoricarpos rotundifolius var. *rotundifolius*	NS	x	x	
Caryophyllaceae				
Stellaria borealis ssp. *sitchana*	NPH	XMG		
Chenopodiaceae				
Chenopodium ambrosioides	IAH			x
Chenopodium foliosum	IAH			XPO
Chenopodium pratericola	NAH	x		x
Grayia spinosa	NS	x		
Salsola tragus	IAH	x		x
Ericaceae				
Arctostaphylos nevadensis	NS	x	x	
Arctostaphylos patula	NS	x		
Fabaceae				
Astragalus purshii	NPH	x		x
Lupinus albicaulis	NPH	x		
Lupinus andersonii	NPH	x		
Lupinus argenteus var. *heteranthus*	NPH	x		x
Lupinus bicolor	NAH	x		
Trifolium andersonii var. beatlyae	NPH	x		
Fagaceae				
Chrysolepis sempervirens	NS	x		
Geraniaceae				
Erodium cicutarium	IAH			XFU

List of plant species occurring in the area of the Basalt Canyon Geothermal Exploration. Habit summarizes the growth form of each species. Plants occurred in one of four habitats. Habit codes are defined below.

Plant Families and Species	Habit	Occurrence in Study Area: Scrub	Forest	Disturbed
Cupressaceae				
Juniperus occidentalis	NT	X	X	
Dryopteridaceae				
Woodsia oregana	NPH	XMG		
Pinaceae				
Abies concolor	NT		X	
Pinus contorta ssp. *murrayana*	NT	XMG		
Pinus flexilis (?, 1 ind.)	NT	XMG		
Pinus jeffreyi	NT	X	X	
Pinus monophylla	NT		X	
Dicots				
Amaranthaceae				
Amaranthus californicus	NAH			XPU
Apiaceae				
Cymopterus terebinthinus var. *petraeus*	NPH	X		
Asteraceae				
Achillea millefolium	NPH	XMG		
Ag[illegible] glauca var. *laciniata*	NPH	X		
Agoseris retrorsa	NPH	X		
Ambrosia acanthicarpa	NAH			X
Artemisia cana ssp. *bolanderi*	NS	X		
Artemisia douglasiana	NPH	XMG		
Artemisia tridentata	NS	X	X	X
Aster ascendens	NPH	X		
Chaenactis stevioides	NAH	X		X
Chrysothamnus nauseosus	NS	X		X
Chrysothamnus parryi ssp. *nevadensis*	NS	X		
Chrysothamnus teretifolius	NS	X		
Chrysothamnus viscidiflorus ssp. *puberulus*	NS	X		
Chrysothamnus viscidiflorus ssp. *viscidiflorus*	NS	X		
Crepis acuminata	NPH	X		
Machaeranthera canescens var. *canescens*	NPH	X		
Rigiopappus leptocladus	NAH			XPO
Senecio aronicoides	NPH	XMG		
Senecio integerrimus var. *exaltatus*	NPH	XMG		
Stephanomeria paniculata	NAH	X		
Stephanomeria spinosa	NPH	X		
Tetradymia canescens	NS	X		
Tragopogon dubius	IBH			X
Wyethia mollis	NPH	X		

Plant Families and Species	Habit	Scrub	Forest	Disturbed
Grossulariaceae				
Ribes cereum var. *cereum*	NS	x	x	
Hydrophyllaceae				
Nama aretioides var. *multiflorum*	NAH			x
Nama californicum	NAH			x
Nama rothrockii	NPH	x		x
Phacelia bicolor	NAH	x		
Phacelia vallis-mortae	NAH	x		x
Phacelia glandulifera	NAH	x		
Phacelia hastata ssp. *hastata*	NPH			x
Phacelia sp.	NAH	x		
Lamiaceae				
Monardella odoratissima ssp. *odoratissima*	NPH	x		
Loasaceae				
Mentzelia congesta	NAH	x		x
Mentzelia dispersa	NAH	x		x
Mentzelia veatchiana	NAH			x
Onagraceae				
Gayophytum diffusum ssp. *parviflorum*	NAH	x		x
Papaveraceae				
Argemone minuta	NPH	x		x
Polemoniaceae				
Allophyllum gilioides	NAH	x		x
Gilia brecciarum ssp. *brecciarum*	NAH	x		
Eriastrum sparsiflorum	NAH	x		x
Leptodactylon pungens	NPH	x		
Linanthus nuttallii ssp. *pubescens*	NPH	x	x	
Phlox condensata	NS	x		
Phlox gracilis	NAH	XMG		
Phlox stansburyi	NPH	x		
Polygonaceae				
Eriogonum maculatum	NAH	x		x
Eriogonum ovalifolium	NPH	x		x
Eriogonum parishii	NAH	x		
Eriogonum umbellatum	NS	x		
Eriogonum umbellatum var. *nevadense*	NS	x		
Polygonum arenastrum	IAH			x
Polygonum polygaloides	NAH	x		
Rumex crispus	IPH	XMG		
Portulacaceae				
Calyptridium monospermum	NPH	x		x
Calyptridium umbellatum	NPH			x

Plant Families and Species	Habit	Scrub	Forest	Disturbed
Rhamnaceae				
Ceanothus velutinus	NS	x		
Rhamnus sp.	NS	x		
Ranunculaceae				
Delphinium cf. *parishii*	NPH	x		
Rosaceae				
Amelanchier utahensis	NS		x	
Holodiscus microphyllus var. *microphyllus*	NS	x	x	
Prunus andersonii	NS	x		
Prunus emarginata	NS	x	x	
Rosa woodsii	NS	x		
Purshia tridentata var. *tridentata*	NS	x		
Rubiaceae				
Galium multiflorum	NPH	x	x	
Kelloggia galioides	NPH	x		
Scrophulariaceae				
Castilleja angustifolia	NPH	x		
Mimulus nanus	NAH	x		
Orthocarpus luteus	NPH	x		
Penstemon azureus var. *angustissimus*	NPH	x		
Penstemon rostriflorus	NPH	x	x	
Verbascum thapsus	IBH	XMG		
Solanaceae				
Chamaesaracha nana	NPH	x		x
Nicotiana acuminata var. *multiflora*	IAH			XFU
Violaceae				
Viola purpurea ssp. venosa	NPH	x		
Monocots				
Cyperaceae				
Carex douglasii	NPGL	x		x
Carex microptera	NPGL	XMG		
Carex raynoldsii	NPGL		x	
Cyperus laevigatus	NPGL			XFU
Juncaceae				
Juncus mexicanus	NPGL			XPO
Liliaceae				
Allium atrorubens var. *cristatum*	NPGL	XMG		
Calochortus leichtlinii	NPGL	x		

Plant Families and Species	Habit	Scrub	Forest	Disturbed
Poaceae				
Achnatherum hymenoides	NPG	X		X
Achnatherum nevadensis	NPG	X	X	X
Achnatherum occidentalis ssp. *californicum*	NPG	X		
Achnatherum occidentalis ssp. *pubescens*	NPG	X		
Agropyron desertorum	IPG			X
Bromus laevipes	NPG	X		
Bromus madritensis ssp. *rubens*	IAG	X	X	X
Bromus suksdorfii	NPG	X		
Bromus tectorum	IAG	X	X	X
Cynodon dactylon	IPG			XPO
Dactylis glomerata	IPG	XMG		
Elymus elymoides ssp. *elymoides*	NPG	X		X
Hesperostipa comata ssp. *comata*	NPG	X		
Hordeum brachyantherum ssp. *brachyantherum*	NPG	X		
Hordeum jubatum	NPG	X		
Leymus cinereus	NPG	X	X	
Leymus triticoides	NPG			XPO
Melica stricta	NPG	X	X	
Muhlenbergia richardsonis	NPG			
Poa fendleriana ssp. *longiligula*	NPG	X		
Poa palustris	IPG	XMG		
Poa pratensis	IPG	X	X	
Poa wheeleri	NPG		X	
Pseudoroegneria spicata ssp. *spicata*	NPG	XMG		

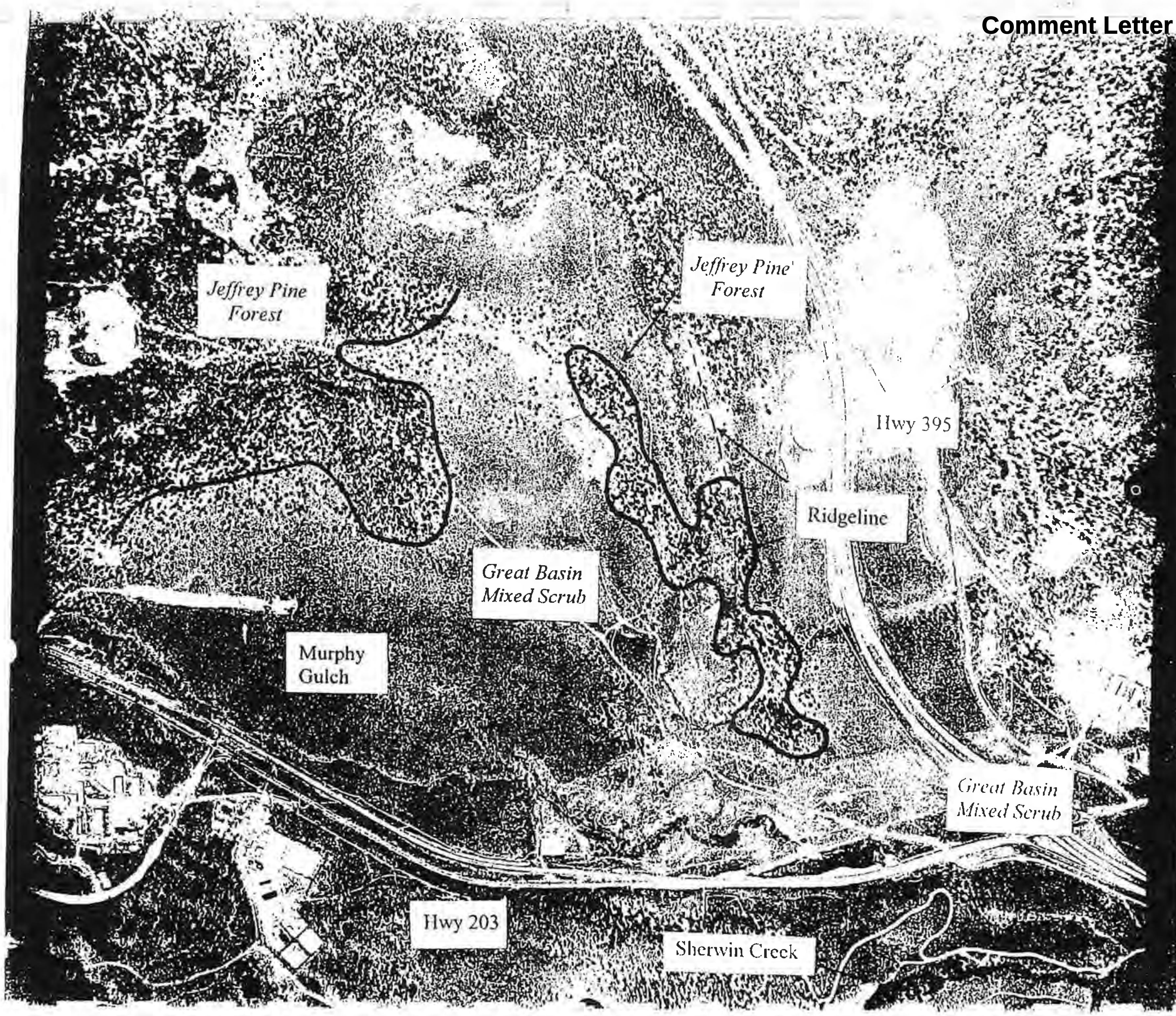
key to growth habit codes:

A	annual
B	biennial
G	grass
GL	grass-like
H	herb
HS	half-shrub
I	introduced
N	native
P	perennial
S	shrub

key to occurrence codes:

MG	restricted to channel at Murphy Gulch
FU	restricted to disturbed fumarole areas
PO	restricted to disturbed ponding basin at extreme eastern tip of survey area

Comment Letter I9



NORTH

Plant community boundaries are broadly depicted at the Basalt Canyon Geothermal Exploration Area Aerial photo taken June 1993

Basalt Canyon Geothermal Surveys Sensitive Species Search

EXHIBIT J

Guidelines to manage sage grouse populations and their habitats

John W. Connelly, Michael A. Schroeder, Alan R. Sands, and Clait E. Braun

Abstract The status of sage grouse populations and habitats has been a concern to sportsmen and biologists for >80 years. Despite management and research efforts that date to the 1930s, breeding populations of this species have declined throughout much of its range. In May 1999, the western sage grouse (C. urophasianus phaios) in Washington was petitioned for listing under the Endangered Species Act because of population and habitat declines (C. Warren, United States Fish and Wildlife Service, personal communication). Sage grouse populations are allied closely with sagebrush (Artemisia spp.). Despite the well-known importance of this habitat to sage grouse and other sagebrush obligates, the quality and quantity of sagebrush habitats have declined for at least the last 50 years. Braun et al. (1977) provided guidelines for maintenance of sage grouse habitats. Since publication of those guidelines, much more information has been obtained on sage grouse. Because of continued concern about sage grouse and their habitats and a significant amount of new information, the Western States Sage and Columbian Sharp-tailed Grouse Technical Committee, under the direction of the Western Association of Fish and Wildlife Agencies, requested a revision and expansion of the guidelines originally published by Braun et al. (1977). This paper summarizes the current knowledge of the ecology of sage grouse and, based on this information, provides guidelines to manage sage grouse populations and their habitats.

Key words Artemisia, Centrocercus urophasianus, guidelines, habitat, management, populations, sage grouse, sagebrush

The status of sage grouse populations and habitats has been a concern to sportsmen and biologists for >80 years (Hornaday 1916, Patterson 1952, Autenrieth 1981). Despite management and research efforts that date to the 1930s (Girard 1937), breeding populations of this species have declined by at least 17–47% throughout much of its range (Connelly and Braun 1997). In May 1999, the western sage grouse (*C. urophasianus phaios*) in Washington was petitioned for listing under the Endangered Species Act because of population and habitat declines (C. Warren, United States Fish and Wildlife Service, personal communication).

Sage grouse populations are allied closely with sagebrush (*Artemisia* spp.) habitats (Patterson 1952, Braun et al. 1977, Braun 1987). The dependence of sage grouse on sagebrush for winter habitat has been well documented (Eng and Schladweiler 1972, Beck 1975, Beck 1977, Robertson 1991). Similarly, the relationship between sagebrush

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Sage grouse on a nest with good shrub and herbaceous cover. The nest was successful.

habitats and sage grouse nest success has been described thoroughly (Klebenow 1969, Wallestad and Pyrah 1974, Wakkinen 1990, Connelly et al. 1991, Gregg et al. 1994). Despite the well-known importance of this habitat to sage grouse and other sagebrush obligates (Braun et al. 1976, Saab and Rich 1997), the quality and quantity of sagebrush habitats have declined for at least the last 50 years (Braun et al. 1976, Braun 1987, Swenson et al. 1987, Connelly and Braun 1997).

Braun et al. (1977) provided guidelines for maintenance of sage grouse habitats. Since publication of those guidelines, much more information has been obtained on relative size of sagebrush habitats used by these grouse (Connelly 1982, Connelly et al. 1988, Wakkinen et al. 1992), seasonal use of sagebrush habitats (Benson et al. 1991, Connelly et al. 1991), effects of insecticides on sage grouse (Blus et al. 1989), importance of herbaceous cover in breeding habitat (Wakkinen 1990, Connelly et al. 1991, Gregg 1991, Barnett and Crawford 1994, Drut et al. 1994*a*, Gregg et al. 1994), and effects of fire on their habitat (Hulet 1983; Benson et al. 1991; Robertson 1991; Fischer 1994; Fischer et al. 1996*a*, 1997; Pyle and Crawford 1996; Connelly et al. 2000*b*). Because of continued concern about sage grouse and their habitats and a significant amount of new information, the Western States Sage and Columbian Sharp-tailed Grouse Technical Committee, under the direction of the Western Association of Fish and Wildlife Agencies, requested a revision and expansion of the guidelines originally published by Braun et al. (1977). This paper summarizes the current knowledge of the ecology of sage grouse and, based on this information, provides guidelines to manage sage grouse populations and their habitats.

Population biology

Seasonal movements and home range

Sage grouse display a variety of annual migratory patterns (Beck 1975, Wallestad 1975, Hulet 1983, Berry and Eng 1985, Connelly et al. 1988, Wakkinen 1990, Fischer 1994). Populations may have: 1) distinct winter, breeding, and summer areas; 2) distinct summer areas and integrated winter and breeding areas; 3) distinct winter areas and integrated breeding and summer areas; or 4) well-integrated seasonal habitats (nonmigratory populations). Seasonal movements between distinct seasonal ranges may exceed 75 km (Dalke et al. 1963, Connelly et al. 1988), which complicates attempts to define populations. Thus, Connelly et al. (1988) suggested that sage grouse populations be defined on a temporal and geographic basis. Because of differences in seasonal movements among populations (Dalke et al. 1963, Wallestad 1975, Connelly et al. 1988, Wakkinen 1990), 3 types of sage grouse populations can

Sage grouse on a nest with poor shrub and herbaceous cover. This nest was unsuccessful. Photo by Jena Hickey.

Sage grouse on winter range. Note the relatively sparse cover; without snow, the canopy cover of sagebrush in this area exceeds 20%.

be defined: 1) nonmigratory, grouse do not make long-distance movements (i.e., >10 km one way) between or among seasonal ranges; 2) one-stage migratory, grouse move between 2 distinct seasonal ranges; and 3) 2-stage migratory, grouse move among 3 distinct seasonal ranges. Within a given geographic area, especially summer range, there may be birds that belong to more than one of these types of populations.

On an annual basis, migratory sage grouse populations may occupy areas that exceed 2,700 km^2 (Hulet 1983, Leonard et al. 2000). During winter, Robertson (1991) reported that migratory sage grouse in southeastern Idaho made mean daily movements of 752 m and occupied an area $\geq$140 km^2. For a nonmigratory population in Montana, Wallestad (1975) reported that winter home range size ranged from 11 to 31 km^2. During summer, migratory sage grouse in Idaho occupied home ranges of 3 to 7 km^2 (Connelly and Markham 1983, Gates 1983).

Despite large annual movements, sage grouse have high fidelity to seasonal ranges (Keister and Willis 1986, Fischer et al. 1993). Females return to the same area to nest each year (Fischer et al. 1993) and may nest within 200 m of their previous year's nest (Gates 1983, Lyon 2000).

Survival

Wallestad (1975) reported that annual survival rates for yearling and adult female sage grouse were 35 and 40%, respectively, for poncho-tagged birds. However, Zablan (1993) reported that survival rates for banded yearling and adult females in Colorado were similar and averaged 55%; survival rates for yearling and adult males differed, averaging 52 and 38%, respectively. In Idaho, annual survival of male sage grouse ranged from 46 to 54% and female survival from 68 to 85% (Connelly et al. 1994). Lower survival rates for males may be related to physiological demands because of sexual dimorphism and greater predation rates (Swenson 1986).

Reproduction

Bergerud (1988) suggested that most female tetraonids nest as yearlings. Although essentially all female sage grouse nested in Washington (Schroeder 1997), Connelly et al. (1993) reported that in Idaho up to 45% of yearling and 22% of adult female sage grouse do not nest each year. Gregg (1991) indicated that, of 119 females monitored through the breeding season in eastern Oregon, 26 (22%) did not nest. However, Coggins (1998) reported a 99% nest initiation rate for 3 years for the same population in Oregon. The differences may be related to improved range condition that resulted in better nutritional status of pre-laying hens (Barnett and Crawford 1994).

Estimates of sage grouse nest success throughout the species' range vary from 12 to 86% (Trueblood 1954, Gregg 1991, Schroeder et al. 1999). Nest success also may vary on an annual basis (Schroeder 1997, Sveum et al. 1998*a*). Wallestad and Pyrah (1974) observed greater nest success by adults than yearlings. However, significant differences in nest success between age groups have not been reported in other studies (Connelly et al. 1993, Schroeder 1997).

Clutch size of sage grouse is extremely variable and relatively low compared to other species of gamebirds (Edminster 1954, Schroeder 1997). Average clutch size for first nests varies from 6.0 to

Sage grouse nest. Photo by Jena Hickey.

9.5 throughout the species' range (Sveum 1995, Schroeder 1997). Greatest and least average clutch sizes have been reported in Washington (Sveum 1995, Schroeder 1997).

Renesting by sage grouse varies regionally from <20% (Patterson 1952, Eng 1963, Hulet 1983, Connelly et al. 1993) to >80% (Schroeder 1997). Despite regional variation, differences in renesting rates due to age have not been documented (Connelly et al. 1993, Schroeder 1997). Because of variation in nest initiation, success, and renesting rates, the proportion of females successfully hatching a brood varies between 15 and 70% (Wallestad and Pyrah 1974, Gregg et al. 1994). Despite this variation, sage grouse generally have low reproductive rates and high annual survival compared to most gallinaceous species (Zablan 1993, Connelly et al. 1994, Connelly and Braun 1997, Schroeder 1997, Schroeder et al. 1999).

Little information has been published on mortality of juvenile sage grouse or the level of production necessary to maintain a stable population. Among western states, long-term ratios have varied from 1.40 to 2.96 juveniles/hen in the fall; since 1985 these ratios have ranged from 1.21 to 2.19 (Connelly and Braun 1997). Available data suggest that a ratio ≥2.25 juveniles/hen in the fall should result in stable to increasing sage grouse populations (Connelly and Braun 1997, Edelmann et al. 1998).

Habitat requirements

Breeding habitats

Leks, or breeding display sites, typically occur in open areas surrounded by sagebrush (Patterson 1952, Gill 1965); these sites include, but are not limited to, landing strips, old lakebeds, low sagebrush flats and ridge tops, roads, cropland, and burned areas (Connelly et al. 1981, Gates 1985). Sage grouse males appear to form leks opportunistically at sites within or adjacent to potential nesting habitat. Although the lek may be an approximate center of annual ranges for nonmigratory populations (Eng and Schladweiler 1972, Wallestad and Pyrah 1974, Wallestad and Schladweiler 1974), this may not be the case for migratory populations (Connelly et al. 1988, Wakkinen et al. 1992). Average distances between nests and nearest leks vary from 1.1 to 6.2 km, but distance from lek of female capture to nest may be >20 km (Autenrieth 1981, Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994, Lyon 2000). Nests are placed independent of lek location (Bradbury et al. 1989, Wakkinen et al. 1992).

Habitats used by pre-laying hens also are part of the breeding habitat. These areas should provide a diversity of forbs high in calcium, phosphorus, and protein; the condition of these areas may greatly affect nest initiation rate, clutch size, and subsequent reproductive success (Barnett and Crawford 1994, Coggins 1998).

Most sage grouse nests occur under sagebrush (Patterson 1952, Gill 1965, Gray 1967, Wallestad and Pyrah 1974), but sage grouse will nest under other plant species (Klebenow 1969, Connelly et al. 1991, Gregg 1991, Sveum et al. 1998*a*). However, grouse nesting under sagebrush experience greater nest success (53%) than those nesting under other plant species (22%, Connelly et al. 1991).

Table 1. Habitat characteristics associated with sage grouse nest sites.

	Sagebrush		Grass		
State	Height[a](cm)	Coverage (%)[b]	Height(cm)	Coverage(%)[c]	Reference
Colo.	52				Petersen 1980
Id.		15		4	Klebenow 1969
Id.	58–79	23–38			Autenrieth 1981
Id.	71	22	18	3–10	Wakkinen 1990
Id.			19–23	7–9	Connelly et al. 1991
Id.	61		22	30	Fischer 1994
Id.		15–32	15–30		Klott et al. 1993
Id.	69	19	34	15	Apa 1998
Mont.	40	27			Wallestad 1975
Oreg.	80	20			Keister and Willis 1986
Oreg.		24	14	9–32	Gregg 1991
Wash.		20		51	Schroeder 1995
Wash.		19		32	Sveum et al. 1998a
Wyo.	36				Patterson 1952
Wyo.	29	24	15	9	Heath et al. 1997
Wyo.	31	25	18	5	Holloran 1999
Wyo.	33	26	21	11	Lyon 2000

[a] Mean height of nest bush.
[b] Mean canopy coverage of the sagebrush surrounding the nest.
[c] Some coverage estimates may include both grasses and forbs.

Mean height of sagebrush most commonly used by nesting grouse ranges from 29 to 80 cm (Table 1), and nests tend to be under the tallest sagebrush within a stand (Keister and Willis 1986, Wakkinen 1990, Apa 1998). In general, sage grouse nests are placed under shrubs having larger canopies and more ground and lateral cover as well as in stands with more shrub canopy cover than at random sites (Wakkinen 1990, Fischer 1994, Heath et al. 1997, Sveum et al. 1998*a*, Holloran 1999). Sagebrush cover near the nest site was greater around successful nests than unsuccessful nests in Montana (Wallestad and Pyrah 1974) and Oregon (Gregg 1991). Wallestad and Pyrah (1974) also indicated that successful nests were in sagebrush stands with greater average canopy coverage (27%) than those of unsuccessful nests (20%). Gregg (1991) reported that sage grouse nest success varied by cover type. The greatest nest success occurred in a mountain big sagebrush (*A. t. tridentata vaseyana*) cover type where shrubs 40–80 cm in height had greater canopy cover at the site of successful nests than at unsuccessful nests (Gregg 1991). These observations were consistent with the results of an artificial nest study showing greater coverage of medium-height shrubs improved success of artificial nests (DeLong 1993, DeLong et al. 1995).

Grass height and cover also are important components of sage grouse nest sites (Table 1). Grass associated with nest sites and with the stand of vegetation containing the nest was taller and denser than grass at random sites (Wakkinen 1990, Gregg 1991, Sveum et al. 1998*a*). Grass height at nests under non-sagebrush plants was greater ($P<0.01$) than that associated with nests under sagebrush, further suggesting that grass height is an important habitat component for nesting sage grouse (Connelly et al. 1991). Moreover, in Oregon, grass cover was greater at successful nests than at unsuccessful nests (Gregg 1991). Grass >18 cm in height occurring in stands of sagebrush 40–80 cm tall resulted in lesser nest predation rates than in stands with lesser grass heights (Gregg et al. 1994). Herbaceous cover associated with nest sites may provide scent, visual, and physical barriers to potential predators (DeLong et al. 1995).

Early brood-rearing areas occur in upland sagebrush habitats relatively close to nest sites, but movements of individual broods may vary (Connelly 1982, Gates 1983). Within 2 days of hatching, one brood moved 3.1 km (Gates 1983). Early brood-rearing habitats may be relatively open

Radiotelemetry and a pointing dog are used to capture sage grouse chicks for a research project in southeastern Idaho.

(about 14% canopy cover) stands of sagebrush (Martin 1970, Wallestad 1971) with ≥15% canopy cover of grasses and forbs (Sveum et al. 1998*b*, Lyon 2000). Great plant species richness with abundant forbs and insects characterize brood areas (Dunn and Braun 1986, Klott and Lindzey 1990, Drut et al. 1994*a*, Apa 1998). In Oregon, diets of sage grouse chicks included 34 genera of forbs and 41 families of invertebrates (Drut et al. 1994*b*). Insects, especially ants (Hymenoptera) and beetles (Coleoptera), are an important component of early brood-rearing habitat (Drut et al. 1994*b*, Fischer et al. 1996*a*). Ants and beetles occurred more frequently ($P=0.02$) at brood-activity centers compared to nonbrood sites (Fischer et al. 1996*a*).

Summer–late brood-rearing habitats

As sagebrush habitats desiccate, grouse usually move to more mesic sites during June and July (Gill 1965, Klebenow 1969, Savage 1969, Connelly and Markham 1983, Gates 1983, Connelly et al. 1988, Fischer et al. 1996*b*). Sage grouse broods occupy a variety of habitats during summer, including sagebrush (Martin 1970), relatively small burned areas within sagebrush (Pyle and Crawford 1996), wet meadows (Savage 1969), farmland, and other irrigated areas adjacent to sagebrush habitats (Connelly and Markham 1983, Gates 1983, Connelly et al. 1988). Apa (1998) reported that sites used by grouse broods had twice as much forb cover as independent sites.

Fall habitats

Sage grouse use a variety of habitats during fall. Patterson (1952) reported that grouse move from summer to winter range in October, but during mild weather in late fall, some birds may still use summer range. Similarly, Connelly and Markham (1983) observed that most sage grouse had abandoned summering areas by the first week of October. Fall movements to winter range are slow and meandering and occur from late August to December (Connelly et al. 1988). Wallestad (1975) documented a shift in feeding habits from September, when grouse were consuming a large amount of forbs, to December, when birds were feeding only on sagebrush.

Winter habitats

Characteristics of sage grouse winter habitats are relatively similar throughout most of the species' range (Table 2). Eng and Schladweiler (1972) and Wallestad (1975) indicated that most observations of radiomarked sage grouse during winter in Montana occurred in sagebrush habitats with >20% canopy cover. However, Robertson (1991) indicated that sage grouse used sagebrush habitats that had average canopy coverage of 15% and average height of 46 cm during 3 winters in southeastern Idaho. In Idaho, sage grouse selected areas with greater canopy cover of Wyoming big sagebrush (*A. t. wyomingensis*) in stands containing taller shrubs when compared to random sites (Robertson 1991).

Table 2. Characteristics of sagebrush at sage grouse winter-use sites.

State	Canopy		Reference
	Coverage[a] (%)	Height[a] (cm)	
Colo.		24–36[bd]	Beck 1977
Colo.		20–30[cd]	Beck 1977
Colo.	43[b]	34[b]	Schoenberg 1982
Colo.	37[c]	26[c]	Schoenberg 1982
Colo.	30–38[de]	41–54[de]	Hupp 1987
Id.	38[e]	56[e]	Autenrieth 1981
Id.	26[b]	29[b]	Connelly 1982
Id.	25[c]	26[c]	Connelly 1982
Id.	15	46	Robertson 1991
Mont.	27	25	Eng and Schladweiler 1972
Mont.	>20		Wallestad 1975
Oreg.	12–17[d]		Hanf et al. 1994

[a] Mean canopy coverage or height of sagebrush above snow.
[b] Males
[c] Females
[d] Ranges are given when data were provided for more than one year or area.
[e] No snow present when measurements were made or total height of plant was measured.

In Colorado, sage grouse may be restricted to <10% of the sagebrush habitat because of variation in topography and snow depth (Beck 1977, Hupp and Braun 1989). Such restricted areas of use may not occur throughout the species' range because in southeastern Idaho, severe winter weather did not result in the grouse population greatly reducing its seasonal range (Robertson 1991).

During winter, sage grouse feed almost exclusively on leaves of sagebrush (Patterson 1952, Wallestad et al. 1975). Although big sagebrush dominates the diet in most portions of the range (Patterson 1952; Wallested et al. 1975; Remington and Braun 1985; Welch et al. 1988, 1991), low sagebrush (*A. arbuscula*), black sagebrush (*A. nova*, Dalke et al. 1963, Beck 1977), fringed sagebrush (*A. frigida*, Wallestad et al. 1975), and silver sagebrush (*A. cana*, Aldridge 1998) are consumed in many areas depending on availability. Sage grouse in some areas apparently prefer Wyoming big sagebrush (Remington and Braun 1985, Myers 1992) and in other areas mountain big sagebrush (Welch et al. 1988, 1991). Some of the differences in selection may be due to preferences for greater levels of protein and the amount of volatile oils (Remington and Braun 1985, Welch et al. 1988).

Effects of habitat alteration

Range management treatments

Breeding habitat. Until the early 1980s, herbicide treatment (primarily with 2,4-D) was the most common method to reduce sagebrush on large tracts of rangeland (Braun 1987). Klebenow (1970) reported cessation of nesting in newly sprayed areas with <5% live sagebrush canopy cover. Nesting also was nearly nonexistent in older sprayed areas containing about 5% live sagebrush cover (Klebenow 1970). In virtually all documented cases, herbicide application to blocks of sagebrush rangeland resulted in major declines in sage grouse breeding populations (Enyeart 1956, Higby 1969, Peterson 1970, Wallestad 1975). Effects of this treatment on sage grouse populations seemed more severe if the treated area was subsequently seeded to crested wheatgrass (*Agropyron cristatum*, Enyeart 1956).

Using fire to reduce sagebrush has become more common since most uses of 2,4-D on public lands were prohibited (Braun 1987). Klebenow (1972) and Sime (1991) suggested that fire may benefit sage grouse populations. Neither Gates (1983), Martin (1990), nor Bensen et al. (1991) reported adverse effects of fire on breeding populations of sage grouse. In contrast, following a 9-year study, Connelly et al. (1994, 2000*b*) indicated that prescribed burning of Wyoming big sagebrush during a drought period resulted in a large decline (>80%) of a sage grouse breeding population in southeastern Idaho. Additionally, Hulet (1983) documented loss of leks from fire and Nelle et al. (2000) reported that burning mountain big sagebrush stands had long-term negative impacts on sage grouse nesting and brood-rearing habitats. Canopy cover in mountain big sagebrush did not provide appropriate nesting habitat 14 years after burning (Nelle et al. 2000). The impact of fire on sage grouse populations using habitats dominated by silver sagebrush (which may resprout following fire) is unknown.

Cheatgrass (*Bromus tectrorum*) will often occupy sites following disturbance, especially burning (Valentine 1989). Repeated burning or burning in late summer favors cheatgrass invasion and may be a major cause of the expansion of this species (Vallentine 1989). The ultimate result may be a loss of the sage grouse population because of long-term conversion of sagebrush habitat to rangeland dominated by an annual exotic grass. However, this situation largely appears confined to the western portion of the species' range and does not commonly occur in Wyoming (J. Lawson, Wyoming Department of Game and Fish, personal communication).

Mechanical methods of sagebrush control have often been applied to smaller areas than those treated by herbicides or fire, especially to convert rangeland to cropland. However, adverse effects of this type of treatment on sage grouse breeding populations also have been documented. In Montana, Swenson et al. (1987) indicated that the number of breeding males declined by 73% after 16% of their study area was plowed.

Brood-rearing habitats. Martin (1970) reported that sage grouse seldom used areas treated with herbicides to remove sagebrush in southwestern Montana. In Colorado, Rogers (1964) indicated that an entire population of sage grouse appeared to emigrate from an area that was subjected to several years of herbicide application to remove sagebrush. Similarly, Klebenow (1970) reported that herbicide spraying reduced the brood-carrying capacity of an area in southeastern Idaho. However, application of herbicides in early spring to reduce sagebrush cover may enhance some brood-rearing habitats by increasing the amount of herbaceous plants used for food (Autenrieth 1981).

Fire may improve sage grouse brood-rearing habitat (Klebenow 1972, Gates 1983, Sime 1991), but until recently, experimental evidence was not available to support or refute these contentions (Braun 1987). Pyle and Crawford (1996) suggested that fire may enhance brood-rearing habitat in montane settings but cautioned that its usefulness requires further investigation. A 9-year study of the effects of fire on sage grouse did not support that prescribed fire, conducted during late summer in a Wyoming big sagebrush habitat, improved brood-rearing habitat for sage grouse (Connelly et al. 1994, Fischer et al. 1996*a*). Prescribed burning of sage grouse habitat did not increase amount of forbs in burned areas compared to unburned areas (Fischer et al. 1996*a*, Nelle et al. 2000) and resulted in decreased insect populations in the treated area compared to the unburned area. Thus, fire may negatively affect sage grouse brood-rearing habitat rather than improve it in Wyoming big sagebrush habitats (Connelly and Braun 1997), but its effect on grouse habitats in mountain big sagebrush communities requires further investigation (Pyle and Crawford 1996, Nelle et al. 2000).

Sage grouse often use agricultural areas for brood-rearing habitat (Patterson 1952, Wallestad 1975, Gates 1983, Connelly et al. 1988, Blus et al. 1989). Grouse use of these areas may result in mortality because of exposure to insecticides. Blus et al. (1989) reported die-offs of sage grouse that were exposed to methamidiphos used in potato fields and dimethoate used in alfalfa fields. Dimethoate is used commonly for alfalfa, and 20 of 31 radio-marked grouse (65%) died following direct exposure to this insecticide (Blus et al. 1989).

Winter habitat. Reduction in sage grouse use of an area treated by herbicide was proportional to the severity (i.e., amount of damage to sagebrush) of the treatment (Pyrah 1972). In sage grouse winter range, strip partial kill, block partial kill, and total kill of sagebrush were increasingly detrimental to sage grouse in Montana (Pyrah 1972) and Wyoming (Higby 1969).

In Idaho, Robertson (1991) reported that a 2,000-ha prescribed burn that removed 57% of the sagebrush cover in sage grouse winter habitat minimally impacted the sage grouse population. Although sage grouse use of the burned area declined following the fire, grouse adapted to this disturbance by moving 1 to 10 km outside of the burn to areas with greater sagebrush cover (Robertson 1991) than was available in the burned area.

Land use

Mining-energy development. Effects of mining, oil, and gas developments on sage grouse populations are not well known (Braun 1998). These activities negatively impact grouse habitat and populations over the short term (Braun 1998), but research suggests some recovery of populations following initial development and subsequent reclamation of the affected sites (Eng et al. 1979, Tate et al. 1979, Braun 1986). In Colorado, sage grouse were displaced by oil development and coal-mining activities, but numbers returned to pre-disturbance levels once the activities ceased (Braun 1987, Remington and Braun 1991). At least 6 leks in Alberta were disturbed by energy development and 4 were abandoned (Aldridge 1998). In Wyoming, female sage grouse captured on leks disturbed by natural gas development had lower nest-initiation rates, longer movements to nest sites, and different nesting habitats than hens captured on undisturbed leks (Lyon 2000). Sage grouse may repopulate an area following energy development but may not attain population levels that occurred prior to development (Braun 1998). Thus, short-term and long-term habitat loss appears to result from energy development and mining (Braun 1998).

Grazing. Domestic livestock have grazed over most areas used by sage grouse and this use is generally repetitive with annual or biennial grazing periods of varying timing and length (Braun 1998). Grazing patterns and use of habitats are often dependent on weather conditions (Valentine 1990). Historic and scientific evidence indicates that livestock grazing did not increase the distribution of sagebrush (Peterson 1995) but markedly reduced the herbaceous understory over relatively large areas and increased sagebrush density in some areas (Vale 1975, Tisdale and Hironaka 1981). Within the intermountain region, some vegetation changes from livestock grazing likely occurred because sagebrush steppe in this area did not evolve with intensive grazing by wild herbivores, as did the grassland prairies of central North America (Mack and Thompson 1982). Grazing by wild ungulates may reduce sagebrush cover (McArthur et al. 1988, Peterson 1995), and livestock grazing may result in high trampling mortality of sagebrush seedlings (Owens and Norton 1992). In Wyoming big sagebrush habitats, resting areas from livestock grazing may improve understory production as well as decrease sagebrush cover (Wambolt and Payne 1986).

There is little direct experimental evidence linking grazing practices to sage grouse population levels (Braun 1987, Connelly and Braun 1997). However, grass height and cover affect sage grouse nest site selection and success (Wakkinen 1990, Gregg 1991, Gregg et al. 1994, Delong et al. 1995, Sveum et al. 1998*a*). Thus, indirect evidence suggests grazing by livestock or wild herbivores that significantly reduces the herbaceous understory in breeding habitat may have negative impacts on sage grouse populations (Braun 1987, Dobkin 1995).

Miscellaneous activities. Construction of roads, powerlines, fences, reservoirs, ranches, farms, and housing developments has resulted in sage grouse habitat loss and fragmentation (Braun 1998). Between 1962 and 1997, >51,000 km of fence were constructed on land administered by the Bureau of Land Management in states supporting sage grouse populations (T. D. Rich, United States Bureau of Land Management, personal communication). Structures such as powerlines and fences pose hazards to sage grouse because they provide additional perch sites for raptors and because sage grouse may be injured or killed when they fly into these structures (Call and Maser 1985).

Weather

Prolonged drought during the 1930s and mid-1980s to early 1990s coincided with declining sage grouse populations throughout much of the species' range (Patterson 1952, Fischer 1994, Hanf et al. 1994). Drought may affect sage grouse populations by reducing herbaceous cover at nests and the quantity and quality of food available for hens and chicks during spring (Hanf et al. 1994, Fischer et al. 1996*a*).

Spring weather may influence sage grouse production. Relatively wet springs may result in increased production (Wallestad 1975, Autenrieth 1981). However, heavy rainfall during egg-laying or unseasonably cold temperatures with precipitation during hatching may decrease production (Wallestad 1975).

There is no evidence that severe winter weather affects sage grouse populations unless sagebrush cover has been greatly reduced or eliminated (Wallestad 1975, Beck 1977, Robertson 1991).

Predation

Over the last 25 years, numerous studies have used radiotelemetry to address sage grouse survival and nest success (Wallestad 1975; Hulet 1983; Gregg 1991; Robertson 1991; Connelly et al. 1993, 1994; Gregg et al. 1994; Schroeder 1997). Only Gregg (1991) and Gregg et al. (1994) indicated that predation was limiting sage grouse numbers, and their research suggested that low nest success from predation was related to poor nesting habitat. Most reported nest-success rates are >40%, suggesting that nest predation is not a widespread problem. Similarly, high survival rates of adult (Connelly et al. 1993, Zablan 1993) and older (>10 weeks of age) juvenile sage grouse indicate that population declines are not generally related to high levels of predation. Thus, except for an early study in Oregon (Batterson and Morse 1948), predation has not been identified as a major limiting factor for sage grouse (Connelly and Braun 1997).

Constructing ranches, farms, and housing developments has resulted in the addition of nonnative predators to sage grouse habitats, including dogs, cats, and red foxes (*Vulpes vulpes*; J. W. Connelly, Idaho Department of Fish and Game, unpublished data; B. L. Welch, United States Forest Service, personal communication) and may be responsible for increases in abundance of the common raven (*Corvus corax*, Sauer et al. 1997). Relatively high raven populations may decrease sage grouse nest success (Batterson and Morse 1948, Autenrieth 1981), but rigorous field studies using radiotelemetry do not support this hypothesis. Current work in Strawberry Valley, Utah, suggests that red foxes are taking a relatively high proportion of the population (Flinders 1999). This may become a greater problem if red foxes become well established throughout sage grouse breeding habitat.

Recommended guidelines

Sage grouse populations occupy relatively large areas on a year-round basis (Berry and Eng 1985, Connelly et al. 1988, Wakkinen 1990, Leonard et al. 2000), invariably involving a mix of ownership and jurisdictions. Thus, state and federal natural resource agencies and private landowners must coordinate efforts over at least an entire seasonal range to successfully implement these guidelines. Based on current knowledge of sage grouse population and habitat trends, these guidelines have been developed to help agencies and landowners effectively assess and manage populations, protect and manage remaining habitats, and restore damaged habitat. Because of gaps in our knowledge and regional variation in habitat characteristics (Tisdale and Hironaka 1981), the judgment of local biologists and quantitative data from population and habitat monitoring are necessary to implement the guidelines correctly. Further, we urge agencies to use an adaptive management approach (Macnab 1983, Gratson et al. 1993), using monitoring and evaluation to assess the success of implementing these guidelines to manage sage grouse populations.

Activities responsible for the loss or degradation of sagebrush habitats also may be used to restore these habitats. These activities include prescribed fire, grazing, herbicides, and mechanical treatments. Decisions on land treatments using these tools should be based on quantitative knowledge of vegetative conditions over an entire population's seasonal range. Generally, the treatment selected should be that which is least disruptive to the vegetation community and has the most rapid recovery time. This selection should not be based solely on economic cost.

Definitions

For the purpose of these guidelines, we define an occupied lek as a traditional display area in or adjacent to sagebrush-dominated habitats that has been attended by ≥2 male sage grouse in ≥2 of the previous 5 years. We define a breeding population as a group of birds associated with 1 or more occupied leks in the same geographic area separated from other leks by >20 km. This definition is somewhat arbitrary but generally based on maximum distances females move to nest.

Population management

1) Before making management decisions, agencies should cooperate to first identify lek locations and determine whether a population is migratory or nonmigratory. In the case of migratory populations, migration routes and seasonal habitats must be identified to allow for meaningful and correct management decisions.

2) Breeding populations should be assessed by either lek counts (census number of males attending leks) or lek surveys (classify known leks as active or inactive) each year (Autenrieth et al. 1982). Depending on number of counts each spring (Jenni and Hartzler 1978, Emmons and Braun

1984) and weather conditions when the counts were made, lek counts may not provide an accurate assessment of sage grouse populations (Beck and Braun 1980) and the data should be viewed with caution. Despite these shortcomings, lek counts provide the best index to breeding population levels and many long-term data sets are available for trend analysis (Connelly and Braun 1997).

3) Production or recruitment should be monitored by brood counts or wing surveys (Autenrieth et al. 1982). Brood counts are labor-intensive and usually result in inadequate sample size. Where adequate samples of wings can be obtained, we recommend using wing surveys to obtain estimates of sage grouse nesting success and juvenile:adult hen (including yearlings) ratios.

4) Routine population monitoring should be used to assess trends and identify problems for all hunted and nonhunted populations. Check stations, wing collections, and questionnaires can be used to obtain harvest information. Breeding population and production data (above) can be used to monitor nonhunted populations.

5) The genetic variation of relatively small, isolated populations should be documented to better understand threats to these populations and implement appropriate management actions (Young 1994, Oyler-McCance et al. 1999).

6) Hunting seasons for sage grouse should be based on careful assessments of population size and trends. Harvest should not be based on the observations of Allen (1954:43), who stated, "Our populations of small animals operate under a 1-year plan of decimation and replacement; and Nature habitually maintains a wide margin of overproduction. She kills off a huge surplus of animals whether we take our harvest or not." To the contrary, sage grouse tend to have relatively long lives with low annual turnover (Zablan 1993, Connelly et al. 1994) and a low reproductive rate (Gregg 1991, Connelly et al. 1993). Consequently, hunting may be additive to other causes of mortality for sage grouse (Johnson and Braun 1999, Connelly et al. 2000*a*). However, most populations appear able to sustain hunting if managed carefully (Connelly et al. 2000*a*).

7) If populations occur over relatively large geographic areas and are stable to increasing, seasons and bag limits can be relatively liberal (2- to 4-bird daily bag limit and a 2- to 5-week season) for hunting seasons allowing firearms (Braun and Beck 1985).

8) If populations are declining (for 3 or more consecutive years) or trends are unknown, seasons and bag limits should be generally conservative (1- or 2-bird daily bag limit and a 1-to 4-week season) for hunting seasons allowing firearms, or suspended (for all types of hunting, including falconry and Native American subsistence hunting) because of this species' population characteristics (Braun 1998, Connelly et al. 2000*a*).

9) Where populations are hunted, harvest rates should be 10% or less of the estimated fall population to minimize negative effects on the subsequent year's breeding population (Connelly et al. 2000*a*).

10) Populations should not be hunted where ≤300 birds comprise the breeding population (i.e., ≤100 males are counted on leks [C. E. Braun, Colorado Division of Wildlife, unpublished report]).

11) Spring hunting of sage grouse on leks should be discouraged or, if unavoidable, confined to males only during the early portion of the breeding season. Spring hunting is considered an important tradition for some Native American tribes. However, in Idaho, 80% of the leks hunted during spring in the early 1990s ($n=5$) had become inactive by 1994 (Connelly et al. 1994).

12) Viewing sage grouse on leks (and censusing leks) should be conducted so that disturbance to birds is minimized or preferably eliminated (Call and Maser 1986). Agencies should generally not provide all lek locations to individuals simply interested in viewing birds. Instead, 1 to 3 lek locations should be identified as public viewing leks, and if demand is great enough, agencies should consider erecting 2–3 seasonal blinds at these leks for public use. Camping in the center of or on active leks should be vigorously discouraged.

13) Discourage establishment of red fox and other nonnative predator populations in sage grouse habitats.

14) For small, isolated populations and declining populations, assess the impact of predation on survival and production. Predator control programs are expensive and often ineffective. In some cases, these programs may provide temporary help while habitat is recovering. Predator management programs also could be considered in areas where seasonal habitats are in good condition but their extent has been reduced greatly. However, predator management should be implemented only if the available data (e.g., nest success <25%, annual survival of adult hens <45%) support the action.

General habitat management

The following guidelines pertain to all seasonal habitats used by sage grouse:

1) Monitor habitat conditions and propose treatments only if warranted by range condition (i.e., the area no longer supports habitat conditions described in the following guidelines under habitat protection). Do not base land treatments on schedules, targets, or quotas.

2) Use appropriate vegetation treatment techniques (e.g., mechanical methods, fire) to remove junipers and other conifers that have invaded sage grouse habitat (Commons et al. 1999). Whenever possible, use vegetation control techniques that are least disruptive to the stand of sagebrush, if this stand meets the needs of sage grouse (Table 3).

Table 3. Characteristics of sagebrush rangeland needed for productive sage grouse habitat.

	Breeding		Brood-rearing		Winter[e]	
	Height (cm)	Canopy (%)	Height (cm)	Canopy (%)	Height (cm)	Canopy (%)
Mesic sites[a]						
Sagebrush	40–80	15–25	40–80	10–25	25–35	10–30
Grass–forb	>18[c]	≥25[d]	variable	>15	N/A	N/A
Arid sites[a]						
Sagebrush	30–80	15–25	40–80	10–25	25–35	10–30
Grass/forb	>18[c]	≥15	variable	>15	N/A	N/A
Area[b]	>80		>40		>80	

[a] Mesic and arid sites should be defined on a local basis; annual precipitation, herbaceous understory, and soils should be considered (Tisdale and Hironaka 1981, Hironaka et al. 1983).

[b] Percentage of seasonal habitat needed with indicated conditions.

[c] Measured as "droop height"; the highest naturally growing portion of the plant.

[d] Coverage should exceed 15% for perennial grasses and 10% for forbs; values should be substantially greater if most sagebrush has a growth form that provides little lateral cover (Schroeder 1995)

[e] Values for height and canopy coverage are for shrubs exposed above snow.

3) Increase the visibility of fences and other structures occurring within 1 km of seasonal ranges by flagging or similar means if these structures appear hazardous to flying grouse (e.g., birds have been observed hitting or narrowly missing these structures or grouse remains have been found next to these structures).

4) Avoid building powerlines and other tall structures that provide perch sites for raptors within 3 km of seasonal habitats. If these structures must be built, or presently exist, the lines should be buried or poles modified to prevent their use as raptor perch sites.

Breeding habitat management

For migratory and nonmigratory populations, lek attendance, nesting, and early brood rearing occur in breeding habitats. These habitats are sagebrush-dominated rangelands with a healthy herbaceous understory and are critical for survival of sage grouse populations. Mechanical disturbance, prescribed fire, and herbicides can be used to restore sage grouse habitats to those conditions identified as appropriate in the following sections on habitat protection. Local biologists and range ecologists should select the appropriate technique on a case-by-case basis. Generally, fire should not be used in breeding habitats dominated by Wyoming big sagebrush if these areas support sage grouse. Fire can be difficult to control and tends to burn the best remaining nesting and early brood-rearing habitats (i.e., those areas with the best remaining understory), while leaving areas with poor understory. Further, we recommend against using fire in habitats dominated by xeric mountain big sagebrush (*A. t. xericensis*) because annual grasses commonly invade these habitats and much of the original habitat has been altered by fire (Bunting et al. 1987).

Although mining and energy development are common activities throughout the range of sage grouse, quantitative data on the long-term effects of these activities on sage grouse are limited. However, some negative impacts have been documented (Braun 1998, Lyon 2000). Thus, these activities should be discouraged in breeding habitats, but when they are unavoidable, restoration efforts should follow procedures outlined in these guidelines.

Habitat protection

1) Manage breeding habitats to support 15–25% canopy cover of sagebrush, perennial herbaceous cover averaging ≥18 cm in height with ≥15% canopy cover for grasses and ≥10% for forbs and a diversity of forbs (Barnett and Crawford 1994, Drut et al. 1994*a*, Apa 1998) during spring (Table 3). Habitats meeting these conditions should have a high priority for wildfire suppression and should

not be considered for sagebrush control programs. Sagebrush and herbaceous cover should provide overhead and lateral concealment from predators. If average sagebrush height is >75 cm, herbaceous cover may need to be substantially greater than 18 cm to provide this protection. There is much variability among sagebrush-dominated habitats (Tisdale and Hironaka 1981, Hironaka et al. 1983), and some Wyoming sagebrush and low sagebrush breeding habitats may not support 25% herbaceous cover. In these areas, total herbaceous cover should be ≥15 % (Table 3). Further, the herbaceous height requirement may not be possible in habitats dominated by grasses that are relatively short when mature. In all of these cases, local biologists and range ecologists should develop height and cover requirements that are reasonable and ecologically defensible. Leks tend to be relatively open, thus cover on leks should not meet these requirements.

2) For nonmigratory grouse occupying habitats that are distributed uniformly (i.e., habitats have the characteristics described in guideline 1 and are generally distributed around the leks), protect (i.e., do not manipulate) sagebrush and herbaceous understory within 3.2 km of all occupied leks. For nonmigratory populations, consider leks the center of year-round activity and use them as focal points for management efforts (Braun et al. 1977).

3) For nonmigratory populations where sagebrush is not distributed uniformly (i.e., habitats have the characteristics described in guideline 1 but distributed irregularly with respect to leks), protect suitable habitats for ≤5 km from all occupied leks. Use radiotelemetry, repeated surveys for grouse use, or habitat mapping to identify nesting and early brood-rearing habitats.

4) For migratory populations, identify and protect breeding habitats within 18 km of leks in a manner similar to that described for nonmigratory sage grouse. For migratory sage grouse, leks generally are associated with nesting habitats but migratory birds may move >18 km from leks to nest sites. Thus, protection of habitat within 3.2 km of leks may not protect most of the important nesting areas (Wakkinen et al. 1992, Lyon 2000).

5) In areas of large-scale habitat loss (≥40% of original breeding habitat), protect all remaining habitats from additional loss or degradation. If remaining habitats are degraded, follow guidelines for habitat restoration listed below.

6) During drought periods (≥2 consecutive years), reduce stocking rates or change management practices for livestock, wild horses, and wild ungulates if cover requirements during the nesting and brood-rearing periods are not met. Grazing pressure from domestic livestock and wild ungulates should be managed in a manner that at all times addresses the possibility of drought.

Sage grouse just leaving a nest in good-condition breeding habitat in southwestern Idaho. Note the height of grass and herbaceous cover.

7) Suppress wildfires in all breeding habitats. In the event of multiple fires, land management agencies should have all breeding habitats identified and prioritized for suppression, giving the greatest priority to those that have become fragmented or reduced by >40% in the last 30 years.

8) Adjust timing of energy exploration, development, and construction activity to minimize disturbance of sage grouse breeding activities. Energy-related facilities should be located >3.2 km from active leks whenever possible. Human activities within view of or <0.5 km from leks should be minimized during the early morning and late evening when birds are near or on leks.

Habitat restoration

1) Before initiating vegetation treatments, quantitatively evaluate the area proposed for treatment to ensure that it does not have sagebrush and herbaceous cover suitable for breeding habitat (Table 3). Treatments should not be undertaken within sage grouse habitats until the limiting vegetation factor(s) has been identified, the proposed treatment is known to provide the desired vegetation response, and land-use activities can be managed after treatment to ensure that vegetation objectives are met.

2) Restore degraded rangelands to a condition that again provides suitable breeding habitat for sage grouse by including sagebrush, native forbs

(especially legumes), and native grasses in reseeding efforts (Apa 1998). If native forbs and grasses are unavailable, use species that are functional equivalents and provide habitat characteristics similar to those of native species.

3) Where the sagebrush overstory is intact but the understory has been degraded severely and quality of nesting habitat has declined (Table 3), use appropriate techniques (e.g., brush beating in strips or patches and interseed with native grasses and forbs) that retain some sagebrush but open shrub canopy to encourage forb and grass growth.

4) Do not use fire in sage grouse habitats prone to invasion by cheatgrass and other invasive weed species unless adequate measures are included in restoration plans to replace the cheatgrass understory with perennial species using approved reseeding strategies. These strategies could include, but are not limited to, use of pre-emergent herbicides (e.g., Oust®, Plateau®) to retard cheatgrass germination until perennial herbaceous species become established.

5) When restoring habitats dominated by Wyoming big sagebrush, regardless of the techniques used (e.g., prescribed fire, herbicides), do not treat >20% of the breeding habitat (including areas burned by wildfire) within a 30-year period (Bunting et al. 1987). The 30-year period represents the approximate recovery time for a stand of Wyoming big sagebrush. Additional treatments should be deferred until the previously treated area again provides suitable breeding habitat (Table 3). In some cases, this may take <30 years and in other cases >30 years. If 2,4-D or similar herbicides are used, they should be applied in strips such that their effect on forbs is minimized. Because fire generally burns the best remaining sage grouse habitats

This breeding habitat is in poor condition because of a lack of understory.

(i.e., those with the best understory) and leaves areas with sparse understory, use fire for habitat restoration only when it can be convincingly demonstrated to be in the best interest of sage grouse.

6) When restoring habitats dominated by mountain big sagebrush, regardless of the techniques used (e.g., fire, herbicides), treat ≤20% of the breeding habitat (including areas burned by wildfire) within a 20-year period (Bunting et al. 1987). The 20-year period represents the approximate recovery time for a stand of mountain big sagebrush. Additional treatments should be deferred until the previously treated area again provides suitable breeding habitat (Table 3). In some cases, this may take <20 years and in other cases >20 years. If 2,4-D or similar herbicides are used, they should be applied in strips such that their effect on forbs is minimized.

7) All wildfires and prescribed burns should be evaluated as soon as possible to determine whether reseeding is necessary to achieve habitat management objectives. If needed, reseed with sagebrush, native bunchgrasses, and forbs whenever possible.

8) Until research unequivocally demonstrates that using tebuthiuron and similar-acting herbicides to control sagebrush has no long-lasting negative impacts on sage grouse habitat, use these herbicides only on an experimental basis and over a sufficiently small area that any long-term negative impacts are negligible. Because these herbicides have the potential of reducing but not eliminating sagebrush cover within grouse breeding habitats, thus stimulating herbaceous development, their use as sage grouse habitat management tools should be examined closely.

Nest habitat is measured in Owyhee County, southwestern Idaho.

John Crawford explains Oregon's sage grouse research program to field-trip attendees during a meeting of the Western States Sage and Columbian sharp-tailed Grouse Technical Committee.

Summer-late brood-rearing habitat management

Sage grouse may use a variety of habitats, including meadows, farmland, dry lakebeds, sagebrush, and riparian zones from late June to early November (Patterson 1952, Wallestad 1975, Connelly 1982, Hanf et al. 1994). Generally, these habitats are characterized by relatively moist conditions and many succulent forbs in or adjacent to sagebrush cover.

Habitat protection

1) Avoid land-use practices that reduce soil moisture effectiveness, increase erosion, cause invasion of exotic plants, and reduce abundance and diversity of forbs.

2) Avoid removing sagebrush within 300 m of sage grouse foraging areas along riparian zones, meadows, lakebeds, and farmland, unless such removal is necessary to achieve habitat management objectives (e.g., meadow restoration, treatment of conifer encroachment).

3) Discourage use of very toxic organophosphorus and carbamate insecticides in sage grouse brood-rearing habitats. Sage grouse using agricultural areas may be adversely affected by pesticide applications (Blus et al. 1989). Less toxic agrichemicals or biological control may provide suitable alternatives in these areas.

4) Avoid developing springs for livestock water, but if water from a spring will be used in a pipeline or trough, design the project to maintain free water and wet meadows at the spring. Capturing water from springs using pipelines and troughs may adversely affect wet meadows used by grouse for foraging.

Habitat restoration

1) Use brush beating or other mechanical treatments in strips 4-8 m wide in areas with relatively high shrub-canopy cover (≥35% total shrub cover) to improve late brood-rearing habitats. Brush beating can be used to effectively create different age classes of sagebrush in large areas with little age diversity.

2) If brush beating is impractical, use fire or herbicides to create a mosaic of openings in mountain big sagebrush and mixed-shrub communities used as late brood-rearing habitats where total shrub cover is ≥35%. Generally, 10-20% canopy cover of sagebrush and ≤25% total shrub cover will provide adequate habitat for sage grouse during summer.

3) Construct water developments for sage grouse only in or adjacent to known summer-use areas and provide escape ramps suitable for all avian species and other small animals. Water developments and "guzzlers" may improve sage grouse summer habitats (Autenrieth et al. 1982, Hanf et al. 1994). However, sage grouse used these developments infrequently in southeastern Idaho because most were constructed in sage grouse winter and breeding habitat rather than summer range (Connelly and Doughty 1989).

4) Whenever possible, modify developed springs and other water sources to restore natural free-flowing water and wet meadow habitats.

Winter habitat management

Sagebrush is the essential component of winter habitat. Sage grouse select winter-use sites based on snow depth and topography, and snowfall can affect the amount and height of sagebrush available to grouse (Connelly 1982, Hupp and Braun 1989, Robertson 1991). Thus, on a landscape scale, sage grouse winter habitats should allow grouse access to sagebrush under all snow conditions (Table 3).

Habitat protection

1) Maintain sagebrush communities on a landscape scale, allowing sage grouse access to sagebrush stands with canopy cover of 10-30% and heights of at least 25-35 cm regardless of snow cover. These areas should be high priority for wildfire suppression and sagebrush control should be avoided.

2) Protect patches of sagebrush within burned areas from disturbance and manipulation. These areas may provide the only winter habitat for sage grouse and their loss could result in the extirpation of the grouse population. They also are important

seed sources for sagebrush re-establishment in the burned areas. During fire-suppression activities do not remove or burn any remaining patches of sagebrush within the fire perimeter.

3) In areas of large-scale habitat loss (≥40% of original winter habitat), protect all remaining sagebrush habitats.

Habitat restoration

1) Reseed former winter range with the appropriate subspecies of sagebrush and herbaceous species unless the species are recolonizing the area in a density that would allow recovery (Table 3) within 15 years.

2) Discourage prescribed burns >50 ha, and do not burn >20% of an area used by sage grouse during winter within any 20–30-year interval (depending on estimated recovery time for the sagebrush habitat).

Conservation strategies

We recommend that each state and province develop and implement conservation plans for sage grouse. These plans should use local working groups comprised of representatives of all interested agencies, organizations, and individuals to identify and solve regional issues (Anonymous 1997). Within the context of these plans, natural resource agencies should cooperate to document the amount and condition of sagebrush rangeland remaining in the state or province. Local and regional plans should summarize common problems to conserve sage grouse and general conditions (Table 3) needed to maintain healthy sage grouse populations. Local differences in conditions that affect sage grouse populations may occur and should be considered in conservation plans. Natural resource agencies should identify remaining breeding and winter ranges in Wyoming big sagebrush habitats and establish these areas as high priority for wildfire suppression. Prescribed burning in habitats that are in good ecological condition should be avoided. Protection and restoration of sage grouse habitats also will likely benefit many other sagebrush obligate species (Saab and Rich 1997) and enhance efforts to conserve and restore sagebrush steppe.

Although translocating sage grouse to historical range has been done on numerous occasions, few attempts have been successful (Musil et al. 1993, Reese and Connelly 1997). Thus, we agree with Reese and Connelly (1997) that translocation efforts should be viewed as only experimental at this time and not as a viable management strategy.

More information is needed on characteristics of healthy sagebrush ecosystems and the relationship of grazing to sage grouse production. Field experiments should be implemented to evaluate the relationship of grazing pressure (i.e., disturbance and removal of herbaceous cover) to sage grouse nest success and juvenile survival (Connelly and Braun 1997). The overall quality of existing sage grouse habitat will become increasingly important as quantity of these habitats decrease. Sage grouse populations appear relatively secure in some portions of their range and at risk in other portions. However, populations that have thus far survived extensive habitat loss may still face extinction because of a time lag between habitat loss and ultimate population collapse (Cowlishaw 1999).

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John W. (Jack) Connelly (left) is a wildlife research biologist with the Idaho Department of Fish and Game. He received his B.S. in fish and wildlife resources from the University of Idaho and M.S. in wildlife biology and Ph.D. in zoology from Washington State University. He has been a member of The Wildlife Society for 25 years and is past-president of the Idaho Chapter and current president of the Northwest Section. He has been involved with research on sage grouse since 1977. Michael A. (Mike) Schroeder (right) is the upland bird research biologist for the Washington Department of Fish and Wildlife. He received his B.S. in wildlife ecology from Texas A&M University, M.S. in zoology from the University of Alberta, and Ph.D. in wildlife biology from Colorado State University. He has been a member of The Wildlife Society for 21 years. He has been studying Washington populations of sage grouse, sharp-tailed grouse, and spruce grouse since 1992. Alan R. Sands retired after 21 years as a wildlife biologist for the Bureau of Land Management and is now employed by The Nature Conservancy as a field representative for southwestern Idaho. He received his B.A. in math and science from San Diego State University and M.S. in wildlife management from Humboldt State University. He has been a member of The Wildlife Society for 25 years and is past vice-president of the Idaho Chapter. Clait E. Braun (center) recently retired from the Colorado Division of Wildlife. He received his B.S. in soil science from Kansas State University, M.S. from the University of Montana in forest wildlife management, and Ph.D. from Colorado State University in wildlife biology. He has been a member of The Wildlife Society for 39 years and is past-editor of The Journal of Wildlife Management, past-president of the Central Mountain and Plains Section, past Council Member, and past-president of The Wildlife Society.

EXHIBIT M

DEPARTMENT OF THE ARMY

LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

January 11, 2013

Office of
District Counsel

Pamela N. Epstein
Adams, Broadwell, Joseph & Cardozo
601 Gateway Blvd., Suite 1000
South San Francisco, CA 94080-7037

RE: Casa Diablo IV Geothermal Development Project

Dear Ms. Epstein,

This letter concerns your Freedom of Information Act (FOIA) request dated December 12, 2012. Your request, assigned number FA-13-0038, is enclosed. Please use this reference number in any further correspondence regarding this request.

In your letter, you requested documents related to the above-referenced project. After an extensive search, no records have been found. Your FOIA request will be administratively closed; no further action is required. If you have any questions, please contact Julie Witt at (213) 452-3947 or by email at julie.m.witt@usace.army.mil.

Sincerely,

Julie Witt
for Burke S. Large
Assistant District Counsel

Enclosure

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CALIFORNIA 95814-2922

January 4, 2013

Office of Counsel

SUBJECT: Freedom of Information Act Request No. FA-13-0050; Documents related to Casa Diablo IV Geothermal Development Project (CACA 11667)

RECEIVED
OFFICE OF COUNSEL

JAN 8 2013

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Ms. Pamela N. Epstein
Adams, Broadwell, Joseph and Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, California 94080-7037

Dear Ms. Epstein:

This office has received your Freedom of Information Act (FOIA) request for documents related to Casa Diablo IV Geothermal Development Project (CACA 11667). I have forwarded your request to the Los Angeles District for a direct reply. Any further inquiries should be addressed to:

Mr. Burke Large
Los Angeles District
Office of Counsel (CESPL-OC)
915 Wilshire Boulevard, Suite 1535
Los Angeles, California 90017

Mr. Large may also be reached by telephone at (213) 452-3954

Sincerely,

Andrea L. Vaiasicca

Andrea L. Vaiasicca
Assistant Freedom of Information Act Officer

cc:

CESPL (Large)

Comment Letter I9 ~~FH~~ 13-0038
FP 13-008714

ADAMS BROADWELL JOSEPH & CARDOZO
A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW
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SACRAMENTO OFFICE
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SACRAMENTO, CA 95814-4721
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FAX (916) 444-6209

December 12, 2012

Received
DEC 17 2012
Office of Counsel

VIA UNITED STATES MAIL

U.S. Army Corps of Engineers
Sacramento Office
1325 J Street, Sacramento, CA 95814-2922
ATTN: FOIA Officer

Re: **Freedom of Information Act Request regarding Casa Diablo IV Geothermal Development Project (CACA 11667)**

Dear FOIA Officer:

Pursuant to the Freedom of Information Act, 5 U.S.C. § 552, we are writing on behalf of California Unions for Reliable Energy to request copies of all file materials in the possession of the United States Environmental Protection Agency related to the Casa Diablo IV Geothermal Development Project (the "Project") proposed by ORNI 50 LLC in Mono County, California. The Project proposes to construct a new 33-megawatt ("MW") geothermal power plant on the existing MPLP geothermal leases near the intersection of California State Route 203 and U.S. Highway 395 approximately 2.5 miles east of the town of Mammoth Lakes. Our request includes but is not limited to:

1. Any and all application and file materials for the Project;

2. Any and all correspondence, air quality analyses and/or modeling, memos, notes, other analyses, electronic mail messages, files, charts, and/or any other documents by, to or from the U.S. Army Corps of Engineers or any other private or governmental entity or individual referring or relating to the Project.

CURE is a coalition of labor unions who encourage sustainable development of California's energy and natural resources. Since its founding in 1997, CURE has been equally committed to building a strong economy and a healthier environment. CURE provides California with reliable energy and power plant jobs while protecting the state's air, land and water from pollution.[1] CURE advocates for the sustainable development of power facilities by sponsoring and disseminating legal and scientific analyses in connection with the environmental impacts of proposed power facilities for the purpose of local, state and federal agency environmental review of proposed projects. As such, CURE's advocacy helps inform the government's environmental review process and increase public awareness of the environmental consequences of proposed development projects.

CURE has a direct interest in enforcing environmental laws to minimize the adverse impacts of projects that would otherwise degrade the environment. Environmental degradation jeopardizes future growth by causing construction moratoriums, depleting limited air pollutant emissions offsets, consuming limited fresh water resources, and imposing other stresses on the environmental carrying capacity of the state. Additionally, union members live and work in the communities and regions that suffer the impacts of projects that are detrimental to human health and the environment. CURE's members also recreate on public land and have an interest in ensuring the multiple uses of those lands.

CURE belongs to the "other" category of document requestors. (*See* 43 C.F.R. § 2.17(a); *see Institute for Wildlife Protection v. U.S. Fish and Wildlife Service*, 290 F.Supp.2d 1226, 1232 (D. Or. 2003.)) CURE is a coalition of non-profit entities, which encourage sustainable development of California's energy and natural resources. CURE is interested in the requested information for the purpose of identifying the Project's potential environmental consequences in order to inform CURE's comments on the Project's environmental analyses pursuant to state environmental law. The requested information advances CURE's interest in advocating for the sustainable development of power facilities at large, holds no intrinsic commercial value for CURE, and does not vest CURE or its members with any competitive advantage as participants in the State's energy industry. *Cf. Public Citizen Health Research Group v. Food and Drug Administration* (1983) 704 F.2d 1280, 1290. Finally, the disclosure of the requested information would likely significantly increase public understanding of the Project because CURE seeks information not previously disclosed by Bureau of Land Management.

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[1] More information regarding CURE, please visit our website, http://www.sbctc.org/cure/default.asp?id=2383&pagetype=subpage.

We will pay for any reasonable costs associated with fulfilling this request up to $200. Please contact me at (650) 589-1660 with a cost estimate before copying the requested materials. Please send the above requested items to:

Pamela N. Epstein
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080

Please call me at 650-589-1660 if you have any questions. Thank you for your assistance with this matter.

Sincerely,

Pamela N. Epstein

PNE:clv

cc: Richard Frank, FOIA Liaison Coordinator (CECC-G), e-mail: foia-liaison@usace.army.mil

EXHIBIT R

Proceedings World Geothermal Congress 2000
Kyushu - Tohoku, Japan, May 28 - June 10, 2000

GEOTHERMAL DEVELOPMENT AND CHANGES IN SURFICIAL FEATURES: EXAMPLES FROM THE WESTERN UNITED STATES

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Key Words: geothermal development, hot springs, impacts, monitoring

ABSTRACT

Changes in surficial thermal features and land-surface elevations can accompany development of geothermal reservoirs. Such changes have been documented to varying extents at geothermal fields in the Western United States, including Long Valley caldera, Coso Hot Springs, and Amadee Hot Springs in California, and Steamboat Springs, Beowawe, Dixie Valley, and Brady Hot Springs in Nevada. The best-documented cases are for the Casa Diablo area in Long Valley caldera, California and for Steamboat Springs, Nevada where hydrologic monitoring programs have delineated some combination of declines in thermal-water discharge, increases in fumarolic steam discharge, and subsidence. At other areas noted above, similar types of changes have occurred but existing monitoring programs do not permit the same level of analysis of cause-and-effect relationships between such surficial changes and contributing factors.

1. INTRODUCTION

In most respects, geothermal energy offers considerable advantages over other forms of electrical and direct-use energy development in terms of minimizing adverse environmental effects. However, exploitable geothermal reservoirs are commonly associated with surficial thermal features such as hot springs and fumaroles, and some level of change in such features can be expected to accompany subsurface pressure changes associated with the production and injection of reservoir fluids. Geothermal reservoir pressure and temperature declines can also result in subsidence of the land surface. Perhaps the best-documented examples are from the Wairakei and Broadlands geothermal fields in New Zealand (Allis, 1981; Glover et al., 1996).

Most areas of existing or potential geothermal development in the Western United States include natural thermal features such as hot springs, geysers, spring-fed thermal pools, and steam-heated features such as fumaroles and hot pools. The extent that these features may be impacted by geothermal development depends on many factors, including both the properties of the subsurface and the details of the development (production and injection) scheme. The hydrologic and mechanical properties of the subsurface are usually not sufficiently known before development begins to predict the distribution and magnitude of surficial changes. Ideally, a hydrologic monitoring program should be in operation before and during development in order to delineate changes from both natural and man-made influences. For a variety of institutional, economic, and engineering reasons, this ideal is rarely met. Even when monitoring data are available, it is often difficult to quantify the relative effects of different factors that can influence surficial conditions, e.g. variations in precipitation and groundwater recharge, pumpage of groundwater aquifers, and crustal unrest (earthquakes and deformation).

The following list (see Figure 1 for locations) includes areas for which some degree of documentation exists for changes in surficial thermal features and land-surface elevations, followed by references to background information.

- Amadee Hot Springs, California: Land subsidence (Unpublished consultant's reports available from Lassen County Planning Department and California Division of Oil, Gas, and Geothermal Resources)
- Beowawe, Nevada: Cessation of geyser discharge (Layman, 1984; Faulder et al., 1997)
- Brady Hot Springs, Nevada: Cessation of hot-spring discharge and onset of boiling and steam upflow from shallow aquifers (Garside and Schilling, 1979)
- Coso Hot Springs, California: Increased activity of steam-heated features (Combs and Rotstein, 1975; Moore and Austin, 1983)
- Dixie Valley, Nevada: Increased activity of steam-heated features and subsidence (Benoit, 1997; Bergfeld et al., 1998)
- Long Valley caldera, California: Increased steam discharge in the well field, decreased thermal-water discharge at sites downstream from the well field, and subsidence (Sorey and Farrar, 1998)
- Steamboat Springs, Nevada: Cessation of geyser discharge (Sorey and Colvard, 1992)

In this paper, we describe the hydrologic monitoring program and the evidence for changes in surficial features associated with ongoing geothermal development in the Casa Diablo area of Long Valley caldera. We also compare and contrast the Long Valley development experience with that at Steamboat Springs, Nevada, and comment on situations at the other development areas listed above.

2. LONG VALLEY CALDERA, CALIFORNIA

2.1 Geothermal Development

The geothermal system in Long Valley involves upflow from a source reservoir in the west moat of the caldera and lateral outflow of thermal water in a generally west to east direction (Sorey et al., 1991). Reservoir temperatures range from 214°C beneath the west moat, to 170°C at Casa Diablo, and 110°C near Hot Creek gorge in the east moat of the caldera (Figure 2). Hot springs discharge primarily within Hot Creek gorge. Geothermal development currently consists of three binary power plants on a combination of private and public lands located at Casa Diablo. The plants produce a total of about 40 MW from wells that tap the shallow, 170°C, reservoir at depths of ~150 m. Plant MP-1 has been in continuous operation since 1985; plants MP-2 and PLES-1 began operations in 1991. In this single-phase, closed system,

cooled geothermal water at ~80°C is reinjected in the well field at depths of about 600 m. Total flow rate through the plants is about 900 kg/s.

Inadvertent leaks of isobutane working fluid into the injection wells at Casa Diablo have provided a useful chemical tracer within the geothermal system. Isobutane has been detected in fumaroles at and near Casa Diablo and in the Hot Bubbling Pool 5 km to the east. Fluorescein tracer tests and isobutane data indicate that less than 10% of the fluid injected at Casa Diablo moves into the production zone. Instead, most of it flows away from the well field within the injection reservoir. The appearance of isobutane at distant thermal features, however, indicates a higher degree of connection between these two zones outside the well field.

2.2 Hydrologic Monitoring Program

The Long Valley area, which includes the resort town of Mammoth Lakes, has numerous features of geologic, hydrologic, and recreational significance. Concerns over possible impacts of geothermal and water-resources developments on surficial thermal features led to establishment of the Long Valley Hydrologic Advisory Committee (LVHAC) in 1987. LVHAC membership includes the U.S. Bureau of Land Management, U.S. Forest Service, U.S. Geological Survey (USGS), Mono County, California State Department of Fish and Game, Mammoth Community Water District, geothermal developers, and various environmental organizations. As described by Farrar and Lyster (1990), the purpose of the LVHAC was to implement a hydrologic monitoring program focused on early detection of changes in surficial features that could be influenced by water-resource developments within the caldera. The LVHAC provides information to permitting agencies on such changes and recommends mitigation alternatives for specific development projects. The committee is advisory and as such its recommendations do not create legal obligations. The USGS, as a non-voting member of the LVHAC, is responsible for collecting and compiling hydrologic monitoring data, and has on occasion been requested to prepare interpretive reports based on these data.

In addition to the hydrologic monitoring program conducted by the USGS, each resource developer is required to monitor conditions in and around their well fields. Thermal and nonthermal subcommittees of the LVHAC meet with specific developers to discuss both public and proprietary monitoring and development data and interpretive analyses of such information. Findings and/or recommendations are conveyed to the LVHAC. Experience has shown that this full and open disclosure and discussion of public and proprietary monitoring data has allowed a more complete understanding of changes accompanying development and promoted an attitude of trust that has helped to avoid litigation. One example of this process is the planning and completion of a numerical model of the response of the geothermal field to development. The modeling was funded by the developer and carried out by one of its consultants, but input and review were sought from members of the thermal subcommittee.

The LVHAC monitoring program includes thermal springs east of Casa Diablo (Figure 2), streamflow measurement sites along Mammoth and Hot Creek, and both thermal and nonthermal wells (e.g. CH10B, and M-14, respectively). Areas of environmental concern include thermal springs at the Hot Creek Fish Hatchery and in Hot Creek gorge. The Hatchery springs discharge at a composite temperature near 16°C, considered optimum for trout-rearing operations. These springs contain a small (~5%) component of thermal water. Springs in Hot Creek gorge discharge at temperatures up to boiling (93°C), and provide a popular environment for bathing in heated creek water.

2.3 Changes in Surficial Features

Geothermal development at Casa Diablo has resulted in declines in reservoir pressure and temperature over the 1985-1998 period. As exemplified by data from observation well 65-32 on the edge of the well field (Figure 3), a cumulative pressure change of 0.1 Mpa between 1985 and 1990 was followed by an additional drop of 0.25 Mpa during 1991 in response to increased production and deepening of injection wells. Between 1991 and 1999, reservoir pressures have declined by about 0.1 Mpa, for a total decline of 0.45 Mpa (4.5 bars). The reduction in reservoir temperature amounts to 10-15°C, compared with localized reductions of ~80°C in the deeper injection zone. Boiling conditions in the heated groundwater system above the production reservoir have resulted in significant steam occurrences at and near the land surface, including fumaroles occupying former hot-spring vents, steam collecting beneath building foundations, and steam flowing upward through the roots of trees.

Data from the USGS monitoring program outside the Casa Diablo area (Sorey and Farrar, 1998a, b) show cessation of spring flow at Colton Spring (2 km east of Casa Diablo) and declines in water level in Hot Bubbling Pool (HBP, 5 km east of Casa Diablo). The water-level record for thermal well CW-3 adjacent to HBP correlates with the pressure record from well 65-32, indicating that the 0.25 Mpa pressure decline in the well field in 1991 (equivalent to a water-level drop of 25 m) caused a drop of 1.2 m in water level at this distance.

At the Hot Creek Fish Hatchery, chemical-flux measurements show that the thermal-water component in the springs has declined by some 30-40% since 1990. However, temperatures in the Hatchery springs have changed mainly in response to variations in the nonthermal component caused by seasonal and annual variations in groundwater recharge. The apparent lack of observable response in spring temperature accompanying the decline in thermal-water component suggests a moderating influence of conductive heating from rocks within and adjacent to the shallow flow zone containing a mixture of thermal and nonthermal fluids.

Total thermal-water discharge at Hot Creek gorge is calculated from chemical flux measurements at gaging sites on Hot Creek upstream and downstream from the thermal springs. Within a measurement error of ~15%, no decrease in thermal-water flow has been detected over the 1988-1998 period and the presence of isobutane has not been detected in the gorge springs. It appears from this that the current level of geothermal development has not caused detectible hydrologic changes beyond distances of about 5 km from the well field.

Leveling data collected along Highway 395 show subsidences in the vicinity of Casa Diablo beginning in 1986,

superimposed on a general pattern of uplift that began in 1980 in response to crustal unrest (Sorey and Farrar, 1998; Sorey et al., 1995). Since 1988, benchmarks at Casa Diablo have subsided approximately 25 cm relative to benchmarks on the resurgent dome, which have risen approximately 20 cm. This perhaps represents a unique situation in that subsidence induced by geothermal fluid withdrawal has allowed the actual land surface elevation to remain relatively constant, while intermittent intrusive activity has cause significant uplift of the surrounding region.

3. STEAMBOAT SPRINGS, NEVADA

3.1 Geothermal Development

The geothermal system beneath the Steamboat Hills, located about midway between Reno and Carson City, Nevada, is currently being developed by two well fields and associated power plants (Figure 4). To the south, the higher-temperature Caithness Power Incorporated (CPI) development involves single-stage steam flash and residual liquid injection. To the north, the lower-temperature Far West Capital (FWC) project involves production and injection of pressurized single-phase liquid and binary power plant conversion. Electrical production totals about 15 MW at the CPI plant and 85-90% of produced fluids are reinjected north of the production well field. The generating capacity of the FWC plants totals about 40 MW and 100% of produced fluids are reinjected in wells adjacent to the production well field.

Between the two development areas is a silica terrace through which hot springs and geysers discharged until 1987, when sustained testing of geothermal wells began and water levels in the spring vents began falling (Sorey and Colvard, 1992; Collar and Huntley, 1990; Collar, 1990). Analyses of available hydrologic and geochemical data have led various authors to conclude that a single, interconnected, geothermal system exists in the Steamboat Springs area (Sorey and Colvard, 1992; Mariner and Janik, 1995, and White, 1968). Hot water flows upward beneath the Steamboat Hills and then laterally toward the north and northeast. In addition to the main terrace described above, the ultimate point of discharge of thermal water under pre-development conditions was Steamboat Creek.

3.2 Hydrologic Monitoring Program

Regulation and monitoring activities at Steamboat have tended to be more complex and difficult to pursue than at Long Valley. Although there are multiple regulatory jurisdictions involved at each area, the absence of an entity such as the LVHAC at Steamboat has made it more difficult to conduct adequate monitoring and to provide for interpretive studies of changes associated with development. This situation still exists today, in spite of the fact that part of the silica terrace and adjacent areas to the west were designated an Area of Critical Environmental Concern by the Bureau of Land Management (Sorey and Colvard, 1992).

Each developer has been responsible for monitoring conditions in and around their well field. A set of wells drilled for testing and monitoring exists in the FWC well field; in the CPI well field wells drilled for stratigraphic information are monitored. A network of wells drilled into the nonthermal groundwater system surrounding the Steamboat Hills is included in the monitoring program carried out by FWC.

3.3 Changes in Surficial Features

Data on pressure changes in the developed well fields are either not publicly available or are difficult to interpret. Pressures declines in both fields appear to be minimal (~0.05 Mpa, or 0.5 bars). This indicates high reservoir transmissivity and pressure support from injection wells. Indeed, tracer tests at the FWC show that most of the injected water remains within the well field (Rose et al., 1999). This is in contrast to the situation at Long Valley described above.

By the time monitoring programs began in earnest in 1986, the geysers and springs were in decline and by 1987, liquid discharge on the main terrace had stopped. Monitoring of water levels in some spring vents continued through 1989, when water levels in the silica-lined spring conduits fell beyond the reach of measuring equipment. Two measurements were also made in 1989-1990 of thermal-water discharge in Steamboat Creek, using chloride flux techniques, for comparison with similar estimates made in the 1950-1960 period (Sorey and Colvard, 1992). These data suggest declines in total discharge of about 40%.

The analysis by Sorey and Colvard (1992) concluded that declines in hot-spring activity and thermal-water discharge at Steamboat Springs resulted from a combination of (1) successive years of below-normal precipitation and groundwater recharge, (2) groundwater pumpage in the South Truckee Meadows (north of the Steamboat Hills), and (3) geothermal fluid production. It was not possible at that time to adequately determine the relative impacts of each factor. However, precipitation has returned to normal or above-normal levels since 1994 and monitoring records show that groundwater levels have risen significantly since that time and are now at nearly the same levels as in the late 1980's. Although no recent measurements have been attempted of water levels in the spring vents on the main terrace, there is no evidence of any renewed spring flow.

4. OTHER AREAS OF GEOTHERMAL DEVELOPMENT

The scale and type of geothermal development at other noted areas in the Western United States vary widely, ranging from a small binary-electric power plant supplied by two production wells and no injection wells at Amadee Hot Springs in northeastern California to the ~250 Mwe steam-flash power plants at Coso Hot Springs in eastern California (Figure 1). In all but one case, all or most of the development area and surficial thermal features are privately owned. The exception is the Coso Hot springs area south of Long Valley in eastern California, where most of the land under development is part of the federally operated China Lake Naval Weapons Center. Thermal features at Coso Hot Springs, located adjacent to the well field, are traditionally utilized by local Native Americans. Environmental agreements between the Navy, the U.S. Bureau of Land Management, and Native American organizations call for mitigation in the event that geothermal development causes changes that negatively effect future use for religious and ceremonial purposes (Bureau of Land Management, 1980).

In cases where geothermal reservoirs and associated surficial thermal features are on privately owned land, regulations governing geothermal development are usually specified by state or county agencies, rather than federal agencies. Monitoring programs may not include observations of thermal features, so that information about changes in thermal features or land elevations is usually anecdotal or unpublished and often not sufficiently detailed to provide adequate documentation of cause-and-effect relations. Even when thermal features are on public lands, hydrologic monitoring may be deemed unnecessary where expected changes in thermal features or land-surface elevations are judged a-priori to be either mitigatable or insignificant.

A common aspect of changes induced by development of hot-water reservoirs is the reduction of liquid discharge in springs and geysers and the increase in steam discharge in fumaroles and other steam-heated features. Available information indicates that such changes have occurred at Long Valley, Steamboat, Beowawe, Amadee Hot Springs, and Brady Hot Springs, while at Coso Hot Springs and Dixie Valley naturally occurring steam discharge has increased during development. At Amadee Hot Springs, Brady Hot Springs, Dixie Valley, and Long Valley, reductions in reservoir pressure have also induced significant levels of land subsidence and ground cracking. As pointed out previously, documentation of such changes and determinations of the influence of various factors on the thermal features is adequate only for Long Valley. At Beowawe and Steamboat Springs, reductions and cessation of geyser activity accompanied the pre-development testing of production wells in the 1970's, at a time when monitoring efforts were inadequate. Some of the previously cited references contain information on thermal features at the "other" areas of geothermal development discussed in this section; additional pertinent references are listed below:

- Beowawe: Zoback (1979); White (1998); Layman (1984); Olmsted and Rush (1987)
- Brady Hot Springs: Ettinger and Brugman (1992); Harrill (1970), Osterling (1969); Olmsted et al. (1975)
- Coso Hot Springs: Monahan and Condon (1991a,b); Erskine and Lofgren (1989); Fournier et al. (1980); Fournier and Thompson (1982)
- Dixie Valley: Williams et al. (1997); Waibel (1987)

5. CONCLUSIONS

Changes in surficial thermal features and land elevations accompanying geothermal development should be viewed as the rule, rather than the exception. This follows from the nature of geothermal reservoirs within flow systems that commonly include discharge of fluids at the land surface. In the absence of fluid injection in locations proximal to such discharge areas, reductions in reservoir pressure will cause some degree of reduction in fluid upflow feeding the thermal features. Natural geyser activity should be expected to be most sensitive to such changes because of the unique combination of processes and characteristics typically required for geyser discharge. Where hot fluids occur at relatively shallow depths, either within a developed reservoir or in the overlying groundwater system, pressure reduction can also induce boiling conditions that result in increases in steam discharge at the land surface.

Factors other than pressure reductions in geothermal reservoirs can influence the temperature and flow rate of surficial thermal features. Information gained from hydrologic monitoring in and around the developed well fields, both during and prior to the development period, can allow quantification of the timing and magnitude of cause-and-effect relations between various factors that affect surficial thermal discharge and guide attempts to mitigate any adverse impacts caused by development.

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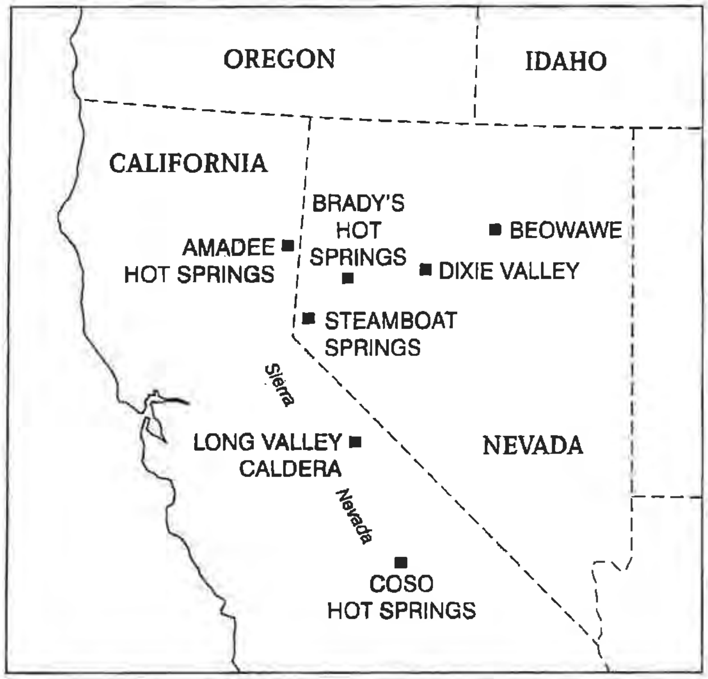


Figure 1. Locations of some geothermal fields where development has been associated with changes in thermal features and/or land subsidence.

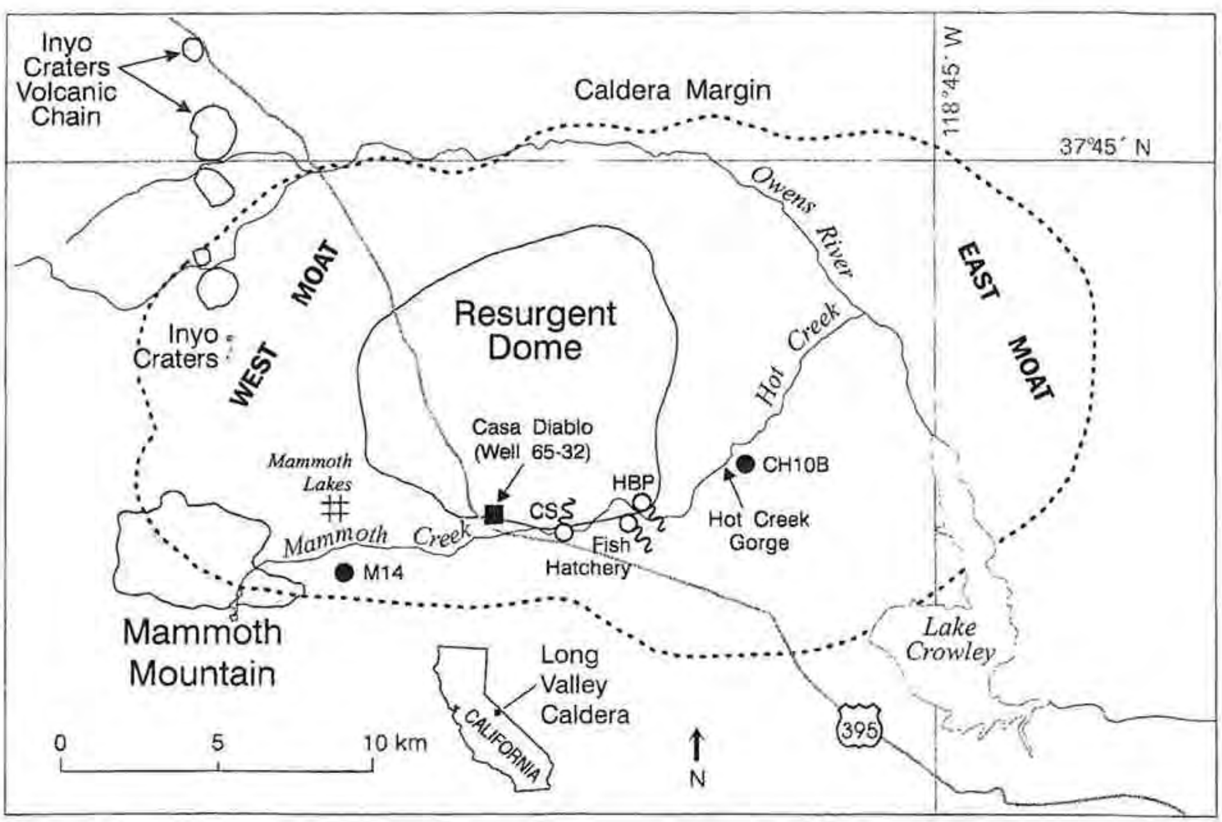


Figure 2. Map of Long Valley caldera showing various geologic and cultural features, and key sites in the hydrologic monitoring program directed by the Long Valley Hydrologic Advisory Committee.

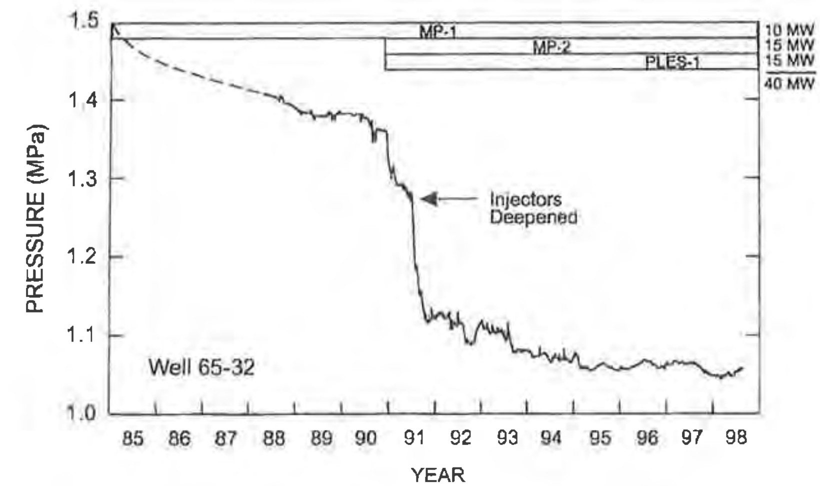


Figure 3. Pressure history in observation well 65-32, located on the edge of the geothermal well field at Casa Diablo, and periods of operation of three geothermal power plants.

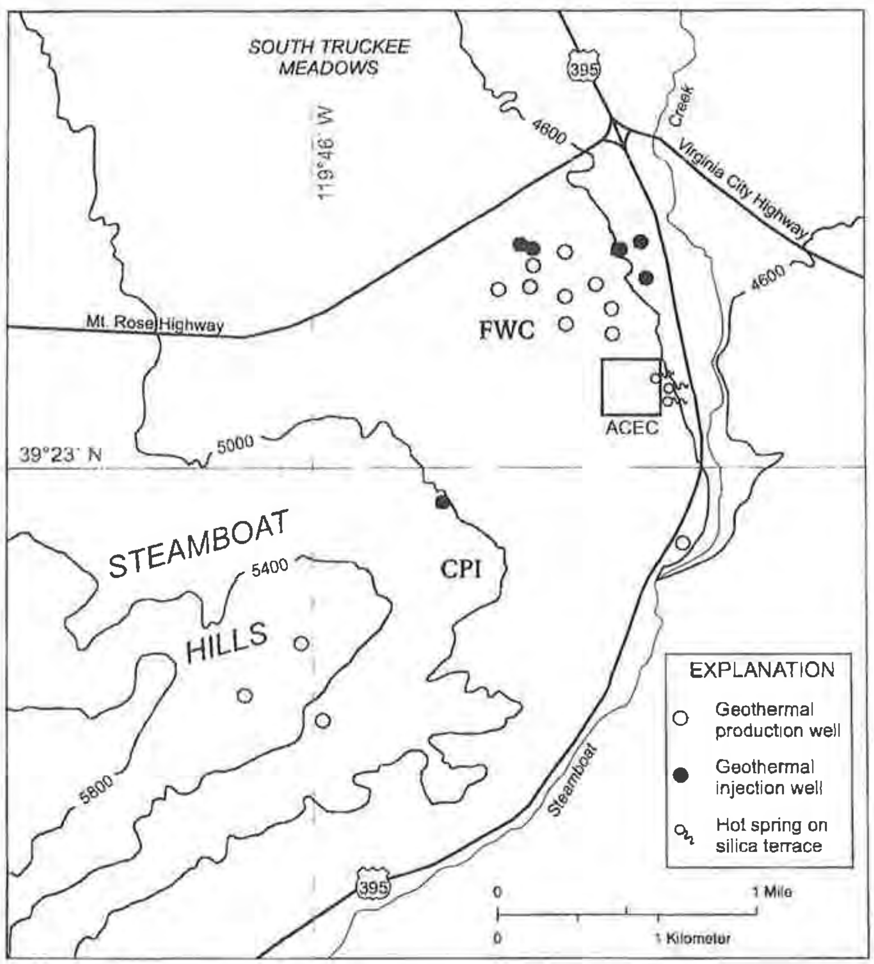


Figure 4. Map of the Steamboat Hills and surrounding region showing approximate wellfield areas for the Caithness Power, Incorporated (CPI) and Far West Capital (FWC) geothermal developments, locations of most of the production and injection wells, some of the vents on the main silica terrace that formerly included active hot springs and geysers, and the outline of the Area of Critical Environmental Concern (ACEC) designated by the Bureau of Land Management.

EXHIBIT S

Appendix M

Long Valley Hydrologic Advisory Committee

Hydrologic Monitoring Data

Comment Letter I9

Long Valley Hydrologic Advisory Committee Hydrologic Monitoring Data

For the Period Ending December 2011

Unpublished provisional U.S. Geological Survey Data
Submitted by J.F. Howle, C.D. Farrar, and Kevin Bazar
Prepared February 13, 2012

LIST OF DATA

GROUND-WATER LEVELS

Daily Mean Water Levels

Hydrograph for well CH-10B.
Hydrograph for well LV-19.

FISH HATCHERY DATA – 1988 through 2011

Measured Values for sites FHAB, FHCD, FH23

Discharge – Daily mean values
Water temperature – Daily mean values

Calculated Values

Thermal water discharge estimate – AB and CD
Thermal water as percent – AB and CD
Total and thermal water discharge -- AB and CD combined

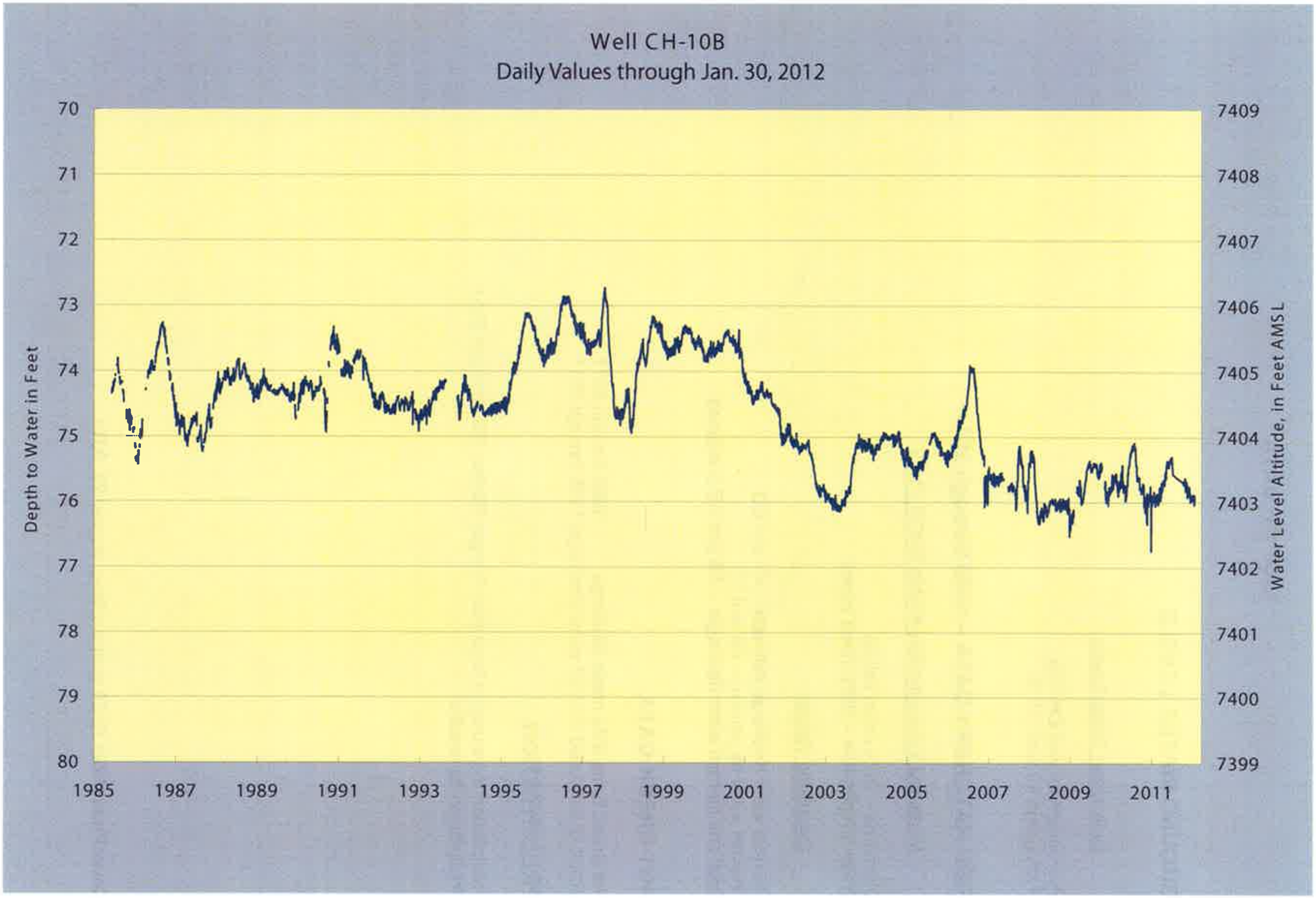
HOT CREEK DATA

Hot Creek flume daily mean discharge 1983 through 2011
Graph of estimated thermal water discharge 1988 through 2011

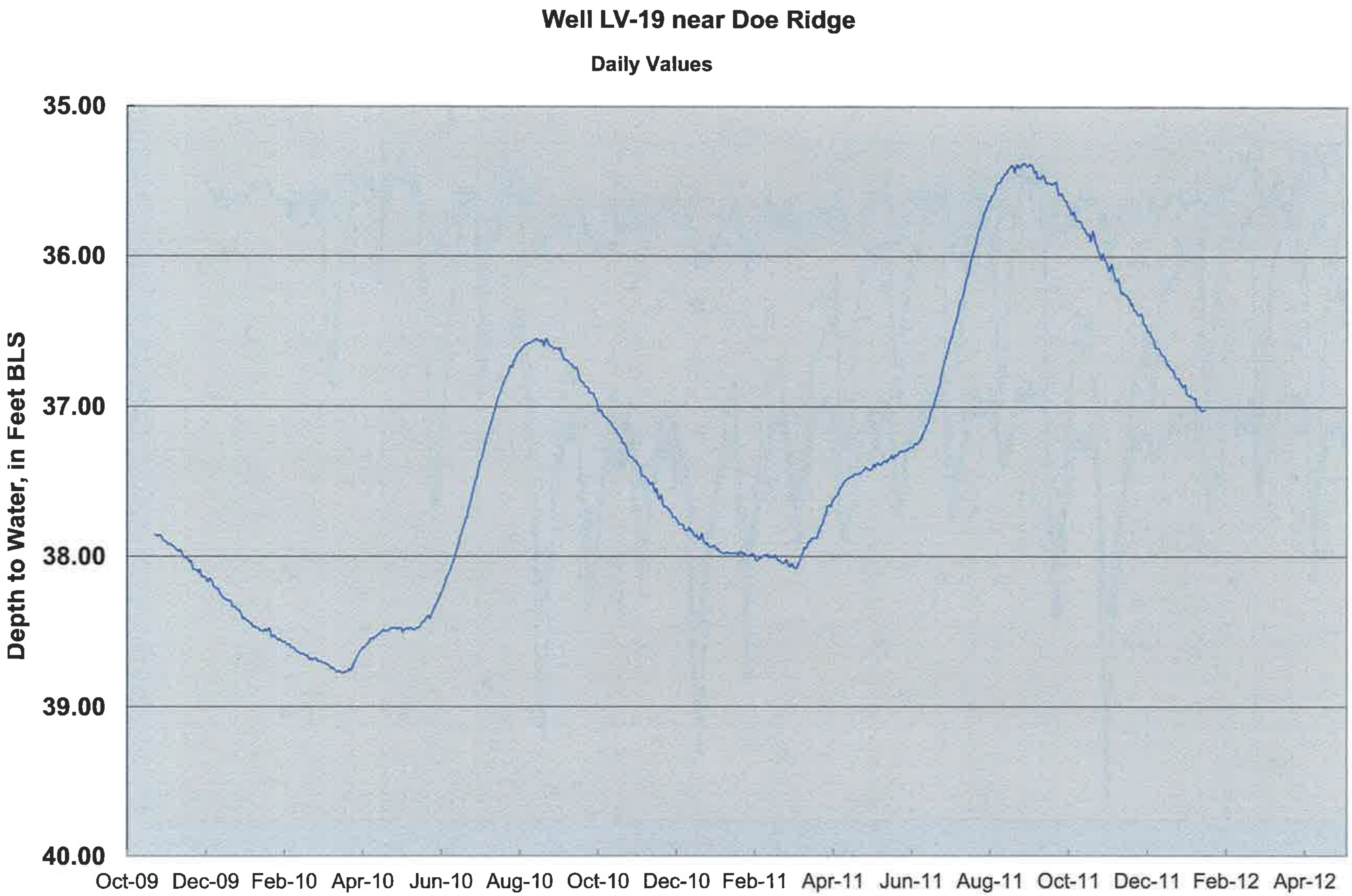
PRECIPITATION

Precipitation measured at Mammoth Ranger Station 1982 through 2011
Precipitation by months

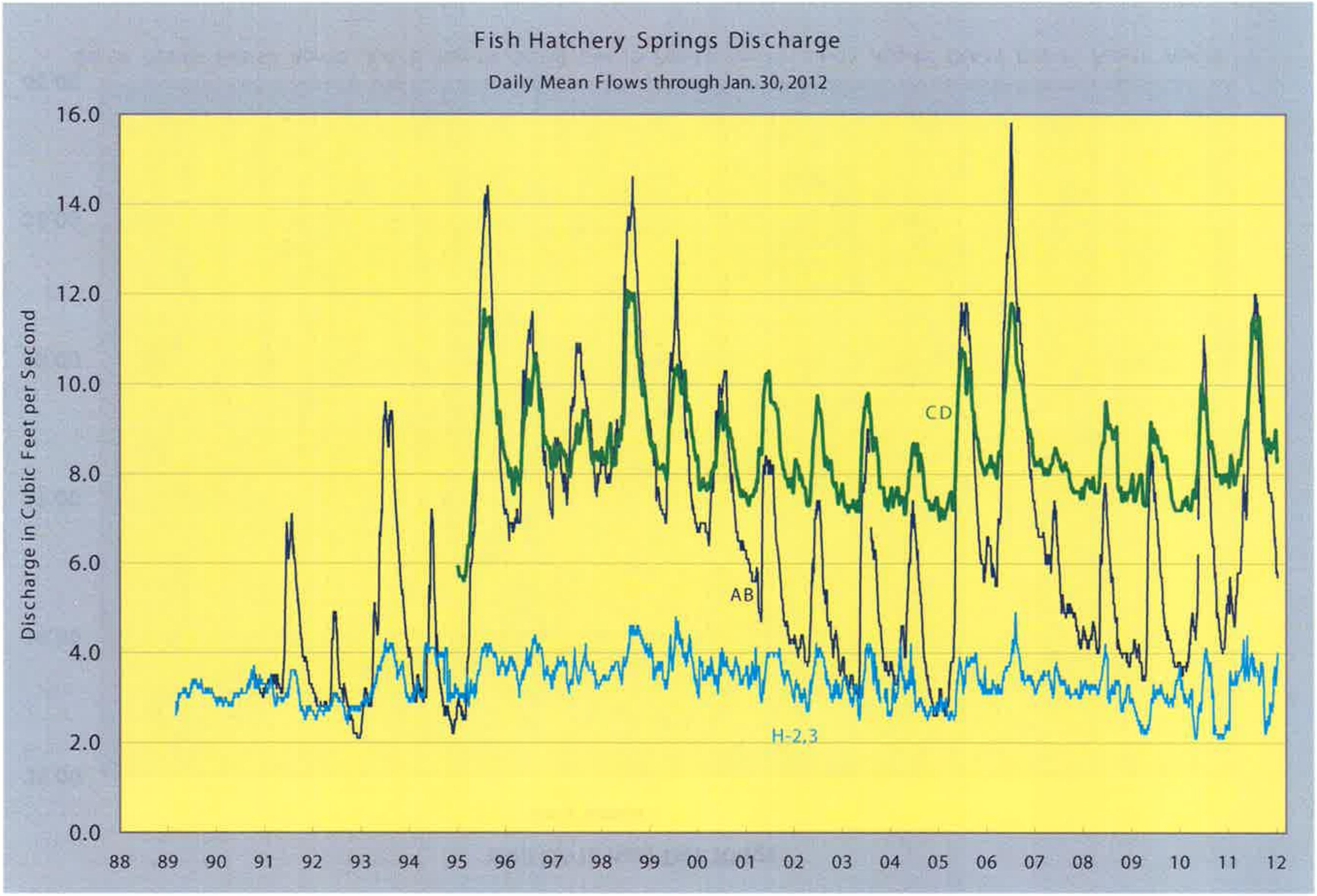
Cover Photo: Well 12-25 during drilling, August 25, 2011.



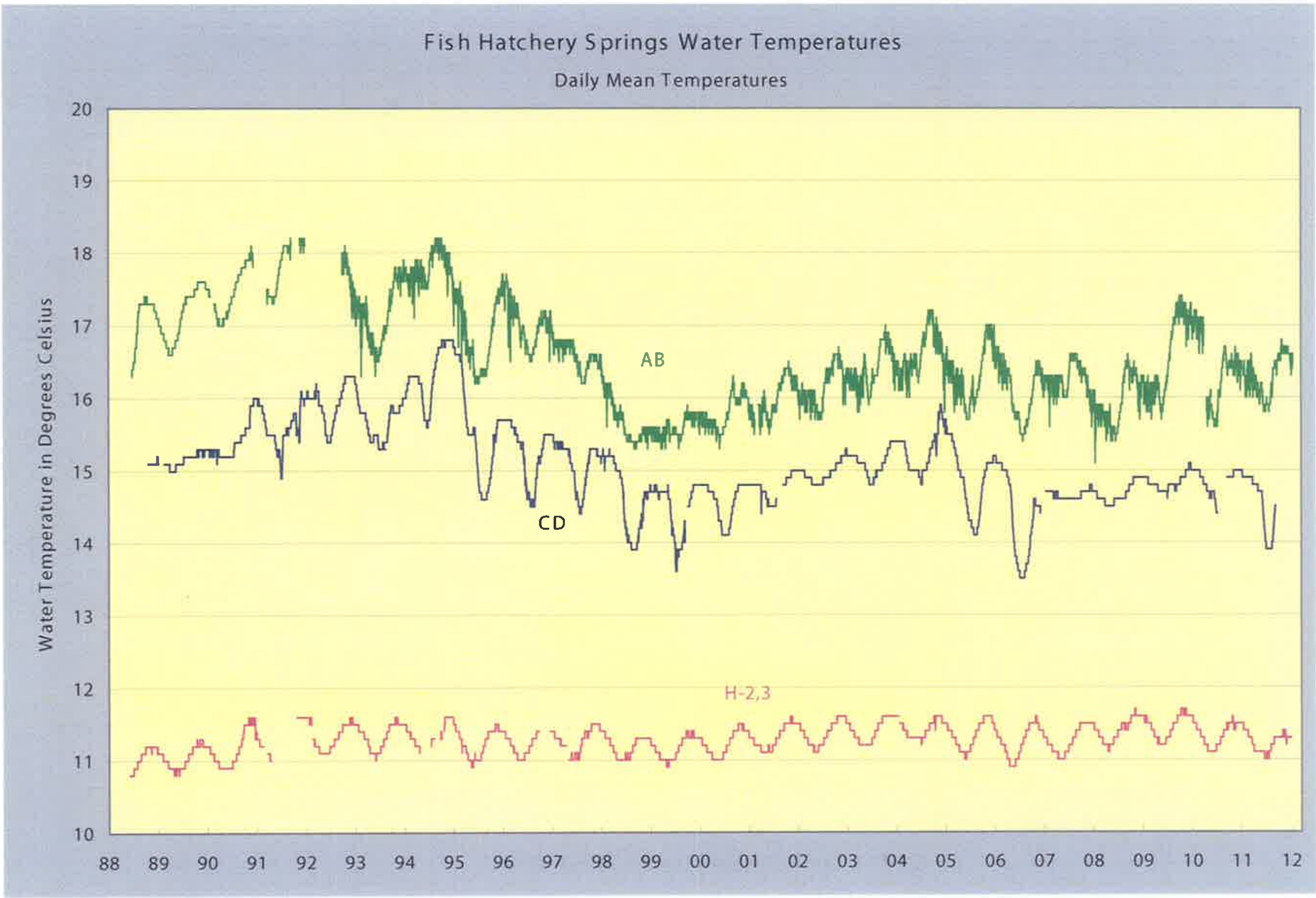
Comment Letter I9

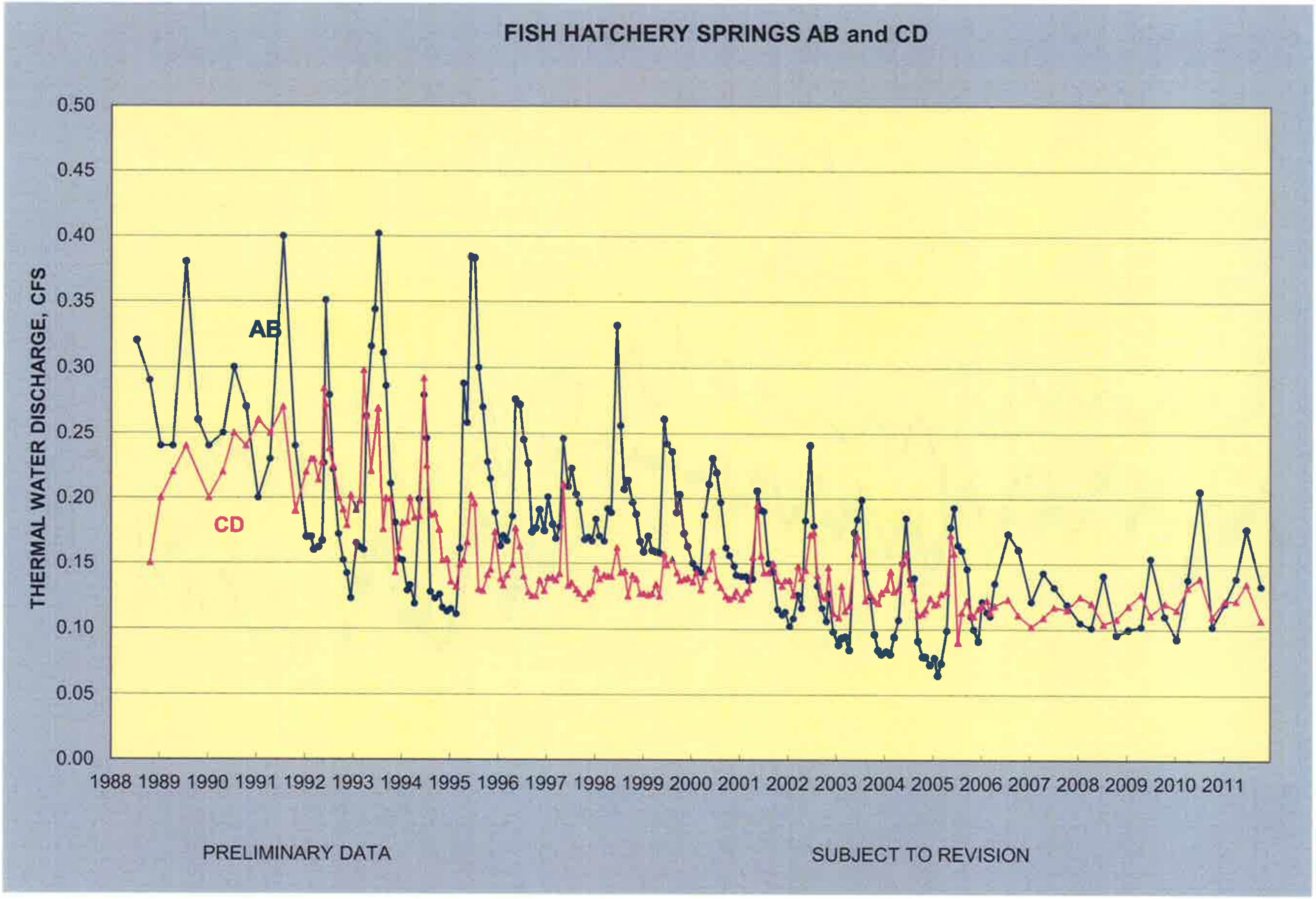


Well LV-19 near Doe Ridge
Daily Values
Depth to Water, in Feet BLS
35.00
36.00
37.00
38.00
39.00
40.00
Oct-09
Dec-09
Feb-10
Apr-10
Jun-10
Aug-10
Oct-10
Dec-10
Feb-11
Apr-11
Jun-11
Aug-11
Oct-11
Dec-11
Feb-12
Apr-12



Comment Letter I9


Fish Hatchery Springs Water Temperatures
Daily Mean Temperatures
Water Temperature in Degrees Celsius
20
19
18
17
16
15
14
13
12
11
10
88
89
90
91
92
93
94
95
96
97
98
99
00
01
02
03
04
05
06
07
08
09
10
11
12
AB
CD
H-2,3



2/13/2012

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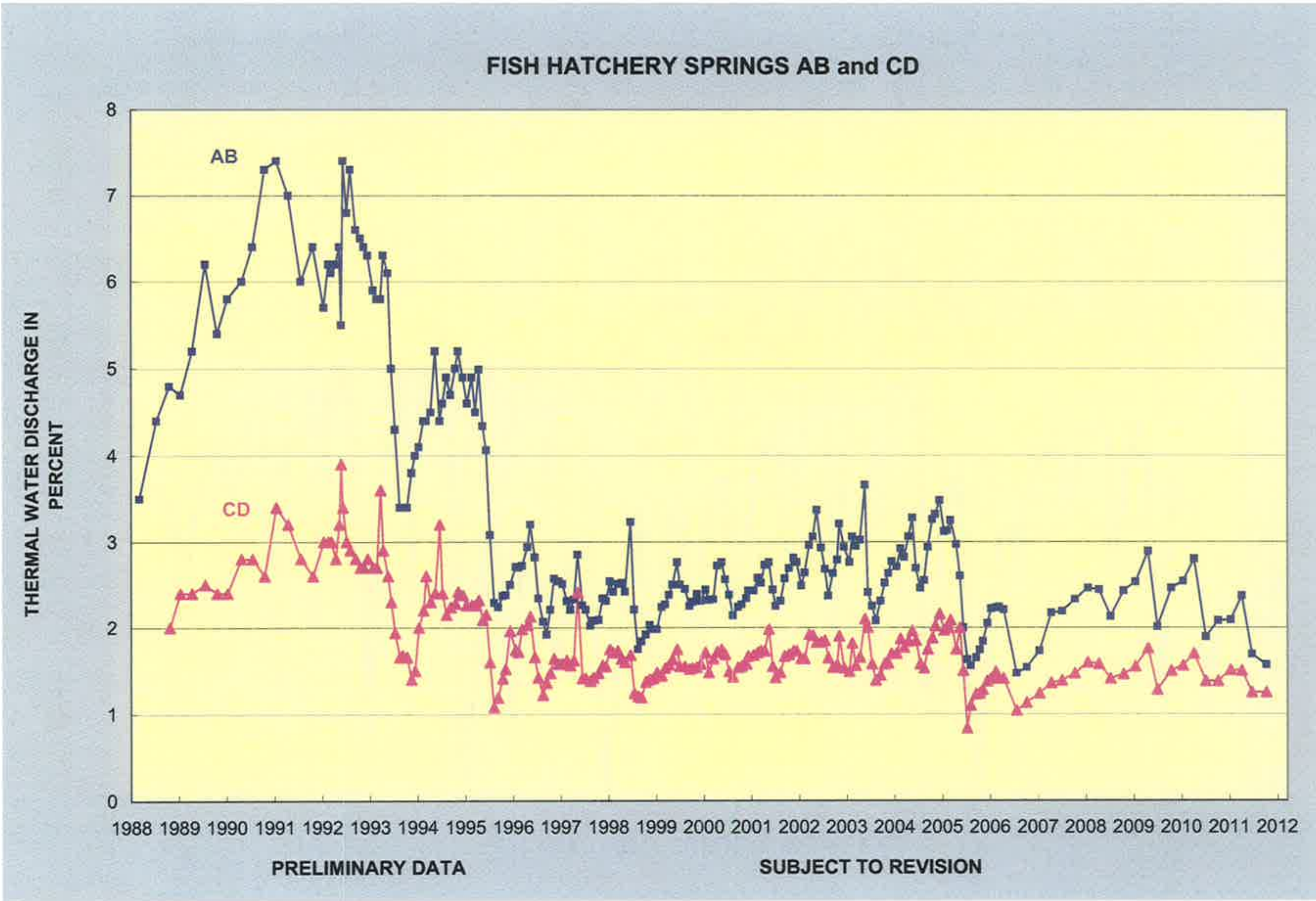

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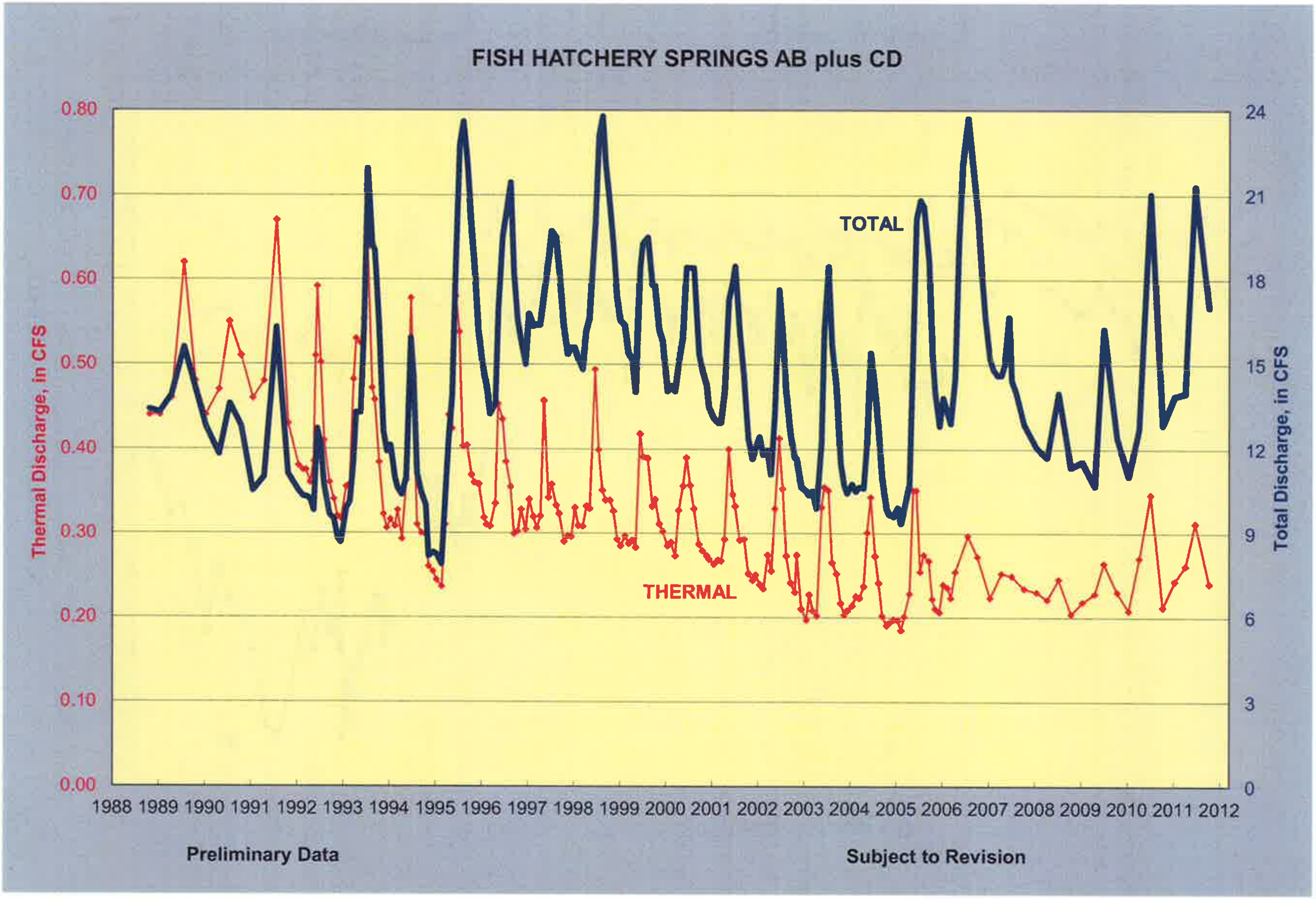

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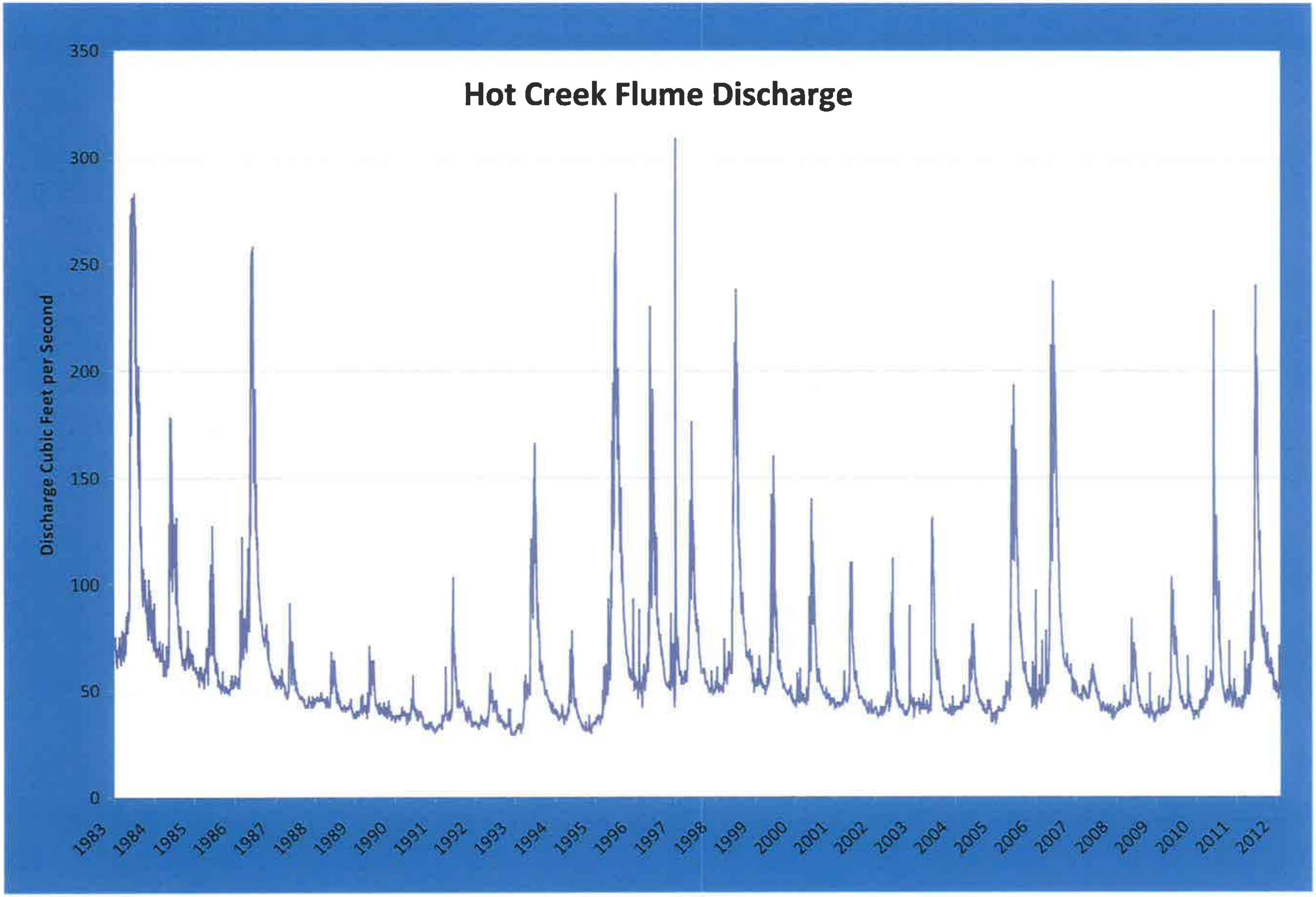
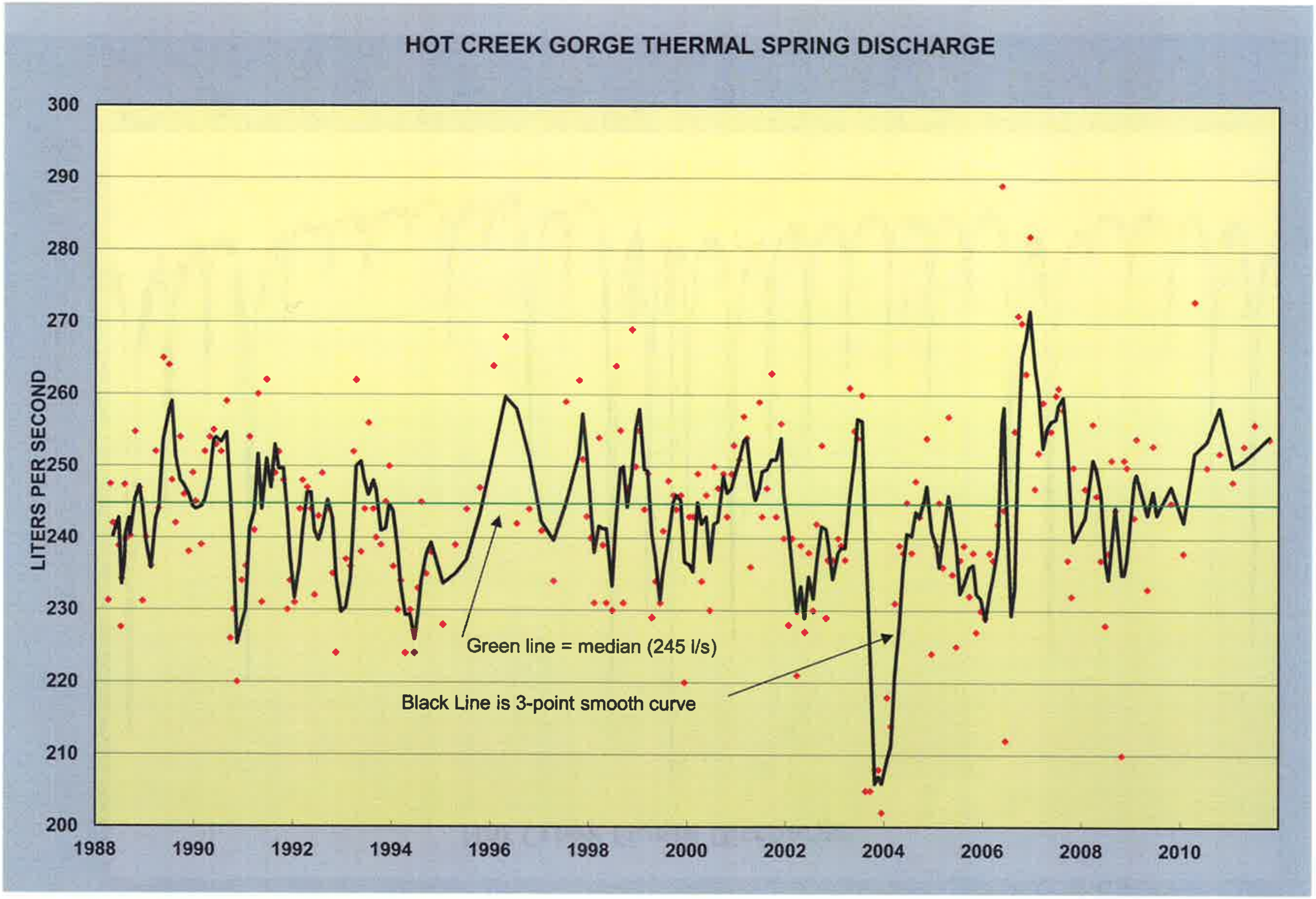

Hot Creek Flume Discharge
Discharge Cubic Feet per Second
350
300
250
200
150
100
50
0
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012



2/13/2012

PRELIMINARY DATA SUBJECT TO REVISION

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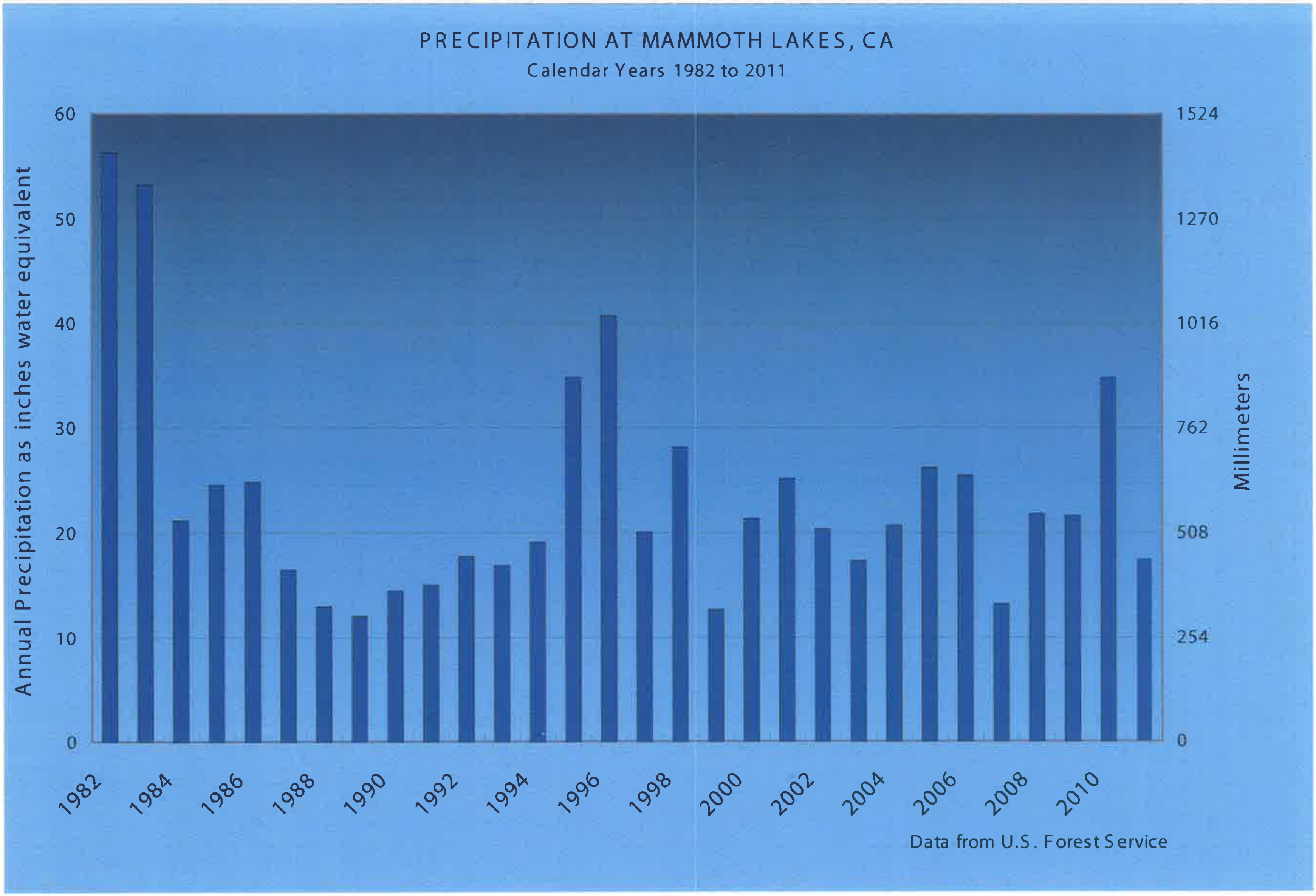
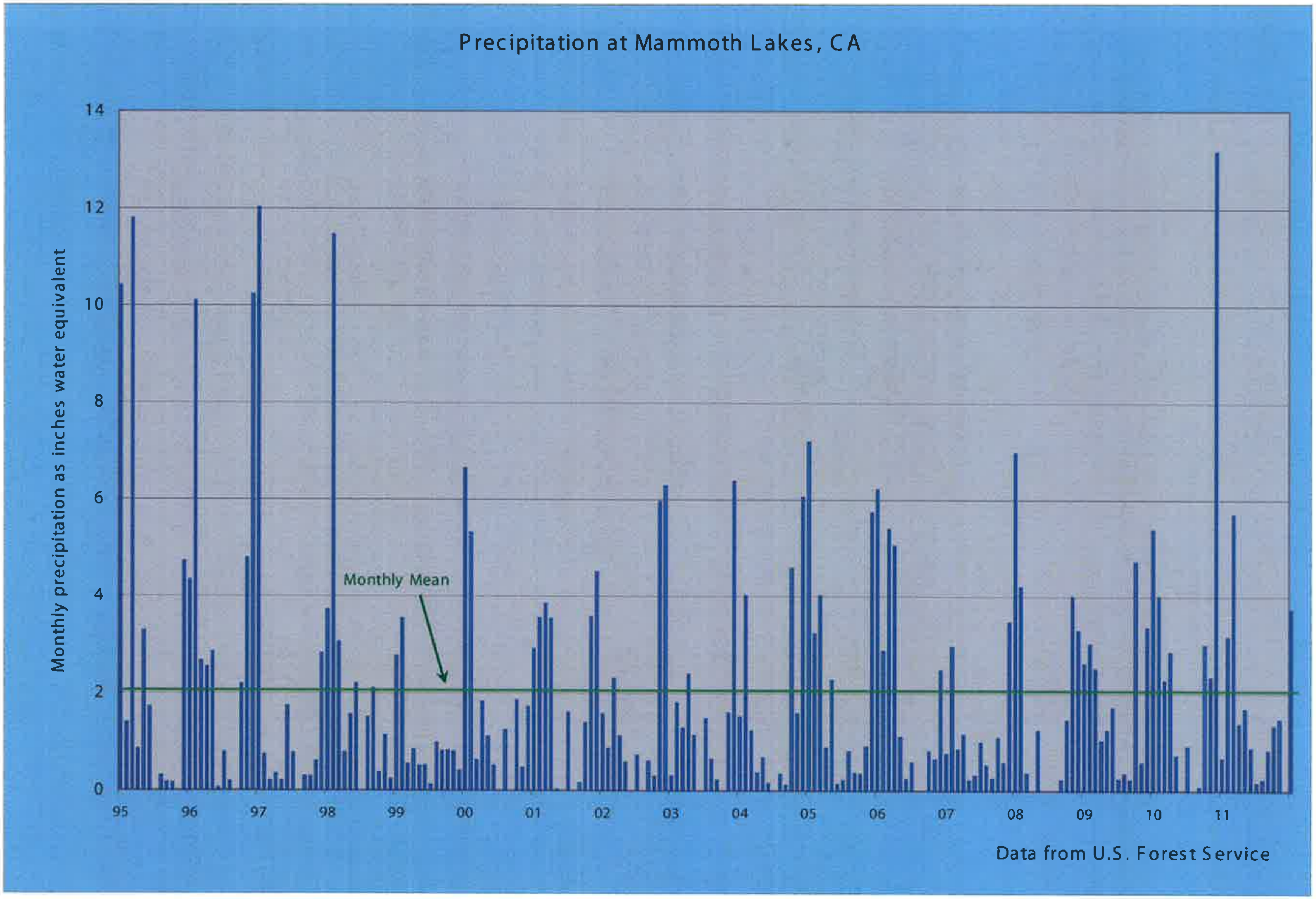
Comment Letter I9




Precipitation at Mammoth Lakes, CA
Monthly precipitation as inches water equivalent
14
12
10
8
6
4
2
0
Monthly Mean
95
96
97
98
99
00
01
02
03
04
05
06
07
08
09
10
11
Data from U.S. Forest Service

2/9/2012

Appendix N

USGS Agreement with Mono County

for Water Resources Investigations

Page 1 of 2

Form 9-1366
(Oct. 2005)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	6000000956
Agreement #:	12WSCA19200
Project #:	
TIN #:	95-6005661
Fixed Cost Agreement	☑ Yes ☐ No

FOR
WATER RESOURCES INVESTIGATIONS

THIS AGREEMENT is entered into as of the 1st day of November, 2011, by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the MONO COUNTY ECONOMIC DEVELOPMENT DEPARTMENT, party of the second part.

1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation for the cooperative water resources investigations in the Mono County Economic Development Department area, herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of $0.

(a) $0.00 by the party of the first part during the period November 1, 2011 to October 31, 2012

(b) $73,000.00 by the party of the second part during the period November 1, 2011 to October 31, 2012

USGS DUNS IS 1761-38857

(c) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.

(d) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.
7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

Page 2 of 2

Form 9-1366 continued	**U.S. Department of the Interior U.S. Geological Survey Joint Funding Agreement**	**Customer #:**	**6000000956**
		Agreement #:	**12WSCA19200**
		Project #:	
		TIN #:	**95-6005661**

8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at costs, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.
9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered **quarterly**. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983).

U.S. Geological Survey
United States
Department of the Interior

USGS Point of Contact

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Address: 6000 J Street, Placer Hall
Sacramento, CA 95819-6129
Telephone: (916) 278-3040
Email: tseubert@usgs.gov

Signatures

By Eric G. Reichard Date 1/19/2012
Name: Eric G. Reichard
Title: Director, USGS California Water Science Center

By________ Date______
Name:
Title:

By________ Date______
Name:
Title:

MONO COUNTY ECONOMIC DEVELOPMENT DEPARTMENT

Customer Point of Contact

Name: Daniel L. Lyster, Director
Address: Post Office Box 2415
Mammoth Lakes, California 93546
Telephone:
Email:

Signatures

By Dan Lyster Date 1-26-12
Name:
Title:

By________ Date______
Name:
Title:

By________ Date______
Name:
Title:

Appendix O

Former Mono County Zoning Ordinance

Comment Letter I9

Title 19

ZONING*

Chapters:

* Editor's Note: The Zoning and Development Code of Mono County was adopted by Ord. 86-520A and amended by Ords. 86-522, 86-520-E, 87-520-E, 87-520-F and 88-520-F. Certain provisions originally set out in Ord. 397 as amended by Ords. 73-435, 79-397-R, 79-397-T, 81-397, 81-397-BB, 85-397-SS have been codified as well.

Chapter 19.00

INTRODUCTORY PROVISIONS

Sections:

19.00.010 Adoption.

There is an adopted zoning and development code for the county as provided by law. (Added by Supp. 1, 1991)

19.00.020 Intent.

The zoning and development code is intended to serve as a basis for all land use regulations adopted by the county. (Added by Supp. 1, 1991)

19.00.030 Authority for regulations.

The zoning and development code is adopted pursuant to the following authority:

A. Local Ordinances and Regulations—California Constitutions, Article XI, Section 7.

B. Planning and Zoning Law, California Government Code, Title 7.

C. Mobilehome Parks Act, California Health and Safety Code, Division 13, Part 2.1.

D. Airport Approaches Zoning Law, California Government Code, Title 5, Division 1, Part 1, Chapter 2, Article 6.5. (Added by Supp. 1, 1991)

19.00.040 Purpose.

A. The purpose of this title is:

1. To encourage, classify, designate, regulate, restrict and segregate the highest and best location for, and use of, buildings, structures, and land for agriculture, housing, commerce, trade, industry, water conservation or other purposes in appropriate places;

2. To regulate and limit the height and sizes of buildings and other structures hereafter designated, erected or altered;

3. To regulate and determine the size of yards and other open spaces;

4. To regulate and limit the density of population; and

5. To divide the unincorporated area of the county into districts of such number, shape and area as may be deemed best suited to carry out these regulations and provide for this enforcement.

B. Furthermore, such regulations are deemed necessary in order to:

1. Encourage the most appropriate use of land;

2. To conserve and stabilize the value of property;

3. To provide adequate open spaces for light and air and to prevent and fight fires;

4. To prevent undue concentration of population;

5. To lessen congestion of streets;

6. To facilitate adequate provisions for community utilities such as water, sewage, schools and other public requirements; and

7. To promote the public health, safety and general welfare. (Added by Supp. 1, 1991)

19.00.050 Consistency.

All of the provisions of the zoning and development code and all of the provisions of the various area general plans prepared therefrom, as well as, any land use authorized by the zoning and development code, shall be consistent with the "Countywide General Plan." Consistency shall mean that the various land uses authorized by the zoning and development code or the various area general plans are compatible with the goals, policies, implementation measures, land uses and programs specified in the "Countywide General Plan." (Added by Supp. 1, 1991)

19.00.060 Interpretation.

Unless otherwise provided, any ambiguity concerning the content or application of the zoning and development code shall be resolved by the planning commission. Furthermore, unless otherwise provided, any ambiguity concerning the content and application of the various area general plans shall be resolved by the planning commission. (Added by Supp. 1, 1991)

19.00.070 Restrictions.

It is not intended by the zoning and development code to interfere with or abrogate or annul any easement, covenant or other agreement between parties. Where the zoning and development code imposes a greater restriction upon the use of building or land, or upon the height of buildings, or requires larger open spaces than are imposed or required by other ordinances, rules, regulations or by easements, covenants or agreements, the provisions of the zoning and development code shall control. (Added by Supp. 1, 1991)

19.00.080 Construction and definition.

For the purpose of carrying out the intent of this title, words, phrases and terms shall be deemed to have the meaning ascribed to them in Chapter 19.01. In construing the provisions of this title, specific provisions shall supersede general provisions relating to the same subject. (Added by Supp. 1, 1991)

19.00.090 Title.

The ordinance codified in this title (Chapters 19.00 to 19.46) shall be known as the "Mono County Zoning and Development Code." (Added by Supp. 1, 1991)

Chapter 19.59

RE DISTRICT—RESOURCE EXTRACTION

Sections:

19.59.010 Purpose and intent.

The intent of the resource extraction (RE) district is to evaluate and, if appropriate, permit resource extraction projects in a manner that is consistent with the provisions of the Mono County general plan, applicable area plans, and applicable state and federal laws, such as the Surface Mining and Reclamation Act of 1975 (SMARA). The resource extraction (RE) district has been established to protect the environment and allow for the conditional development of on-site resources, including but not limited to, mineral resources, geothermal resources, wind and solar energy resources, hydropower resources and timber resources. (Ord. 94-02 § 2 (part), 1994)

19.59.020 Applicability.

The resource extraction (RE) district may be applied only to areas with existing or proposed resource development activities. The establishment of resource extraction (RE) districts is also intended to encourage and facilitate public awareness concerning the potential for resource and energy-related extraction activities in areas where significant resource deposits or energy-related resources have been identified.

In compliance with general plan policies, mining operations, geothermal operations, small-scale hydroelectric generation facilities, wind and solar energy generation facilities and similar resource extraction activities may be permitted only in areas designated resource management and zoned resource extraction. Within those areas, all resource development projects shall comply with the provisions of this chapter. (Ord. 94-02 § 2 (part), 1994)

19.59.030 Criteria for applying the RE district zone.

In applying the RE district zone to a specific site, one or more of the following criteria must be demonstrated to the satisfaction of the county:

A. An active resource development project currently exists on the subject lands.

B. The project qualifies under the "vesting" provisions as specified in the California Surface Mining and Reclamation Act (SMARA).

C. It has been reasonably determined to the satisfaction of the county that potentially significant resources exist on the lands under consideration. This determination may be based on reports filed by a registered professional acceptable to the county, and funded by the applicant, or in the case of surface mining operations, on mineral land classification reports filed in conjunction with SMARA.

D. In areas with conflicting resource values, it has been reasonably determined to the satisfaction of the county that the proposed resource development activity, and therefore the proposed RE district, is the highest and best use of the land, and is in full compliance with the general plan. (Ord. 94-02 § 2 (part), 1994)

19.59.040 Uses permitted.

The following uses are permitted within the RE district, plus such other uses as the planning commission finds to be similar and not more obnoxious or detrimental to the public health, safety and welfare:

A. Geological, geochemical or geophysical mapping, surface sampling by hand of outcrops and soil, and activities which do not involve extensive excavation, devegetation, or other potentially significant environmental effects;

B. Such other uses as the director may determine to be of an infrequent nature and which involve only minor surface disturbances;

C. Residential uses are limited to caretaker units or on-call employee housing associated with on-site resource development projects; such residential units shall be removed during the final reclamation process. Residential subdivisions or other types of permanent residential development are not allowed;

D. Agricultural uses that are compatible with the resource extraction activity. (Ord. 94-02 § 2 (part), 1994)

19.59.050 Uses permitted subject to director review.

The following uses may be permitted subject to review and approval by the director in conformance with the director review process:

A. Excavations or grading conducted for farming or on-site construction for the purpose of restoring land following a flood or natural disaster;

B. Resource development activities involving the prospecting for, or extraction of, minerals for commercial purposes and the removal of overburden in total amounts of less than one thousand cubic yards in any one parcel of one acre or less;

C. Resource development activities that do not involve either the removal of more than one thousand cubic yards of minerals, ore or overburden; or involve more than one acre in any one parcel;

D. Surface mining operations that are required by federal law in order to protect a mining claim, if such operations are conducted solely for this purpose and in compliance with applicable federal regulations which administer the affected mined lands;

E. Such other surface mining operations as are categorically determined by the State Mining and Geology Board to be exempt from the provisions of SMARA; and/or those particular resource development activities with similar impacts that the county may determine to be of infrequent nature and/or involve insignificant amounts of surface disturbance. (Ord. 94-02 § 2 (part), 1994)

19.59.060 Uses permitted subject to use permit.

The following uses may be permitted subject to obtaining a use permit in conformance with applicable provisions of the county general plan and the Mono County Code:

A. Surface mining operations as defined in SMARA;

B. Subsurface mining operations;

C. Exploring, drilling, processing, stockpiling and transporting of gas, oil and other hydrocarbons;

D. Exploring, drilling and development of geothermal resources;

E. Construction and operation of geothermal power plants, hydropower plants, and wind and solar power plants;

F. Resale and wholesale distributing of materials produced on site and accessory uses, including but not limited to constructing and using rock crushing plants, aggregate washing, screening and drying facilities and equipment, ore reduction plants, asphalt and concrete batching plants, and storage of materials and machinery which is in use and utilized by the permitted operation. (Ord. 94-02 § 2 (part), 1994)

19.59.070 Use permit requirements.

A. Filing.

1. Submittal. An application for a use permit shall be accompanied by the appropriate filing fee and shall be submitted to the planning department or energy management department on forms provided by the applicable department. Applications must be complete.

2. Acceptance. An application for a use permit shall not be deemed complete or accepted for filing and the processing time limits shall not begin to run until the planning or energy management department accepts the application as complete.

B. Procedure.

1. Use Permit Processing. Within thirty days after receipt of a resource use permit application, the department shall review the application and shall notify the applicant or his designated representative, in writing, concerning any application deficiencies.

a. Applications shall be deemed complete, unless the applicant or his designated representative has been notified in writing that the application is incomplete prior to the expiration of the thirty-day review period. Acceptance of the application as complete shall not constitute an indication of project approval.

b. Complete applications shall be processed in accordance with the provisions of Chapter 19.38, Use Permits, and for surface mining operations, with the applicable provisions of SMARA.

2. Nonuse of Permit. In conformance with Chapter 19.38, Use Permits, failure to commence diligent resource development activities within one year subsequent to permit issuance, or within the period determined by the planning commission, shall render the use permit null and void. Documentation that the operator has made every attempt to secure required permits at the state or federal level but that, despite due diligence, the permits have not yet been issued may serve to stay this requirement.

C. Environmental Compliance. Permits shall be processed in accordance with CEQA, the Mono County Environmental Handbook and general plan policies. Common environmental documentation may be used for the exploratory and development permit stages of a project when consistent with CEQA.

Permits shall contain conditions which assure compliance with CEQA and with applicable laws and regulations of Mono County and other agencies with jurisdiction.

D. Monitoring. In accordance with general plan policies and CEQA requirements, when applicable, permits shall contain conditions for ongoing monitoring of operations.

The conservation/open space element contains monitoring requirements for geothermal development, mineral resource development and timber development. (Ord. 94-02 § 2 (part), 1994)

19.59.080 Project development—Phasing requirements.

In compliance with general plan policies, geothermal projects shall be developed in a phased manner. In addition to the phasing requirements listed below, energy resource extraction projects shall comply with all phasing requirements in the general plan (conservation/open space element, energy resource policies).

A. Phasing of Geothermal Projects. Geothermal development shall be subject to the following phased permitting process:

1. The geothermal exploration permit shall regulate geothermal exploration and reservoir characterization activities. The primary purpose of the exploratory phase is to determine hydrologic, geologic and other relevant characteristics of the geothermal resource being considered for development. During the exploratory phase, the permittee shall develop sufficient data, to the satisfaction of the county, to determine whether there is a geothermal resource adequate to sustain the proposed development project.

2. The geothermal development permit shall regulate geothermal development, operations, termination of operations, site reclamation, and reserve monitoring. The purpose of the development phase is to regulate all geothermal development, including the siting and construction of facilities, conditions of operation, maintenance of roads and equipment, and to assure the protection of the environment.

B. Phasing of Other Resource Development Activities. Other resource development activities may be subject to a phased permitting process, depending on the nature of the resource and its development. (Ord. 94-02 § 2 (part), 1994)

19.59.090 Amendments.

A. Minor Amendments to an Approved Resource Development Permit.

1. Minor Amendment: Minor changes to an approved resource development permit may be approved by the planning department director or the energy management director in accordance with the following provisions.

2. Processing: Requests for approval of a minor amendment shall be submitted on forms provided by the planning department or energy management department, along with the applicable fees. Within thirty days of receipt of such a request, the appropriate director shall determine whether or not the application should be considered a minor amendment. The director shall approve or deny the request and notify the applicant in writing within ten days of his decision. The decision of the director as to whether or not the request should be approved or denied shall be final, unless an appeal is filed. If it is determined that the request is not a minor amendment, the request may be processed as a major amendment.

3. Requests for a minor amendment may be approved only if the director is able to make all of the following findings:

a. The proposed change involves only minor changes in the siting or operations of the project and will not affect the basic character or implementation of the permit.

b. No substantial adverse environmental damage, either on-site or off-site, will result from the proposed change and the proposed change is consistent with adopted environmental determinations.

c. The proposed change will not be detrimental to the public health, safety and welfare and is compatible with the objectives and policies of the general plan and applicable specific plans.

B. Major Amendments to an Approved Resource Development Use Permit.

1. Major Amendment: Major amendments to approved resource development use permits may be approved by the planning commission subject to the following provisions.

2. Processing: Applications for proposed amendments shall be submitted on forms provided by the planning department or energy management department and shall include such data as may be required to complete an environmental assessment. Applications shall include the required filing fee, and shall be noticed and scheduled for public hearing before the planning commission in the same manner as the original permit submittal.

3. Amendments may be approved by the planning commission only if all of the following findings can be made:

a. The proposed amendments are necessary or desirable to assure a more practical recovery of the resource or to avoid multiple future disturbances of surface land or waters.

b. No substantial adverse environmental damage, either on-site or off-site, will result from the proposed change and that the proposed change is consistent with adopted environmental determinations.

c. The security required to be filed by the applicant with the county is adequate or additional security has been filed to guarantee compliance with the revised permit.

d. The permit, as amended, will continue to meet the requirements of this chapter and will be conducted in conformity with all applicable laws, ordinances and regulations of all agencies with jurisdiction over the resource development project.

e. The approval of the amendment will not be detrimental to the public health, safety or welfare and is compatible with the objectives and policies of the general plan, and applicable specific plans, the zoning and approved end use of the site. (Ord. 94-02 § 2 (part), 1994)

19.59.100 Development standards.

The following minimum development standards shall apply to all projects in the resource extraction district unless amended through the specific plan process. Other standards or conditions identified during the use permit process may also apply.

A. Lot Size and District Area. The minimum lot size and district area shall be forty acres or a quarter, quarter section, with the exception of patent and/or historical mining claims and "vested operations" which shall be considered on a case-by-case basis. Minimum lot size and district area may be reduced in conformance with the development plan or specific plan process.

B. Setbacks.

1. No processing equipment or facilities shall be located and no resource development shall occur within the following minimum horizontal setbacks:

a. One hundred feet from any interior public street or highway unless the public works director determines that a lesser distance would be acceptable.

b. One hundred feet away from any exterior property line;

c. Five hundred feet from any adjacent private dwelling, institution, school or other building or location used for public assemblage;

d. No geothermal development located within the Hot Creek buffer zone shall occur within five hundred feet on either side of a surface watercourse (as indicated by a solid or broken blue line on U.S. Geological Survey 7.5 or 15-minute series topographic maps).

2. No residential uses shall be located within the following minimum horizontal setbacks:

a. Fifty feet from any interior public street or highway unless the public works director determines that a lesser distance would be acceptable;

b. Fifty feet from any exterior property line.

C. Visual Impacts.

1. Siting. All resource development projects shall be sited, designed and operated to minimize impacts to the surrounding visual environment, in conformance with applicable provisions of the county's general plan and this code. The conservation/open element contains policies relating to the siting of various types of energy resource projects.

2. Screening. Screening shall be required for uses which are contiguous to any residential or commercial district or use, for uses in scenic highway corridors or important visual areas, and for uses with an identified significant visual impact. Screening may be achieved through the use of siting, landscaping, fencing, contour grading, constructed berms and/or other appropriate measures. If landscaping is chosen as a method of screening, a landscape plan shall be submitted as part of the use permit application.

3. Lighting. Exterior lighting shall be shielded and indirect and shall be minimized to that necessary for security and safety.

4. Materials and Colors. Materials for structures, fences, etc. should harmonize with the natural surroundings, whenever possible. Materials should be nonreflective or should be painted with a matte finish. Colors for structures, fences, etc. should blend into the natural surroundings.

D. Erosion and Sediment Control.

1. Siting. All resource development projects shall be sited designed and operated to minimize erosion and sediment transport, in conformance with applicable provisions of the county's general plan, this code, and applicable state and federal regulations. The conservation/open element, energy resource section, contains policies relating to the siting of various types of energy resource projects.

Siting should minimize impacts to the natural landscape. Project design should encourage the joint use of facilities whenever possible in order to minimize disturbance to the natural environment. Access and construction roads should be located so that natural features are preserved and erosion is minimized.

2. Site Disturbance. Earthwork, grading and vegetative removal shall be minimized. Existing access roads shall be utilized whenever possible. Construction of new access roads, frontage roads or driveways shall be avoided except where essential for health and safety. Earthwork and grading shall be performed in accordance with Chapter 13.08 of this code.

3. Revegetation. Site disturbances shall be revegetated in conformance with the reclamation plan developed pursuant to Chapter 19.60 of this code.

4. Drainage. Drainage facilities shall be constructed and maintained in accordance with Chapter 13.08 of this code and with any applicable requirements of the

Lahontan regional water quality control board pertaining to waste discharge.

E. Cultural Resources. The applicant shall stop work and notify appropriate agencies and officials if archaeological evidence is encountered during construction or operations. No disturbance of an archaeological site shall be permitted until such time as the applicant hires a qualified consultant and an appropriate report is filed with the county planning department which identifies acceptable site mitigation measures, which shall then become conditions of the use permit and the reclamation plan (if applicable).

F. Noise. All resource development projects shall be sited, designed and operated to minimize noise impacts to the surrounding environment, in conformance with applicable provisions of the county's general plan (noise element) and Chapter 10.16 of this code.

G. Air Quality. All resource development projects shall be designed and operated in compliance with all requirements of the great basin unified air pollution control district and applicable provisions of the county's general plan.

H. Safety, Including Hazardous Materials and Hazardous Waste. All projects shall comply with applicable safety standards. Hazardous waste shall be maintained in conformance with the Mono County general plan (hazardous waste management element) and the Mono County integrated waste management plan. (Ord. 94-02 § 2 (part), 1994)

19.59.110 Reclamation requirements.

Standards and procedures for the reclamation of resource development activities in Mono County are contained in Chapter 19.60 of this code. All resource development projects must comply with Chapter 19.60 of this code. Reclamation plans must be submitted as part of the use permit application. (Ord. 94-02 § 2 (part), 1994)

19.59.120 Financial assurances.

Financial assurance requirements for the reclamation of resource development activities in Mono County are contained in Chapter 19.60 of this code. All resource development projects must comply with the financial assurance requirement. (Ord. 94-02 § 2 (part), 1994)

19.59.130 Inspections.

A. Requirements. The use permit shall establish an inspection schedule for compliance with use permit conditions. Inspections shall occur at least once a year, but may occur more often depending on the nature of the project. The inspection schedule may change over the lifetime of the project. The annual inspection for mining operations shall coincide with the annual inspection required by SMARA. Chapter 19.60 establishes an inspection schedule for reclamation plans. The required inspections for compliance with use permit conditions and reclamation plan requirements should coincide.

B. Procedure. The operator shall file a request for annual inspection with the county compliance officer at least once in each calendar year. Requests for annual inspections shall be accompanied by the appropriate filing fee.

The compliance officer shall inspect or cause to be inspected the site within thirty working days of receipt of the application for inspection and the filing fee. Unless otherwise agreed, failure to inspect within thirty working day shall be deemed a finding that the resource development operation is in compliance with its use permit. (Ord. 94-02 § 2 (part), 1994)

19.59.140 Administration.

A. Appeals. Appeals of any decision resulting from the requirements of this chapter may be made in conformance with the provisions of Chapter 19.42, Appeals.

B. Fees. Fees required in conjunction with the provisions of this chapter shall be established from time to time by the board of supervisors. (Ord. 94-02 § 2 (part), 1994)

19.59.150 Enforcement.

A. Enforcement. The provisions of this chapter shall be enforced by the energy management department, the planning department, and/or the county compliance officer or such other persons as may be designated by the board of supervisors. Enforcement of the provisions contained in this chapter shall be in accordance with applicable provisions of this code.

B. Right of Entry. Whenever it becomes necessary to inspect resource development activities as provided in this chapter or to investigate complaints associated with resource development activities or to monitor conditions of approval as may be imposed on resource development activities, reasonable access to the project site shall be afforded by the operator in conformance with Chapter 1.08 of this code. Authorized representatives of the county, upon presentation of appropriate credentials, shall have access to the site without advance notice. (Ord. 94-02 § 2 (part), 1994)

EXHIBIT W

Economic Benefits of Proposed M-1 Geothermal Power Replacement Plant Mono County, California

Prepared for
Ormat Technologies

Prepared by
Wahlstrom & Associates

September 6, 2011

TABLE OF CONTENTS

FIGURES

* * *

1. Project Description

The Mammoth Pacific geothermal complex is located on unincorporated land in Mono County, 2.5 miles east of the Town of Mammoth Lakes, northeast of the junction at US Highway 395 and State Route 203. The complex includes three geothermal power plants built between 1984 and 1990 that have a generating capacity of 29 megawatts (MW). The existing facility produces enough electricity to power approximately 21,750 homes. The electricity is sold under long-term contracts to Southern California Edison.

During late 2010, Ormat Nevada, Inc. (ONI) acquired sole ownership of the geothermal complex site, power plants, equipment, and future rights to develop additional geothermal facilities on more than 10,000 acres of undeveloped federal land. The Company proposes to replace the 7 MW 1984 facility (G1) with a more modern and efficient advanced technology plant (M1) that can produce 18 MW of electricity.

The new plant will be located only 500 feet from the existing plant (See Figure 1). A pipeline will connect the replacement plant with the existing wells, which means that no new geothermal wells will need to be constructed. In addition, a new 12.47 KV substation/switching station will be constructed to connect the new power plant to the existing transmission line.

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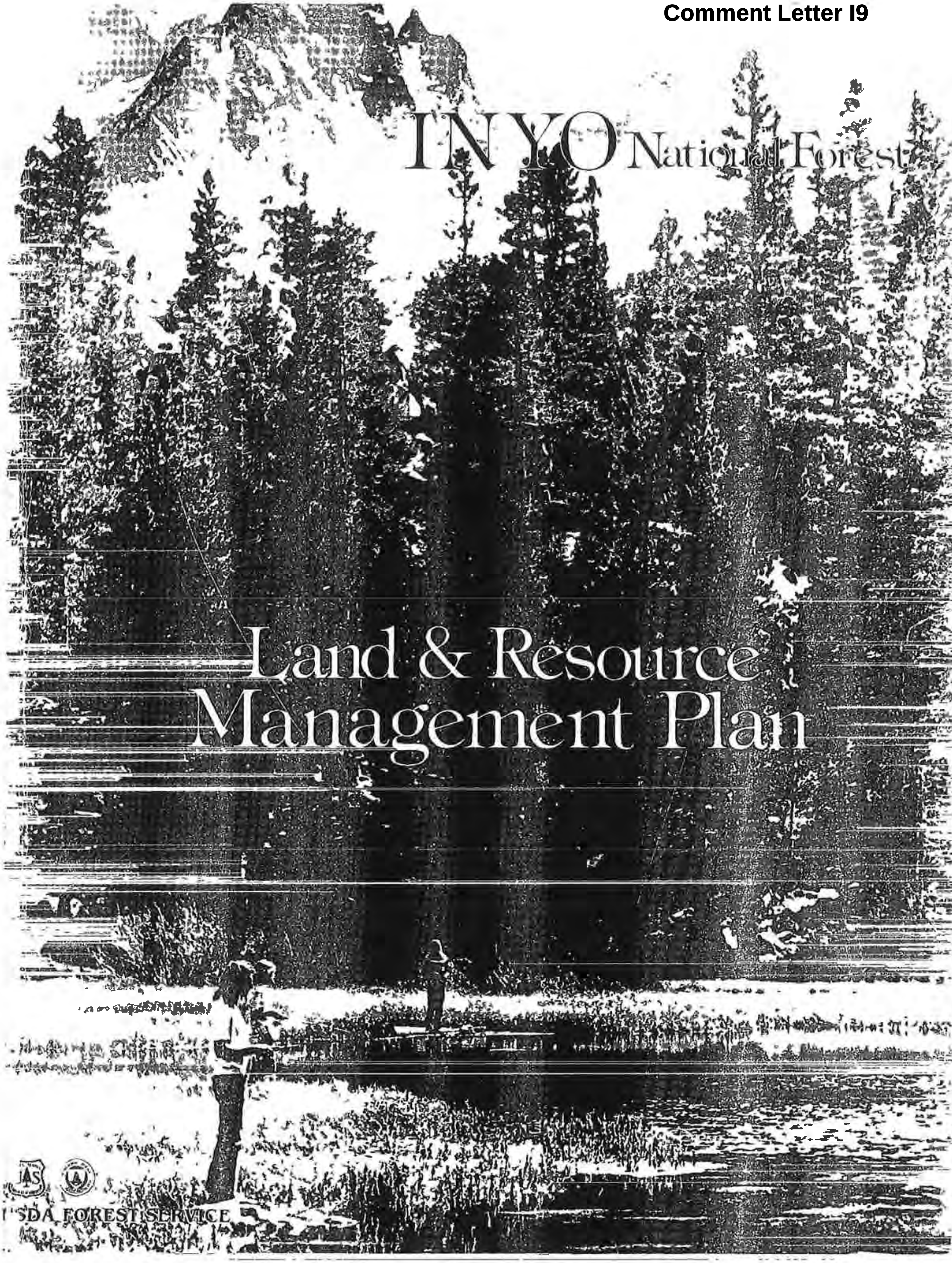
EXHIBIT X

Comment Letter I9

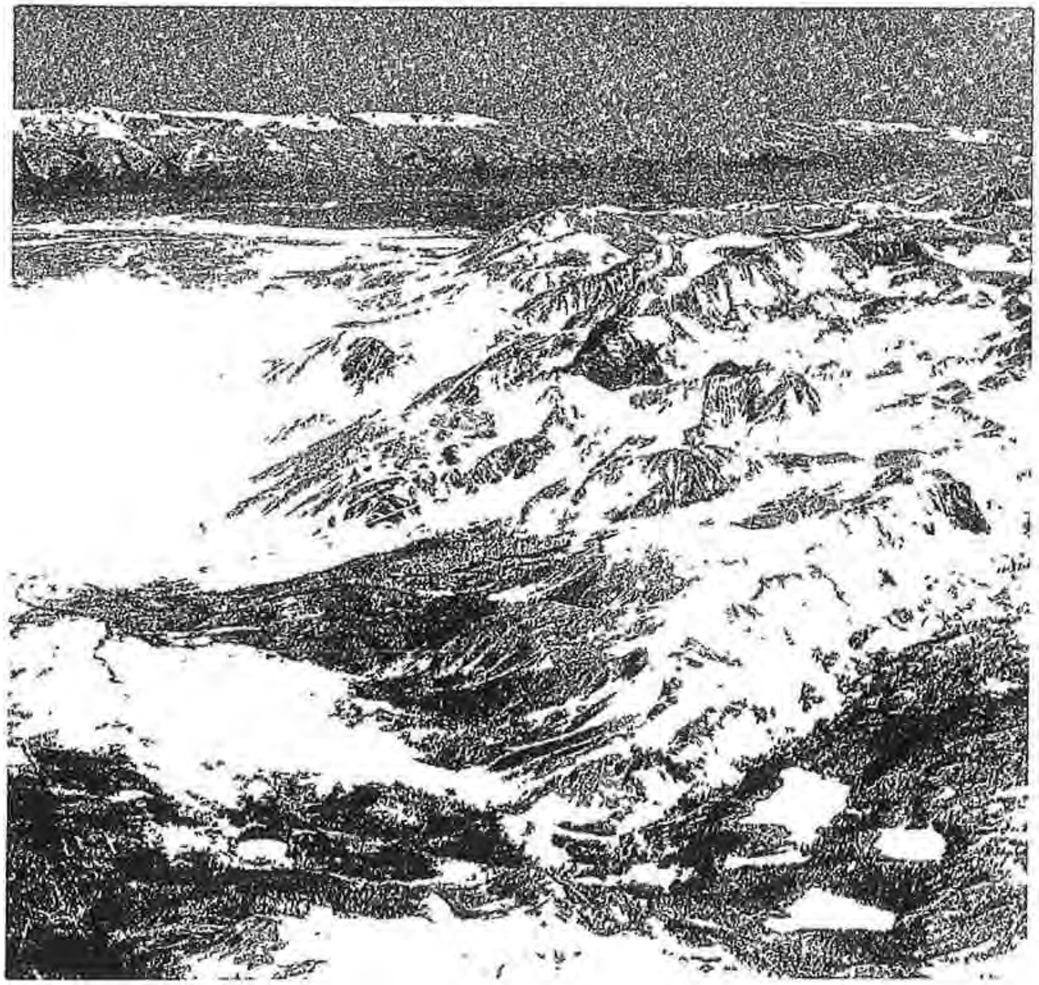


INYO National Forest

Land & Resource Management Plan

USDA FOREST SERVICE

CHAPTER I



Introduction

CHAPTER I. Introduction

Purpose of the Forest Plan

The purpose of the Inyo National Forest Land and Resource Management Plan is to provide integrated, multiple resource management direction for all Forest resources for the next decade (1988-1997). The Plan has been developed through a planning and environmental analysis process that is documented in the accompanying Environmental Impact Statement (EIS). This Plan details the Preferred Alternative analyzed in the EIS.

The Plan prescribes management direction for the most suitable combination of management practices, sets ten- to fifteen-year objectives, provides for the mutiple use and sustained yield of goods and services, maximizes long-term net public benefits, proposes environmentally sound management, and responds to major public issues and management concerns.

In September 1984 Congress designated the Mono Basin National Forest Scenic Area which encompasses approximately 116,000 acres of land within the Inyo National Forest boundary. Resource and development planning for the Scenic Area is being conducted in a separate planning process. The new Comprehensive Management Plan for the Scenic Area will be incorporated into the Forest Plan.

Relationships with Other Environmental Documents

The Plan will supersede all existing plans for individual resources or land units. These existing plans will be treated in one of three ways: (1) incorporated into the Plan without revision, (2) incorporated with direction to be revised or updated, or (3) replaced by the Plan. See Appendix A for the list.

In addition to replacing and/or incorporating earlier plans, the Plan calls for the development of several resource implementation plans during the coming decade. Those new planning requirements are listed in Appendix A.

The Plan and its Environmental Impact Statement will serve as umbrella documents for all future planning on the Inyo. Most individual projects will still require an environmental analysis before implementation, but these will be tiered to the EIS. For those projects that require additional analysis, only that information needed for site-specific decisions will be addressed.

Plan Implementation

The Final Plan incorporates many of the comments received from the public in response to review of the Draft Plan. The Final Plan and Environmental Impact Statement will be approved with a Record of Decision signed by the Regional Forester. The approved Plan will become effective no less than thirty days after publication in the Federal Register of a Notice of Availability of the Final EIS. When that process is complete, direction in the Plan will be implemented.

Implementation of the Plan will mean a change from current management direction, including the annual budget and objective programs, to reflect resource emphasis shifts. Current management is represented by the No Action Alternative (CUR) in the Environmental Impact Statement; the Plan program is represented by the Preferred Alternative (PRF). Chapter III, Summary of the Analysis of the Management Situation, compares both programs.

Plan management direction is described in Chapter IV. In some cases, new activities are proposed; in others, direction calls for a change from current management. In the former case, proposed actions can begin immediately. In the latter, a period of adjustment may be needed.

Changes in management direction will be implemented through the annual budgeting and work planning processes. These processes allow for adjustments to reflect current priorities. The degree to which this Plan will be implemented depends to a large extent on the appropriation of funds by Congress and allocation to the Forest through budget procedures.

When the Plan is implemented, subject to valid existing rights, all outstanding and future permits, contracts, cooperative agreements, and other instruments for Forest land use and occupancy will conform to the Plan. The Plan will be used by the Forest to direct management activities in conjunction with other documents that provide policy direction. These include Forest Service Manuals and Handbooks and the Pacific Southwest Regional Guide. Direction from these other sources is repeated in the Plan only where it is necessary for purposes of emphasis.

The National Forests are managed under a variety of federal laws which are documented in the Code of Federal Regulations (CFR). All Forest Service activities must adhere to these laws.

Amendments, Revisions, and Appeals

At intervals specified in Chapter V, Monitoring and Evaluation, Forest activities will be monitored to determine whether the goals and objectives of the Plan are being met. The Plan can be amended at any time if monitoring results indicate that it is needed. An amendment will require an environmental analysis to determine whether the amendment represents a significant change from the Plan. If the change is significant, preparation of an Environmental Impact Statement and formal public involvement are required. If not, the kind of public involvement and the documentation that is needed will be determined by the type and magnitude of the proposed change.

The Plan will ordinarily be revised every ten years or at most every fifteen years. Revision may also be proposed in the interim if conditions have changed enough to affect Forest-wide programs set forth in the Plan. A Plan revision always requires a change to this Environmental Impact Statement, incorporating public involvement procedures as required by the National Environmental Policy Act (NEPA).

The Regional Forester's decision to approve the Plan and its Environmental Impact Statement is subject to the public's rights of administrative appeal. Preliminary process decisions are not subject to appeal [See 36 CFR 211.18(b)(11)].

Plan Organization

The Plan is organized into chapters as follows:

Chapter I. Introduction. This chapter describes the purpose of the Plan, its relationship with other plans and environmental documents, how it will be implemented, and procedures for amendment and revision.

Chapter II. Issues and Concerns. This chapter summarizes the issues and concerns that were identified in this planning process on the Inyo National Forest and discusses the ways in which the Plan responds to those issues and concerns.

Chapter III. Summary Analysis of the Management Situation. This chapter describes Forest resources in terms of current direction, the opportunities for change, supply and demand, and the Plan's management emphasis for each resource.

Chapter IV. Management Direction. This chapter describes in detail how the Forest will be managed during this planning period. This includes Goals, Objectives, Forest-wide Standards and Guidelines that will be applied when managing each resource, Management Prescriptions that give specific direction for emphasizing individual resources, and Management Area Direction. The Forest is divided into twenty management areas. Each area has a different set of management prescriptions that apply to it, and each has specific direction. Maps of each area with prescription boundaries are included in this chapter.

Chapter V. Monitoring and Evaluation. This chapter describes and schedules the activities that will be needed to monitor and evaluate the Plan's direction considering outputs, objectives, and environmental impacts.

Chapter VI. Glossary.

Chapter VII. Index.

Appendix A: Resource Plans

Appendix B: Research Needs and Technical Data Needs

Appendix C: Tentative Ten-Year Timber Sale Action Plan.

CHAPTER V

Rocky Rockwell

Monitoring and Evaluation

CHAPTER V. Monitoring and Evaluation

Forest planning is a dynamic process that does not end with publication of the Plan. Monitoring and evaluation activities provide information to help determine whether or not Inyo National Forest programs are meeting the Plan's objectives. It is through this process that corrections and adjustments are made in management activities, the degree of implementation is assessed, and the need for change is determined.

Monitoring and evaluation are separate, sequential activities. Monitoring consists of collecting information from selected sources to measure the effects of Forest Service activities. This information will indicate whether programs are consistent with the objectives and costs projected in the Plan and whether they are adhering to the Plan's Standards and Guidelines and responding to the public's and management's expressed concerns.

In the evaluation stage, information obtained in monitoring is compared with Plan requirements. When differences are noted, their significance will be evaluated. The Plan can be amended at any time if monitoring results indicate that it is needed. An amendment would require an environmental analysis to determine whether the amendment represents a significant change from the Plan. If the proposed change from the Plan is significant, preparation of an Environmental Impact Statement and formal public involvement are required. If not, the kind of public involvement and the decision documentation that is needed will be determined by the type and magnitude of the proposed change.

The purpose of the Monitoring Plan is to assess the success of Plan implementation and determine whether the Plan needs to be amended or whether management activities need to be revised.

Monitoring Process

Results of monitoring and evaluation will be reported periodically as displayed in the Monitoring Plan Tables. Data sources for the monitoring plan include:

1. Management Reviews. General Management Review, Program Review and Activity Review.

2. Ongoing Inventories and Monitoring Programs. Soil productivity monitoring, water quality monitoring, forest inventory plots for timber, range utilization inventories, threatened and endangered species monitoring, etc.

3. Management Attainment Reports. Target accomplishment reports filed by Forest Supervisor's Staff and District Rangers three times per year and forwarded to the Regional Forester.

The Monitoring Plan is designed to monitor implementation of the Plan. It is not intended to replace ongoing detailed, resource specific monitoring. Results of the detailed current monitoring efforts will also be used to evaluate Plan implementation.

Monitoring will be performed by appropriate individuals throughout the Forest as follows:

1. Forest Staff. Each Staff Officer is responsible for preparing a more detailed resource monitoring plan for his/her respective function, with assistance from the District Rangers; providing technical advice and support in implementing the Monitoring Plan; periodically reviewing activities to ensure implementation of monitoring plans; and assembling the monitoring results at the close of each Fiscal Year.

2. District Rangers. Each District Ranger is responsible for assisting the Forest Staff Officers in preparing more detailed monitoring plans for each resource; monitoring the annual work plans of resource specialists reporting to him/her; ensuring that monitoring is carried out according to the plans, and submitting the results of monitoring to the appropriate Staff Officer.

3. Land Management Planning Staff Officer. At the close of each Fiscal Year, the Land Management Planning Staff Officer will incorporate all monitoring information, evaluate the results with the Forest Staff, and formally report findings and recommendations to the Forest Supervisor.

Evaluation Process

The Monitoring Evaluation Process displayed on the next page illustrates the steps necessary for an effective monitoring and evaluation plan. Based on the results of this process, need for further action is recommended to the Regional Forester.

Evaluation of the results of the site-specific monitoring program will be documented and available for public review. The significance of the results of the monitoring program will be analyzed by the Forest Supervisor. Based on the evaluation, there may be a need for further action. Management actions are a result of the monitoring and evaluation process can include:

1. No action needed. Monitoring indicates Plan Goals, Objectives, and Forest-wide Standards and Guidelines are achieved.

2. Refer recommended action to the appropriate line officer for improvement of application of Standards and Guidelines, Prescriptions, or Management Area Direction.

3. Modify portions of the Plan as a Plan Amendment.

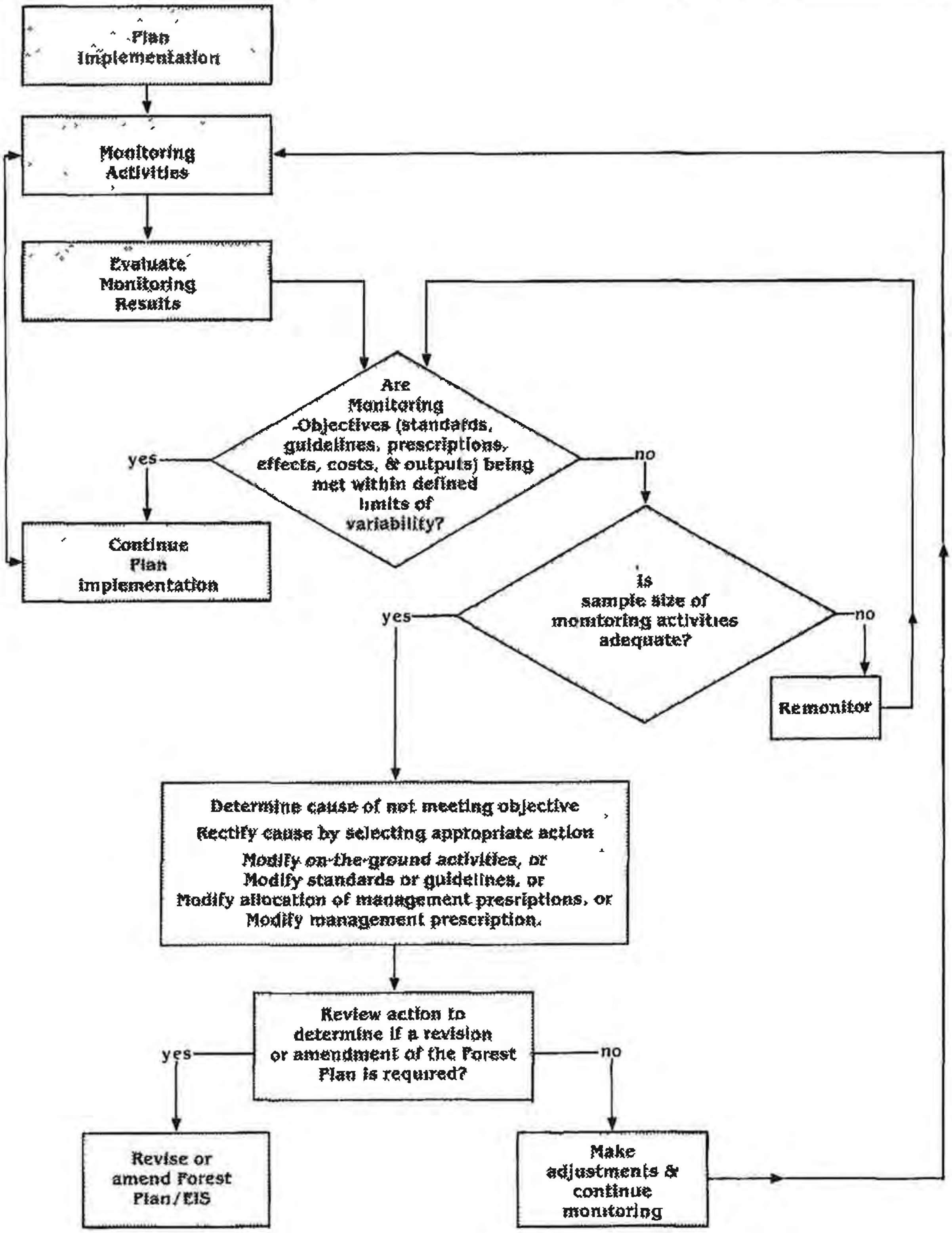
4. Modify Prescription boundaries as a Plan Amendment.

5. Revise the projected schedule of outputs.

6. Initiate revision of the Plan.

Plan modification and/or revision will be made in accordance with the National Environmental Policy Act and National Forest Management Act regulations. Resource activities, practices or effects to be monitored are displayed in this section.

Monitoring Evaluation Process



MONITORING PLAN BY RESOURCE

The following tables display how the management activities on the Forest will be monitored. This information will be used to evaluate Plan implementation. The tables contain the following columns:

1. Activity to be Measured.

2. Monitoring Objective.

3. Monitoring Technique. A description of how the data will be gathered.

4. Expected Precision and Validity. Precision is the exactness or accuracy of measurement techniques. Validity is the expected probability that information acquired through sampling will reflect actual conditions. Both precision and validity are quantitatively rated as either high, medium, or low according to whether the maximum measurement is within 10%, 33%, or 50% of the sample mean, respectively.

5. Frequency and Reporting Period. The minimum frequency for data gathering; the minimum period for reporting the data.

6. Standard of Comparison and Variation from the Standard Requiring Further Action. The anticipated result, level, or status of the action, effect, or resource to be monitored and the expected variation of observations in relation to the standard. When this limit is exceeded, the cause of the variation must be rectified or the monitoring process modified, as appropriate.

8. Average Annual Cost. The Forest's best estimate of the annual cost of monitoring. This is cost is in addition to the annual appropriated functional costs. If the costs are shown as zero, they are included in the annual appropriated functional costs.

INYO NATIONAL FOREST PLAN IMPLEMENTATION MONITORING PROGRAM

Inyo National Forest Plan Implementation Monitoring Program

Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision/ Validity	Frequency/ Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost (*)
APPLIES TO ALL RESOURCE ELEMENTS (Responsible Official Forest Supervisor)						
Implementation of Management Direction and Management	Ensure compliance with Forest Plan direction	Sample project plan and Environmental Assessments for compliance	High	Ongoing/ Annually	Any deviation from Plan direction	$14,500
	(Responsible Official	Land Management Planning Staff Officer)				
Cost and Benefits of Implementing the Forest Plan	Validate predicted versus actual Plan Implementation costs	Analyze expenditure and allocation	High	Annually/ 5 years	10% difference between predicted and actual costs of Implementing the Forest Plan	U (**)
	Determine the economic effects of Plan Implementation	Review cost/ benefit comparisons in project records	Medium	5 years/ 5 years	33% variation from benefit/cost ratios predicted in Forest Plan	U (**)
Resource Output attainment	Compare actual vs predicted outputs	Attainment reports	High	Annually/ Annually	10% deviation from predicted outputs over a five year period	U (**)
AIR QUALITY	(Responsible Official	Watershed Staff Officer)				
Air Quality	Evaluate compliance with State and Federal Air Quality standards in designated Class I and Class II airsheds	Monitor AQRV indicators by photography, measurement, analysis, and recordation	Varies with Technique	Continuous Monitoring/ 5 years	California Air Resources Control Board standards Any deviation from designated federal and state standards	$ 5,000

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Inyo National Forest Plan Implementation Monitoring Program

Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision/ Validity	Frequency/ Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost (*)
CULTURAL RESOURCES	(Responsible Official	Recreation Staff Officer)				
Mitigation and protective measures	Assess effectiveness of protective measures taken to achieve "no effect" status on cultural resources from land use projects and other resource management activities	On-site inspection photography, measurement, and recordation	Medium	Annually/ 5 years	Protective measures are effective on less than 90% of sites samples per year	$ 3,000
	Assess target to complete a total Culural Resource Inventory's by the year 2030	Monitor status of inventory	High	Annually/ Annually	10% deviation from target to inventory 40,000 acres per year	$ 500
	Determine the occurence and extent of vandalism effectiveness of cultural resources public awareness, interpretation, and enforcement programs	Signing sites, periodic on-site inspection, photography, measurement, and recordation	High High/Medium	Annually, or in response to reports of damage/ annually.	Standard is the pre-vandalized condition, as shown on site survey records or other documents	$ 6,000

INYO NATIONAL FOREST PLAN IMPLEMENTATION MONITORING PROGRAM

Inyo National Forest Plan Implementation Monitoring Program

Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision/ Validity	Frequency/ Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost
DIVERSITY	(Responsible Official	Wildlife Staff Officer)				
Vegetative Diversity	Ensure that the Forest-wide distribution of all successional stages meet Forest Service Guidelines & Prescriptions, that spatial and structural diversity is maintained in riparian areas, and that the prescribed quantity, quality and distribution of snags and down woody material is maintained	Compare existing and longterm minimum levels Sample range, recreation, timber and prescribed burn projects to determine the cumulative effects on successional stage, spatial and diversity	Low	5 years/ 10 years	20% change in the expected acreage of successional stages of major vegetation types as a result of forest management activities	$ 6,000
FISH	(Responsible Official	Wildlife Staff Officer)				
Threatened and Endangered Fish	Ensure compliance with recovery plan Forest-wide Standards and Guidelines	GAWS inventory of existing and potential habitats Population inventories coordinate with California Fish and Game for existing and re-introduced populations	Medium/High	3 years/ 3 years Project EAs, EISs, and reports	Existing population censuses, recovery plan criteria	$ 4,000

INYO NATIONAL FOREST PLAN IMPLEMENTATION MONITORING PROGRAM

Inyo National Forest Plan Implementation Monitoring Program

Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision/ Validity	Frequency/ Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost (*)
FISH (CON'T)	(Responsible Official	Wildlife Staff Officer)				
Trout Streams	Monitor habitat condition of resident trout Ensure that the integrity and productivity of trout streams are *maintained or enhanced* through the protection of such trout habitat factors as streambanks stability, bank and stream cover, riparian vegetation, and channel bottom composition	Conduct stream surveys in cooperation with CDSG where possible Sample *project EAs and* conduct field project reviews	Medium	Project by project basis Annually, with 5 year trend evaluation	Activities that cause deviation from Forest Service Guidelines require an environmental analysis	$13,000
PEST MANAGEMENT	(Responsible Official	Forest Integrated Pest Management Coordinator, State and Private Forestry, and Forest Pest Management)				
Damage and Populations	Early detection and evaluation of pest related problems on commercial timber lands and other Forest lands	Aerial and ground surveys, surveillance, timber stands examinations and other resource-specific examinations	Medium	Annually/ As needed	Pest related damage levels must not interfere with the attainment of Management Goals and Objectives	U (*)

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Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision/ Validity	Frequency/ Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost (*)
PROTECTION	(Responsible Official	Fire Management Staff Officer)				
Fire Suppression	Validate predictions of acres burned by wildfire for next Forest Plan update	From fire report compare actual acres burned with predictive tables	High	5 years/ 10 years	Variation - 50% between actual and predicted acres burned within a Management Area	U (*)
RANGE	(Responsible Official	Range Staff Officer)				
Range Utilization	Ensure proper level of forage utilization in riparian areas and meadows and others AOP compliance	Conduct sample field surveys	Medium	Annually/ 5 years	15% deviation from standards as expressed in allotment management plans or Range Management Handbook	$56,000
Range Forage Improvement	Determine effectiveness of browse release projects	Conduct field surveys following browse release projects	Medium	Annually/ 5 years	50% deviation from predicted results	$ 500 per project
Range Condition and Trend	Determine the effects of grazing levels on the range resource Update AMPs as per Manual and Plan	Permanent and paced transects	Medium	5 years/ 5 years	Downward trend in soils or vegetation on range allotments	$38,000
Wild Horse and Burro	Determine effectiveness of wild horse management	Monitor wild horse numbers & sex ratios and vegetative conditon of habitat	High	Annually/ 10 years	Downward trend in soils or vegetation Decline in wildlife or wild horse conditions	$14,000

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Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision/Validity	Frequency/Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost (1)
RECREATION	(Responsible Official	Recreation Staff Officer)				
Recreation Use	Determine total recreation use check coefficients by ROS class	RIM system and other sampling techniques	Medium	Annually/ 5 years	10% variation between actual and predicted RVDs by ROS class	$ 7,000
OHV use on land and other Resources	Determine if adverse effects on natural resources are occurring or likely to occur	Photograph and/ or field measurement	Medium	Annually/ 3 years	25% deviation from standard prescribed in the OHV monitoring plan	$10,000
RIPARIAN	(Responsible Official.	Watershed Staff Officer)				
Protection and Diversity	Ensure that management prescriptions and Forest Service Guidelines adequately protect meadows and riparian areas and their associated values Ensure that spatial and structural vegetative diversity is maintained in riparian areas	Field surveys	Medium	5 years/ 10 years	Activities that cause deviation from Forest Service Guidelines require an environmental analysis	$ 1,000
Protection and Mitigation	Determine whether mitigation measures for small hydro projects & geothermal development are sufficient & effective in maintaining riparian vegetation & other riparian dependent resources	Field review of applied mitigation measures	Medium	5 years/ 10 years	20% deviation from Forest Service Guidelines	$ 5,000 Per Project

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Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision/ Validity	Frequency/ Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost
SENSITIVE PLANTS	(Responsible Official	Wildlife Staff Officer)				
Sensitive Plant Species Habitat	Detect changes in key populations of each species and assess impacts on selected populations of occupied habitats Identify key populations that will be used for monitoring purposes	Population trend censuses, Baseline and past-project surveys for input into EAs Use applicable techniques identified in Interim or Species Management Guides	High/High	Annually/ Annually for specific projects 3-5 Years/ 3-5 Years or according to Interim or Existing Management Guides	Forest Standards & Guidelines, Species Management Guides. Sensitive Plant Handbook/No new impacts to plant populations that do not have species management plan, unless recommended by the Forest Supervisor	$12,000
TIMBER	(Responsible Official	Timber Management Officer)				
Reforestation	Determination of success of regeneration practices	Described in PSH 2470 Includes sampling of species, survival, planting stock and density	High	1st & 3rd growing season after reforestation and maintained until fully certified as established/ 5 years	Described in PSH 2470 A trend in either mortality or growth inhibiting factors that indicated minimum stantards will not be met at some future time	$ 5,000
Suitability for Timber Production	Determine if lands classed as not suited for timber production are suitable	Project evaluation and timber inventory	High	Annually for projects examined & at least every 10 years for all lands	Lands identified as unsuited for any reason are determined suited and are 10% of current suitable lands	U (*)

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Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision/Validity	Frequency/Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost ($)
TIMBER (CON'T)	(Responsible Official:	Timber Management Officer)				
Annual Programmed Sale Quantity Acres and Volume Offered and Harvested by Prescription and Forest Type	Ensure implemenatation of the timber sale programmed is consistent with the Plan	Management Reviews Programmed Harvest Statement Timber Sale EAs	High	Annually/ 10 years	30% of acres and 10% of allowable sale quantity volume for a decade, by prescription, or by forest type	$ 1,000
VISUAL RESOURCES	(Responsible Official	Recreation Staff Officer)				
Visual Condition of Forest	Determine if VQOs are being met as per Plan	Field reviews & photo points	High	Annually/ 10 years	VQO and EVC as defined in FSM 2380 5% failure to achieve the planned VQO on total projects	$ 2,000
Trend of Visual Character	Determine if desired character stated in plan is being approached or maintained	Field reviews with landscape control point photo method	High	5 years/ 5 years	Plan and PSW-91 of 1973 Indication of trend away from the stated goal	$ 2,500
Visual Resource Improvement	Determine if an active program of visual resource improvement is being carried out	Field reviews and photo point	Medium	Annually/ Annually	Plan and Planning records and FSM 2380 Less than 50% accomplishment of visual resource improvement projects in any year	$ 500
WATERSHED: SOILS AND WATER	(Responsible Official	Watershed Staff Officer)				
Soil Productivity	Verfiy adequacy of Prescriptions, Standard and Guidelines in maintaining and improving soil productivity	Observations & measurements, and validate the use of BMPs in project activity	Medium	Annually/ 5 years	Improvement and maintenance measures 90% successful, 90% of prescribed BMPs are implemented	$14,000

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Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision / Validity	Frequency / Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost (*)
WATERSHED: SOILS AND WATER (CON'T)		(Responsible Official Watershed Staff Officer)				
Water Quality Management	Assess compliance with BMP direction, and to continue to evaluate the effectiveness of BMP	Review of prepared EAs, review of contract provisions, field activity reviews, water quality analysis field observations	High	Ongoing as part of EA and contract review process, and as field trips are taken Annual activity review	Implementing documents for three projects are found to be missing needed water quality mitigation measures Water quality objectives violated Two field reviews identify mitigation measures are not being implemented	$12,000
Watershed Improvement	Evaluate effectiveness of watershed improvement measures	Observations and measurements	Medium	Annually/ 5 years	80% survival rate of project over a 10 year period	$ 5,000
WILDLIFE	(Responsible Official	Wildlife Staff Officer)				
Goshawk	Ensure project compliance with Forest-wide Standards and Guideline Determine population & habitat trends	Survey all known nest sites within areas managed for timber annually Survey 50% of known nest sites outside of areas managed for timber annually	Medium	Annually/ Annually Specific project EAs or reports	Forest-wide Standards and Guide lines and habitat capability models	$ 3,000

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Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision/ Validity	Frequency/ Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost (1)
WILDLIFE (CON'T)	(Responsible Official	Wildlife Staff Officer)				
Mule Deer	Insure compliance with California Fish & Game Deer herd management plans, Forest-wide Standards and Guidelines, Management Area Direction	Coordinate compliance counts with California Fish and Game, evaluate habitat for specific proposed project	Medium	Annually/ Annually Specific EAs and reports	Previous census information, Forest-wide Standards and Guide lines, Management Area Direction state deer herd plans, deviation from standards of these documents +/- 10% change in population levels over 5 years	$ 8,000
Peregrine Falcon Recovery	Verify nesting and reproductive success of peregrine falcons Implement recovery plan Two nesting pairs	Field surveys of historic nest areas and high potential nest sites	Medium/ High	Annually/ Annually	Establishment of two nestings pairs Comparison of sightings from year to year No active site in 5 years or decline in sightings over 5 years	$ 2,000
Sierra Nevada and Nelson Mountain Sheep	Insure compliance with Forest-wide Standards & Guidelines, and recovery plans	Conduct herd composition counts with California Fish and Game, of existing populations, will be inventoried every other year	Medium/ High	Annually/ 2 years	Recovery plan objectives, Forest-wide Standards and Guide lines, previous censuses, +/- 10% change in population levels over a 5 year period or or deviation from above documents	$ 8,000
Winter Bald Eagle Habitats	Implement recovery plan Evaluate trends of habitats delineated to to meet recovery goals Determine trend of winter populations	Survey known winter areas, survey capability of of delineated habitats for specific proposed projects	Medium/ High Winter areas High/High Specific projects	Annually/ Annually Specific EAs or reports	Forest-wide Standards and local recovery plans, and Habitat Capability Models and Forest-wide Standards and Guidelines, deviation from the above or +/- 25% change in population levels	$ 2,000

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Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision/ Validity	Frequency/ Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost (1)
WILDLIFE (CON'T)	(Responsible Official	Wildlife Staff Officer)				
Other State listed or sensitive species as afffected by specific projects Sierra Nevada red fox, pine marten, fisher wolverines, and spotted owl, great gray owl	Ensure protection provided by Forest-wide Standards and Guideline and Habitat Capability Models	Appropriate survey methods Application and development of Habitat Capability to delineate habitats on project areas	Medium	Project Basis/ Project Basis	Past population surveys, Habitat Capability Models, Forest-wide Standards and Guidelines, or lowers habitat capability for species	$ 8,000
Threatened Endangered and Sensitive Species *Management*	Ensure that management activities afford protection of all Threatened Endangered and Sensitive species as prescribed in Plan	Sample EAs and conduct field surveys of completed project	Medium	Annually/ Annually	Any detectable decline in population	$ 4,000
Trends of Habitat Capability for Management Indicator	To ensure that habitat capability trends *for* MIS are consistent with Plan direction.	Field surveys *and office re-*view of projects to determine habitat capability for MIS	Medium	Annually/ *5 years*	20% variation in expected *change* in habitat capability, or habitat capability is 10% above viable levels	$ 6,000

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Activity to be Measured	Monitoring Objective	Monitoring Technique	Expected Precision/ Validity	Frequency Reporting Period	Standard of Comparison and Variation from Standard Requiring Further Action	Additional Annual Cost (*)
WILDLIFE (CON'T)	(Responsible Official	Wildlife Staff Officer)				
Quantity and Distribution of Snags and Downed Logs	Ensure minimum quanity, quality, and distribution of snags, dead and down woody material	Review EAs and conduct field surveys of completed projects; monitor MIS group	Medium	Annually/ 5 years	Any detectable decline in snags and downed logs from shown in Forest-wide Standards and Guidelines	$ 2,000
Relationship between MIS and Represented species	To validate that maintenance of MIS habitat capability maintains habitat for the species they represent	Field survey to determine if represented species are present	Medium	Annually/ 5 years	70% of species represented are present	$ 6,000
WILDERNESS	(Responsible Official	Recreation Staff Officer)				
Actual Use Compared to Planned (established) Desired Conditions	Measure changes and compare with limits of acceptable change and evaluate associated environmental effects	Remeasure campsite condition class, record changes according to FSM2323 1 R-5 supp #145	Medium	Annually/ 5 years	Any decline in campsite condition Class below Class III	$20,000

Comment Letter I9

CHAPTER IV

Phil Collins

Management Direction

CHAPTER IV. Management Direction

Introduction

This chapter documents how the Inyo National Forest will be managed during this planning period. It provides direction to Forest land managers and explains to the public the reasons why specific areas are managed for specific reasons and how that will be accomplished.

The chapter is divided into five sections:

1. **Forest Goals** lists the resources of the Forest with their respective management goals.

2. **Forest Objectives** lists outputs for each resource that will result from implementing the Plan.

3. **Forest-wide Standards and Guidelines** are the bases for all management activities on the Forest. Each resource has a set of standards and guides to ensure that the resource is protected, maintained or developed in an environmentally sound and economically cost-effective way. These standards and guides apply to all areas of the Forest.

4. **Management Prescriptions** prescribe how areas on the Forest will be managed with a specific resource emphasis. For example, any Wilderness on the Forest no matter where it is located will be managed under Prescription #1 - Designated Wilderness. Each prescription describes the objective of management and the area's resource emphasis.

5. **Management Area Direction** delineates boundaries of the twenty management areas on the Forest. Each of these has a different mix of prescriptions, but all are managed under the Forest-wide Standards and Guidelines.

National Forests are managed under a variety of federal laws ranging from the U.S. Mining Laws of 1872 to the National Forest Management Act of 1976. Forest Service Manuals and Handbooks and the Pacific Southwest Regional Guide provide additional policy direction. The Plan supplements but does not replace the direction from those sources.

Variance from Forest-wide Standards and Guidelines, Prescriptions, or Management Area Direction may occasionally be needed due to unforeseen site conditions, uncontrollable circumstances or unexpected natural phenomena. Where variance is unavoidable, it will be documented in an appropriate project environmental analysis. If necessary, the Plan can be amended or revised.

Forest Goals

The multiple-use management goals that follow describe the desired future condition of the Inyo National Forest. These goals are derived from laws, regulations, policies, Resources Planning Act (RPA) Program goals, the Pacific Southwest Regional Guide, and identified Inyo National Forest issues and concerns.

ECONOMIC/SOCIAL

The Forest is managed in an economically efficient and cost-effective manner while responding to the economic and social needs of the public and local communities.

AIR QUALITY

National Forest System lands are managed to maintain air quality that complies with all applicable regulations. The conduct of Forest management activities is carried out in a manner consistent and compatible with the attainment of state and federal air quality objectives.

CULTURAL RESOURCES

Identification, evaluation, protection, and interpretation of cultural and historic resources are continuous and an integral part of management of the Forest.

DIVERSITY

The Forest has achieved diversity of plant and animal communities by providing a threshold level of vegetation types and seral stages.

ENERGY

Maximum public benefits are obtained from the energy resources of National Forest System lands, while adverse environmental effects on other Forest resources from exploration, development and extraction are minimized. Management operations on the Forest are energy-efficient.

FACILITIES

An efficient Forest transportation system, administrative sites, and other facilities are in place and maintained at least to the minimum standards appropriate for planned uses and the protection of resources.

FISH

Fish habitat is managed to provide species diversity, to ensure that viable populations of native vertebrates are maintained and the habitats of management emphasis species are maintained or improved.

GEOLOGY

Geologic resources, including groundwater, are assessed. The risks to persons and projects from potential geologic processes such as landslides, earthquakes, and volcanic events are recognized and provisions are made for them.

LANDS

The Forest has a land and resource management structure and program with compatible relationships between National Forest System lands and adjacent non-federal lands. Specific activities to accomplish this goal are: special use administration, electronic site management, utility corridor management, rights-of-way management, withdrawal, landownership adjustment, and property boundary resurvey and monumentation.

MINERALS

Maximum public benefits are obtained from the mineral (including geothermal) resources of National Forest System lands, while adverse environmental effects on other Forest resources from exploration, development and extraction are minimized.

PEST MANAGEMENT

Pest-related damage is maintained at levels that do not unacceptably impact land and resource management goals and objectives.

PROTECTION

The Forest has a cost-effective fire management program that minimizes resource losses and serious or long-lasting adverse effects from wildfire. The Forest Service mission in fire management is to use fire as a resource management tool.

RANGE

A sustained yield of forage is provided, range condition is improved, and grazing capacity is increased on suitable range, while other resource values are maintained or improved through cost-effective development and improved management.

RECREATION

A broad range of developed and dispersed recreation opportunities in balance with identified existing and future demand is provided.

RESEARCH NATURAL AREAS

All botanical Research Natural Areas are established and targets are met. All qualified aquatic and geologic candidates are identified and recommended for establishment.

RIPARIAN AREAS

Riparian areas are managed to protect or improve riparian area-dependent resources while allowing for management of other compatible uses.

SPECIAL INTEREST AREAS

Special Interest Areas (botanic, geologic, scenic, zoologic) are managed to fulfill the intent and purpose for which the areas are established.

THREATENED, ENDANGERED, OR SENSITIVE SPECIES

The habitats of threatened or endangered animals are protected or improved to assist the recovery of the species in cooperation with state and other federal agencies. Sensitive plant species are protected to ensure they will not become threatened or endangered.

TIMBER

The timber resource is managed to provide a sustained yield of commercial sawtimber, public fuelwood, and miscellaneous wood products, while other resource values are maintained at or above those minimums prescribed by law and/or regulation.

VISUAL RESOURCES

The quality of the scenic resource and viewing opportunities are maintained or enhanced.

WATERSHED

National Forest management activities are conducted to maintain or improve soil productivity, to maintain favorable conditions of waterflow, and to comply with water quality goals as specified in state and federal clean water legislation for the sustained benefit of consumptive and nonconsumptive users of water.

WILD AND SCENIC RIVERS

The newly designated North Fork of the Kern and South Fork of the Kern Wild and Scenic Rivers are managed to protect their wild and scenic qualities. The Middle Fork of the San Joaquin is managed so as not to preclude its designation as a Wild and Scenic River.

WILDERNESS

Classified wilderness is managed to protect and perpetuate the wilderness character of the area; to provide opportunities for primitive recreation; to maintain wildlife and fish, scenic, and watershed values; and to maintain or enhance the quality of wilderness experiences.

WILDLIFE

Wildlife habitat is managed to provide species diversity, to ensure that viable populations of existing native vertebrates and invertebrates are maintained, and that the habitats of management emphasis species are maintained or improved.

Forest Objectives

Forest objectives are the quantified resource and activity outputs for the 10-year planning period (1988-1997). The following table displays the outputs or inventory from the base year of 1982; the 1980 Resources Planning Act (RPA) targets for the years 1990 and 2030; and the outputs that will result from implementing the Plan. They are displayed in this manner for comparison purposes. There are no RPA targets for many of the categories.

Forest Objectives
Average Annual Outputs for Decade 1

Resource Elements	Base Year 1982	1980 RPA Goals 1990	1980 RPA Goals 2030	Decade 1 (1988-1997)
FACILITIES				
Administrative Sites				
Forest Service owned (no.)	6			8
leased (no.)	1			1
Dams and Reservoirs				
Forest Service (no.)	3			3
State/Local (no.)	4			4
Private (no.)	11			11
Roads (miles)				
Construction (total)	0			2.5
recreation (site access)	0			0
(interior)	0			2.5
Reconstruction (total)	25			15.0
timber	15			5.0
recreation (site access)	5			5.0
(interior)	5			5.0
Maintenance (total)	974			977
Trails (miles)				
Construction (total)	0			24.3
existing wilderness	0			0.7
recommended wilderness	0			1.8
concentrated rec. areas	0			9.0
open National Forest	0			1.0
OHV	0			1.8
nordic	0			10.0

Forest-wide Standards and Guidelines

Forest-wide Standards and Guidelines set the minimum resource conditions that will be maintained throughout the Forest. They provide specific guidelines for the management of each resource to ensure its protection or enhancement. They apply wherever the resource or activity occurs. More specific or additional direction may be given by Management Prescriptions or Management Area Direction.

This section displays the guidelines for managing all resources of the Forest.

Energy

- Authorize the development of wind as an energy source where development is compatible with the attainment of established Forest goals for other resources or uses.

- Authorize new hydroelectric power facilities as an energy source when development of projects will allow streamflow sufficient to maintain resident trout fisheries, maintain Visual Quality Objectives, and uphold wildlife and riparian resource objectives.

- Assure that energy conservation practices are applied to National Forest management programs.

- To the extent possible, require the use of existing roads, disturbed areas, and the co-location or clustering of energy development facilities such as roads, pipelines, powerplant and support structures.

Facilities

- Provide additions to the transportation system for resource development. Provide public access to public land and developed recreation sites, consistent with Forest goals and objectives.

- Reconstruct and regulate traffic as needed for public safety and/or resource protection.

- Address concerns for public safety and resource protection through road closure, relocation or reconstruction of non-system roads consistent with available budgets.

- Maintain facilities to established standards, make them energy efficient, and/or replace if necessary.

- Schedule facilities maintenance and replacement per the following priorities:

  1. Correct inventoried health and safety items.

  2. Accomplish annual recurrent maintenance.

  3. Eliminate inventoried maintenance backlogs.

  4. Replace condemned facilities if there is a continued need and no feasible alternatives are available. If construction funds are not available, continue rehabilitation/refurbishing work necessary to maintain facilities at habitable standards while perpetuating the life of the structure.

  5. Provide new facilities where needed.

- Consider mass transit options when vehicle use exceeds the capacity of existing roads or threatens to damage resource values or when public facilities can best be served by a community-wide system proposed by another entity.

- Provide trails for hikers, skiers, equestrians, bicyclists, snowmobilers, the handicapped, and off-highway vehicle users when compatible with user needs, level of development, and Forest goals and objectives.

- Maintain trails to assigned maintenance levels.

- Coordinate trail construction, rerouting, improvement, and maintenance with cooperating or affected agencies.

- Separate incompatible trail uses where feasible.

- Utilize existing developed facilities, roads, and trails for both summer and winter recreation activities, whenever possible, before developing new ones for exclusive seasonal use.

Fish

Threatened and Endangered Fish

- Rehabilitate and maintain essential habitat for these species according to species' recovery plans and Memoranda of Understanding with the California Department of Fish and Game and the U.S. Fish and Wildlife Service.

- Provide high quality habitat for threatened and endangered fish species based on the results of habitat capability model analyses.

- Manage all stream reaches of essential habitat as depicted in the Recovery Plan to the following guidelines in consultation with the U.S. Fish and Wildlife Service.

  1. Do not allow any activity that results in more than 10 percent degradation of the habitat within any given stream reach; this conclusion must be supported by data that results from the use of a quantitative methodology survey such as GAWS, COWFISH, etc.

  2. Restore unstable or eroding streambanks to attain a streambank system that is no more than 10 percent unstable at any given time.

  3. Retain vegetation adjacent to perennial streams that affords stream shading and streambank stability.

Fisheries

- Provide medium- to high-quality habitat for resident fish species based on the results of the appropriate habitat capability model.

- Manage all stream reaches of all state designated wild trout waters according to the following:

1. Any activity that results in trampling and chiseling should not exceed 10 percent of any given stream reach. A reach is defined as a continuous portion of a stream with homogeneous physical characteristics. Use the current situation as documented in the Final Environmental Impact Statement (EIS) as a reference point.

2. Restore unstable or eroding streambanks to attain a streambank system that is no more than 10 percent unstable at any given time.

3. Streamside vegetation should provide a minimum of 90 percent of the habitat's capability to provide stream shading and fish cover.

- Manage all stream reaches containing resident fish according to the following:

  1. Any activity that results in trampling and chiseling should not exceed 20 percent of any given stream reach. Use the current situation as documented in the EIS as a reference point.

  2. Restore unstable or eroding streambanks to attain a streambank system that is no more than 20 percent unstable at any given time.

- Prohibit stream-modifying construction activities within or immediately adjacent to the aquatic zone during the following spawning seasons:

  1. in streams with spring spawning species (rainbow, cutthroat, and golden trout), February 15-August 20;

  2. in streams with fall spawning species (brown and brook trout), October 1-April 15.

  Exceptions to (1) and (2) above must be approved by the Forest Supervisor.

- Design stream crossings to accommodate fish passage where proposed roads and trails will cross streams that support active or potential fisheries.

- Maintain instream flows needed to support existing resident fisheries.

- Maintain water levels in reservoirs and natural lakes to support fisheries to at least existing levels.

- Negotiate with the Federal Energy Regulatory Commission (FERC) and the affected utility companies to rewater selected reaches of streams for the re-establishment of resident trout fisheries.

- Coordinate with the California Department of Fish and Game to establish standards for viable populations and tolerable levels of depletion for resident fish species.

Geology

- Design and construct structures or facilities located near active faults and/or areas of known seismic activity to withstand seismic impacts. Relocate structures or facilities to less active sites where design and construction is not economically efficient.

- Conduct on-site geologic investigations prior to surface or vegetation-disturbing activities on lands mapped as highly or extremely unstable on Forest geologic resource inventory maps. Assess the feasibility of mitigation measures and include stability mitigation measures in project operating plans and design specifications.

- Make a slope suitability examination based on sheer strength/sheer stress relationships before constructing roads or other permanent developments in areas that are a hazard because of instability.

- Cooperate with other agencies, where appropriate, in identifying geologic hazards in areas of existing roads or facilities and assess the feasibility of implementing hazard mitigation measures.

- Wherever appropriate, include information explaining local geology or interesting geologic features in interpretive displays, publications, and interpretive programs.

Hardwoods

- Protect the integrity of the hardwood ecosystem in all existing oak stands.

Lands

Electronic Sites

Fully develop existing sites before authorizing new sites. Authorize new sites or expand existing sites only after analysis indicates such use is compatible with Forest goals and objectives.

Landownership Adjustments

- Acquire lands by exchange, purchase, or donation in the following priority:

  1. Highest priority:

     a. lands with water frontage such as lakes, streams, floodplains, wetlands, and riparian zones;

     b. key game management areas and lands having endangered or threatened fish, wildlife, or plant habitat;

     c. lands needed to reduce fire risks;

Special Uses

- Issue special use permits only if private land suitable for the use is not reasonably available and if the use is compatible with established Forest goals and objectives.

- Apply the following priority when evaluating special use permit applications:

  1. public uses (governmental)

  2. semi-public uses

  3. private (exclusive) uses.

- Issue no special use permits on lands identified for exchange when this would reduce future exchange opportunities.

Utility Corridors

- Participate in the Eastern Sierra Interagency Utility Corridor Study to identify an east/west corridor designation.

Withdrawals

- Review existing withdrawals and recommend revocation when the purposes for which the withdrawals were established no longer exist or can no longer be administratively accomplished.

- Initiate Forest Service withdrawals for new sites only when other available surface use and occupancy controls cannot protect the surface resources.

Minerals

Minerals Management: General

- Administer mining laws and regulations to permit the uninterrupted production of minerals while assuring the adequate protection of other resources and environmental values.

- Where valid existing rights within withdrawn areas are exercised, operating plans should be consistent with the purpose of withdrawals.

- Coordinate the mineral management program with the Bureau of Land Management.

Leasable Minerals: Oil, Gas, and Geothermal

- Provide for the leasing of National Forest lands for exploration and development of oil, gas and geothermal resources commensurate with other resource values. Follow existing Memoranda of Understanding between the Bureau of Land Management and the Forest Service that relate to oil, gas, and geothermal mineral activities. Follow applicable regulations, operating orders, and notices for oil, gas, and geothermal leases issued pursuant to appropriate authority.

- Prepare environmental documents that analyze full-scale development prior to consenting to Bureau of Land Management's issuance of geothermal leases.

- Prepare postlease environmental documents in cooperation with the Bureau of Land Management for site-specific exploration, development, and production proposals. Assure that impacts to resources are appropriately analyzed. Assure that impacts to these resources are mitigated to the extent possible.

- Consider the location of fluid conveyance lines and facilities for geothermal development to ensure the viability of deer migration corridors. Encourage geothermal development that utilizes air cooling rather than evaporative cooling systems.

Leasable Minerals: Other

- Provide for leasing National Forest System lands for the exploration and development of minerals, commensurate with other resource values, as specified under the Minerals Leasing Act of 1920 and the Minerals Leasing Act for Acquired Lands of 1967. This includes hardrock minerals. Follow applicable laws and regulations.

Locatable Minerals

- Allow all National Forest System lands not specifically withdrawn from mineral entry to be available for mineral exploration, location and extraction under applicable laws and regulations.

Saleable Minerals

- Utilize common variety minerals, e.g., sand, gravel, and borrow material without encroaching upon other resource values. Encourage the use of materials that are available from the private sector where possible.

- Provide for the sale of common variety minerals when such action will not cause unacceptable damage to the surface resources. This includes impacts on surface-based access.

Pest Management

- Coordinate pest control programs with the U.S. Fish and Wildlife Service, the California Department of Fish and Game, the California Department of Health Services, other federal, state, and local agencies, and private sector groups as needed.

- Follow an Integrated Pest Management approach to managing pests during the planning and implementation of all appropriate activities, particularly those that influence vegetation. Consider and analyze, on a site-specific project basis, a full range of pest management alternatives that include cultural, biological and mechanical methods. Select treatment methods through the environmental analysis process that consider the environmental effects, treatment efficacy, and cost effectiveness of each alternative. Determine monitoring and enforcement plans to implement specific measures during this site-specific process. Pest detection, surveillance, evaluation, prevention, suppression, and post-action evaluation are integral components of this Integrated Pest Management approach.

- Treat green pine stumps that are eight inches and larger in diameter with borax to minimize the aerial spread of annosus root disease in stands that are managed for timber production. Treat all green conifer stumps with borax in areas managed with a concentrated/developed recreation emphasis.

Protection

- Implement a fire management program consisting of: 17 percent prevention and detection, 83 percent suppression and aviation, and the application of all appropriate wildfire suppression strategies (confinement, containment, and control).

- Use Prescriptions and Management Area Direction and fire management action plans when determining the appropriate wildfire suppression strategy.

- Use prescribed fire as a management tool.

- Consider both existing conditions and the effect of future management activities in the area surrounding the project area when developing treatment standards for fuels.

- Coordinate with local fire districts in the development of major new structural facilities on National Forest lands.

- Allowable burned acre objectives for specific areas will be determined in the preparation of fire management area plans.

- The Forest Service mission in fire management is to use fire as a resource management tool.

Range

- Develop range resources to their reasonable potential and manage them for sustained yields.

- Provide grazing tenure to lend stability to the local livestock-raising community and established ranching operations.

- Manage grazing allotments according to a planned management system.

- Use repeated treatments, if necessary, to establish vegetation on fill material where bridges or culverts cross streams.

- Heavily armor the streambed both upstream and downstream from each road, trail, and livestock path crossing that has neither a bridge nor a culvert. Give highest priority to streams that contain threatened or endangered trout species and watersheds that provide domestic water supplies.

- Use the following spacing of cross-drains on unsurfaced roads as a guide:

Road Gradient (%)	Spacing (feet)
1-3	1,200
4-6	700
7-9	400
10-14	250
15-20	120

- Outslope unsurfaced roads and trails where user safety and designed use are not jeopardized.

- Avoid creating berms that hinder drainage on low gradient roads.

- Revegetate roads and trails when use is terminated.

- Return all lands in declining watershed condition to equilibrium.

Wild and Scenic Rivers

- Develop management plans in conjunction with the Sequoia National Forest for the newly designated North Fork of the Kern and South Fork of the Kern Wild and Scenic Rivers.

- Undertake no management activities that would preclude designation of the Middle Fork of the San Joaquin River as a Wild and Scenic River.

Wilderness

- Develop management plans or amend existing plans to address wilderness designated by the California Wilderness Act of 1984 or any wilderness legislation enacted during the planning period.

- Manage wilderness under the following guidelines: maintain a predominantly natural and natural-appearing environment, facilitate low frequencies of interaction between users, and exercise necessary controls primarily from outside the wilderness boundary. Any on-site controls should be subtle.

Wildlife

Threatened, Endangered, and Sensitive Animal Species

- Consider threatened and endangered species as below viability until recovery is achieved. Emphasize the protection and improvement of habitat for threatened or endangered wildlife. Manage for the protection and enhancement of all historically and potentially threatened or endangered species habitat as necessary to meet recovery levels.

- Cooperate with the Fish and Wildlife Service and California Department of Fish and Game in the management of threatened and endangered species and the restoration of habitat. Submit proposals for actions that might affect the continued existence of a threatened or endangered species to the U.S. Fish and Wildlife Service for formal consultation.

- Develop and implement a consistent, systematic, biologically sound strategy to manage sensitive species and their habitats so that federal listing does not occur.

- Permit scientific studies on sensitive species only if the studies would benefit the species.

Management Indicator Species

Management Indicator Species are those that the Forest identified for one or more of the following reasons: federally designated threatened or endangered species; sensitive species; harvest species; ecological indicator species; or special interest species.

Populations of species in these categories will be maintained at viable levels. These Standards and Guidelines apply to existing and potential habitats for these species.

Carnivores (State-listed or Sensitive): Sierra Nevada red fox, pine marten, fisher, wolverine

1. Inventory project areas where development or habitat alteration projects could alter habitats required by these species.

2. Maintain the integrity of habitats required by these species. Manage known habitats to ensure that breeding and adjacent foraging habitats are maintained.

Mule deer (Harvest)

1. Maintain or enhance the integrity of key winter ranges, holding areas, migration routes, and fawning areas for mule deer. Although management activities may allow for some alteration of their habitat, the goal is to maintain deer habitat to support deer population levels consistent with deer herd management objectives.

- Design vegetative treatment units on summer, winter, and transition ranges so that the distance from forage to cover does not exceed six hundred feet.

- Recognize the sensitivity of infringement on known key mule deer fawning areas during the critical fawning period from June 15 to July 15. Resolve conflicts in favor of fawning areas.

- Manage summer and transition ranges for each herd to provide a thermal cover to forage ratio between 20:80 and 80:20 on each area.

- Develop water sources where water is needed and opportunities are available.

- Coordinate with Caltrans and the counties to provide the safest possible road crossings for mule deer.

2. Recognize the importance of key deer habitats. Emphasize the protection of critical deer habitat when analyzing development proposals.

3. Determine forage allocation for deer on the basis of five pounds of forage per deer per day (6.5 deer per AUM).

4. Coordinate with California Department of Fish and Game in implementing existing deer herd plans. Cooperate with the Department of Fish and Game in the preparation of needed additional deer herd plans.

<u>Bald eagle (Endangered)</u>

1. Manage for recovery. Recovery may require the management of potential sites as well as occupied sites.

2. Use the presence of bald eagles and results of the habitat capability model for the species to establish the existing and potential wintering areas including winter roosts, foraging areas, and daytime perches.

3. Maintain the integrity of existing wintering areas. Do not establish new winter uses or recreation developments within one-quarter mile of such areas.

4. Maintain and enhance fish, waterfowl, and other prey-base populations within winter foraging areas where opportunities exist.

5. Implement the Pacific States Bald Eagle Recovery Plan. Prepare a local winter bald eagle management plan that tiers to the Pacific States Plan.

Golden eagle and prairie falcon (Special Interest)

1. Maintain or enhance the integrity of nesting habitats for golden eagles and prairie falcons.

   - Limit human disturbance within one-quarter mile of nest sites from February 1 through June 30.

   - Provide for several successional stages and vegetation types within five miles of nest sites.

   - Provide artificial ledges on cliffs where the lack of ledges is a limiting factor.

Tule elk (Special Interest)

1. Follow the direction of the Tule Elk Management Plan for the Owens Valley.

Peregrine falcon (Endangered)

1. Implement the Pacific Coast American Peregrine Falcon Recovery Plan prepared by the U.S. Fish and Wildlife Service.

2. Establish two nesting pairs of peregrine falcons.

Goshawk (Sensitive)

1. Maintain a density of at least one goshawk territory per eighteen square miles within goshawk habitat range. Distances between territories or clumps of territories will not exceed twelve miles. Goshawk habitat range is defined as an area containing active or potential nesting habitat as defined below.

2. Maintain at least one hundred acres of mature timber per territory to provide suitable conditions for the nest stand and an alternate nest stand. If the nest stand and an alternate nest stand are known, delineate at least fifty acres around each stand. If only the nest stand is known, delineate either one hundred acres around the nest stand or at least fifty acres around the nest stand and, within a half-mile radius, at least fifty acres around a potential alternate nest stand. Ensure that replacement stands are incorporated in territories.

3. Give preference to currently active nest territories when delineating a population network.

4. Include the following elements in potential goshawk habitat or territories retained to assure species viability: (a) five or more vegetation types and three or more seral stages within two miles of the nest stand; (b) at least 40 percent canopy cover; (c) a water source within one-quarter mile of the nest stand; and (d) a nest stand location on a slope of less than 20 percent.

5. Locate territories in areas classified as unsuitable for commercial timber management wherever possible.

6. Exclude timber activities within occupied nest stands during the nesting period. Timber activities during other time periods should be limited to those activities that meet the habitat variables associated with suitable habitat in the Forest's goshawk habitat capability model.

Blue grouse (Harvest)

1. Maintain or enhance blue grouse habitat by protecting vegetative diversity, riparian habitat, and down logs.

Sage grouse (Harvest)

1. Maintain a shrub canopy cover of at least 20 percent on at least 30 percent of vegetation treatment areas within six miles of known strutting grounds (leks).

2. Allow no vegetative treatment in sage grouse habitat that would have a significant negative impact on this species.

3. Recognize the sensitivity of sage grouse leks during the period from March 1 and April 30. Resolve conflicts in favor of sage grouse.

4. Cooperate with the California Department of Fish and Game in reintroduction efforts.

Spotted owl/Great gray owl (Sensitive)

1. Conduct periodic inventories. If spotted owl pairs are located, manage their habitat as needed to maintain natural distribution on the Forest.

2. If great gray owls are documented, maintain foraging and nesting habitat where management activities could alter their habitat.

Sierra Nevada mountain sheep (Sensitive) and Nelson mountain sheep (Special Interest)

1. Maintain existing mountain sheep habitat. Where feasible, expand their ranges by transplanting animals to suitable unoccupied habitats as per the criteria stated in the Sierra Nevada Mountain Sheep Recovery Plan.

2. Permit no increase in existing livestock use if the increase is shown to be deleterious to mountain sheep populations as defined in the Recovery Plan.

3. Maintain the health of established mountain sheep populations. If disease transmission from domestic livestock is shown to be deleterious to mountain sheep populations, find ways to alleviate this problem.

Management Prescriptions

Management Prescriptions specify how all the Forest resources will be managed to emphasize a specific resource. Each prescription has a different resource emphasis. Several prescriptions may be implemented within one Management Area, depending on the resources and use of the area.

This section describes the purpose of each prescription, what the resource emphasis will be and where the prescription will be applied. It displays direction for management of each resource. There are eighteen prescriptions that will be implemented.

Designated Wilderness (#1)

The purpose of this prescription is to protect wild lands and their wilderness values of natural ecological integrity and natural appearance.

The emphasis is on providing opportunities for solitude, challenge, and primitive recreation.

This prescription applies to the existing Ansel Adams, Hoover, Golden Trout, John Muir, South Sierra, and any Wilderness designated by Congress during the planning period.

Element	Management Direction
Air Quality	Monitor air quality on Class I airsheds to detect degradation. Recommend abatement measures after Air Quality Related Values and indicators are determined.
Cultural Resources	Protect significant cultural properties by limiting or distributing use.
Energy	Permit no new energy developments.
Facilities	Allow no road construction.
	Manage the trail system as determined in the management plan for each wilderness. Maintain trails to assigned maintenance levels.
	Mount signs to be unobtrusive and not detract from the surrounding natural environment. Sign only as needed for progressive travel. Do not sign features other than passes.
	Use fords at stream crossings unless a bridge is needed for safety or route connection. Construct needed bridges using materials and methods that will best preserve wilderness values.
	Emphasize the use of native materials when designing resource protection improvements.
	Allow snow survey cabins to remain in wilderness only if essential for the safety of surveyors. Remove snow survey cabins after the associated survey sites have been correlated with, and replaced by, sites outside wilderness. Make exceptions if a cabin is needed for safe long-distance travel to a site that is still in use.

Where a demonstrated need is identified, allow automatic snow survey instrumentation and temporary seismic stations in wilderness with the condition that the facilities will be periodically evaluated for need. When the instruments are no longer needed, the facilities would be removed and the site restored to as near a natural condition as possible.

Fisheries

Allow aerial fish stocking in wilderness if it avoids impacts on visitors and involves only lakes that were aerially stocked before the affected wilderness was legislatively designated. Licensed fishing is allowed.

Geology

Consider the risk from landslide and seismic processes when locating new trails. Provide information on these risks to wilderness users.

Lands

Attempt to acquire all private land inholdings.

Minerals

Determine the validity of existing mining claims when a plan of operations is submitted. Subject to valid existing rights, designated wilderness areas are withdrawn from further mineral entry.

Administer operating plans to protect wilderness values and grandfathered valid existing rights.

Allow no mineral leasing, including geothermal leasing, in designated wilderness.

Permit no sales or extraction of common variety minerals in designated wilderness.

Pest Management

Allow insect and disease infestations to run their natural courses except where it is necessary to prevent unacceptable damage to resources on adjacent lands or to prevent unnatural loss to the wilderness resource because of exotic pests.

Protection

Use the fire suppression strategies of confinement, containment, or control for management of unplanned natural fires. Control all unplanned human-caused fires.

Obtain approval prior to emergency use of the following suppression activities: Regional Forester approval for tractor use and/or for heliport construction; Forest Supervisor approval for helispot construction, retardant application other than short-term or fugitive-dye, wheeled vehicles, generators, or chain saws (unless for direct suppression).

Apply low-impact suppression tactics such as reliance upon natural barriers unless more direct attack is needed to protect persons or adjacent property values. Favor the use of water over land disturbance. Favor cold-trailing over handline construction.

Mitigate temporary fire camps, helispots, evidence of vehicles, and other disturbances created by emergency fire suppression activities.

Use prescribed fire (planned ignitions only) to reduce the risks and consequences of wildfire within wilderness or escaping from wilderness to an acceptable level.

Range

Administer the range grazing program as defined by Forest Service Manual 2323.2 (Wilderness) and Forest Service Manual 2200 (Range).

Allotment Management Plans (AMPs) will consider recreational stock grazing.

Recreation

Distribute publications to wilderness users that emphasize wilderness regulations, etiquette, and health and safety considerations including fire safety.

Allow the dispersed recreation activities appropriate to Primitive and Semi-Primitive Non-Motorized Recreation Opportunity Spectrum (ROS) classes. Allow no off-highway/over-snow (OHV/OSV) vehicle use.

Emphasize minimum impact camping techniques when interacting with wilderness users or developing informational handouts.

Require that campsites be located one hundred feet or more from lakeshores, trails and streams where terrain permits, but in no case closer than twenty-five feet.

Advocate and enforce the pack-it-in, pack-it-out program for trash.

Prohibit discharge of firearms except for emergencies, or for taking wildlife as permitted under state game laws.

Prohibit wood fires in areas that are environmentally sensitive or where wood is scarce.

	Allow loose herding of pack and saddlestock only where trail conditions make it unsafe to tie stock together.
	Prohibit overnight picketing or tethering of stock in meadows. Require that stock tied overnight be tied to hitch lines on hard sites.
	Require that feed for recreation stock be packed into the wilderness under the following conditions: before the grazing season, where feed is unavailable, or where grazing would damage natural resources.
	Prohibit tying of stock within one hundred feet of water, trails, or campsites except when loading or unloading. When loading or unloading, tie stock only to trees eight inches in diameter or larger.
	Issue no new permits for pastures or stock packing services in the Ansel Adams, Hoover, John Muir, or Golden Trout Wildernesses. Allow for a transfer permit when ownership changes or permits are renewed if continued use is compatible with wilderness management objectives.
	Emphasize the number of wilderness rangers during the restricted season in heavily used, popular areas to maximize personal contacts with wilderness users.
Threatened, Endangered, or Sensitive Species	Protected sites of threatened, endangered, or sensitive plants and animals by restricting or redirecting use.
Timber	Allow no timber harvesting.
Visual Resources	Meet the Preservation Visual Quality Objective (VQO).
Watershed	Permit weather modification as long as effects on climate, wilderness use seasons, and other resources are acceptable.
	Incorporate the Forest Watershed Improvement Needs Plan while protecting wilderness values.
	Educate the public with regard to Giardia.
Wild and Scenic Rivers	Incorporate both wild and scenic river management direction and wilderness management where a designated river segment extends into designated wilderness.

Wilderness

Establish capacity limits for each wilderness and implement entry limits on specific trailheads to regulate use when use exceeds capacity.

Establish the season during which entry limits will apply. The restricted use season may vary from one trailhead to another.

Redirect or restrict use where necessary to restore impaired wilderness resources.

Limit party size and number of stock per party to a level that protects social and natural resource values. The level may vary within or between wildernesses.

Apply trailhead entry quotas to both commercial and noncommercial users.

Determine the current level of noncommercial and commercial backpacking and mountaineering use. Establish an appropriate level for these types of use.

Apply quotas on the Pacific Crest Trail to only those travelers who begin their trip at a trailhead with quotas.

Prohibit wheeled mechanical devices including, but not limited to, bicycles, wagons, and carts except those needed for administrative purposes or for use by physically handicapped persons under special permit.

Construct no benches, tables, or shelters.

Allow plant collection and scientific research under permit on a case-by-case basis.

Require the removal of airplane wreckage by owner or insurance company.

Notify the appropriate military authority of low-level flights over wilderness until flights cease. Coordinate with the Federal Aviation Administration to update wilderness boundaries on flight charts.

Limit commercial wilderness activities under permit to those that meet public needs and cannot be provided elsewhere.

Permit no competitive type events in wilderness.

Wildlife	Protect the integrity of natural ecological processes by restoring those processes that have been altered by human activities. Protect key habitat for Management Indicator Species by limiting or distributing use. Manage mountain sheep habitat to maintain and/or enhance carrying capacity. Relocate existing or construct new recreation trails only in areas where the trails will not cause significant adverse effects upon the use by mountain sheep of their habitat. Identify and provide for this sensitivity in the appropriate wilderness management plan. Licensed hunting is allowed.

Proposed Wilderness (#2)

The purpose of this prescription is to recognize and protect wilderness attributes of Further Planning Areas recommended for wilderness pending Congressional designation.

The emphasis is on providing traditional public uses during the interim that do not jeopardize designation as wilderness.

This prescription applies to the Table Mountain and Tioga Lake Further Planning Areas and portions of the White Mountains and Paiute-Mazourka Further Planning Areas. These total approximately 172,600 National Forest System acres.

Element	Management Direction
Air Quality	Maintain Air Quality Related Values.
Energy	Permit no new energy developments or leases.
Facilities	Allow no road construction or reconstruction. Maintain, reconstruct, or construct trails on the current inventory according to established Forest-wide priorities. Retain other facilities if desired, but do not expand them.
Fisheries	Continue current management, including aerial fish stocking and habitat improvement to the extent that wilderness values are not adversely affected. Licensed fishing is allowed.
Lands	Consider the acquisition of private lands inside the proposed wilderness boundary on a Forest-wide priority basis. Allow special uses to continue, but not to expand. If a current permit terminates or expires, a new permit will only be issued on an annual basis.
Minerals	Determine the validity of existing mining claims when a plan of operations is submitted. Administer operating plans to protect inherent wilderness attributes and grandfathered valid existing rights. Allow no mineral leasing, including geothermal leasing, in proposed wilderness. Permit no sales or extraction of common variety minerals in proposed wilderness.

Mule Deer Habitat (#4)

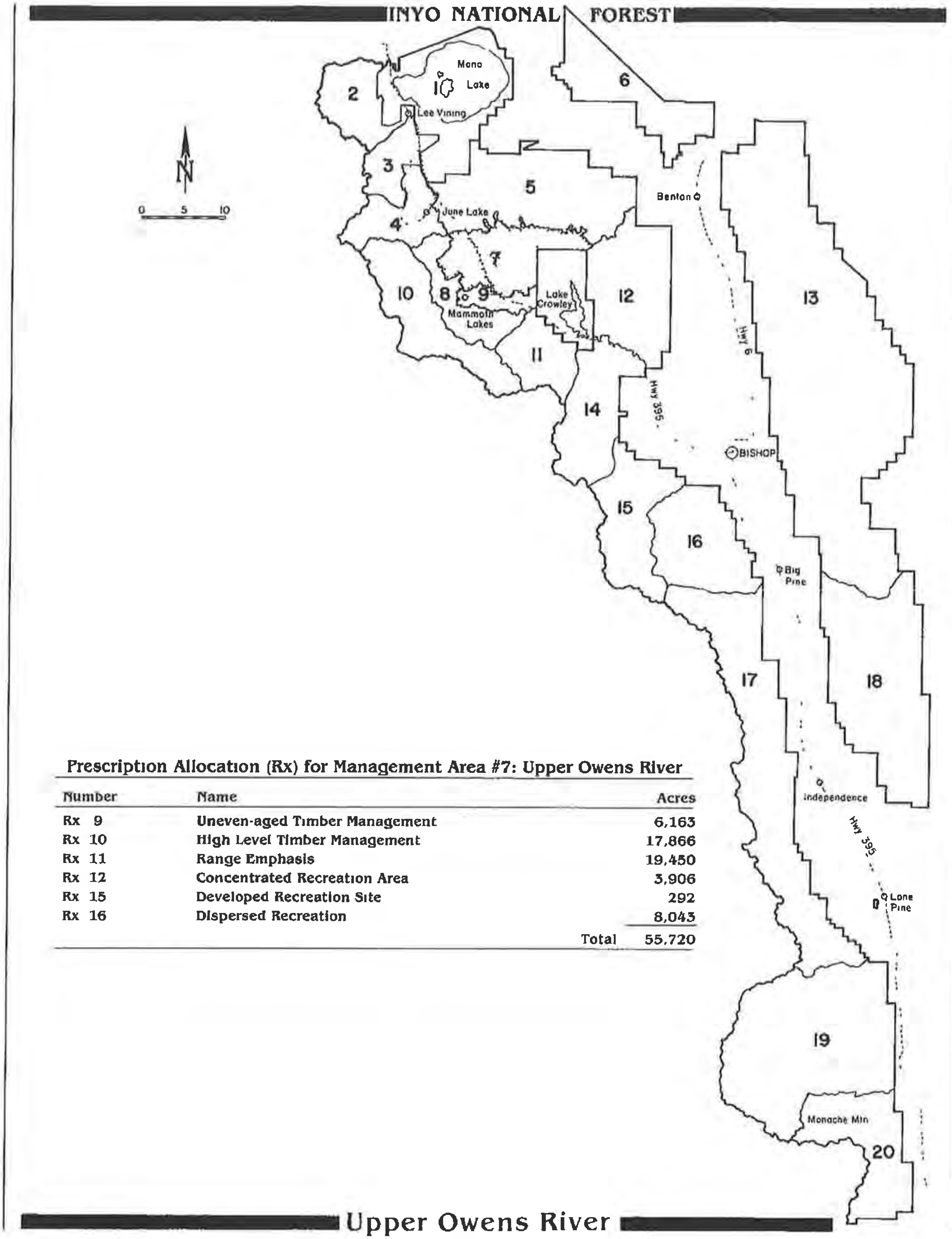
The purpose of this prescription is to preserve or enhance key mule deer habitat in order to maintain or increase existing population levels.

The emphasis is on key mule deer habitat, fawning areas, winter range, migration corridors, and holding areas. Other management activities will be prohibited or reduced if they present unresolvable conflicts in these key areas.

Element	Management Direction
Energy	Recommend in favor of energy development where development is determined to be compatible with wildlife values. Recommend against energy development where impacts to wildlife values cannot be mitigated or are unacceptable.
Facilities	Locate trails and manage their use so they do not conflict with mule deer habitat. Do not establish roads or heliports where they would conflict with mule deer.
Minerals	Work with claimants and mineral operators to limit mineral exploration/development activities within mule deer migration corridors during migration periods, within key fawning areas, and on key winter range if it is determined on a project-specific basis that mineral operations would affect mule deer usage of these habitats.
Protection	Use the fire suppression strategies of confinement, containment, or control for management of unplanned natural fires. Control all unplanned human-caused fires. Prescribed fire may be used for habitat improvement.
Range	Manage livestock Animal Unit Months (AUMs) on key deer winter range and other critical habitats such as migration routes, holding areas and fawning areas according to objectives of the Deer Herd Management Plans approved jointly by the Forest, the Bureau of Land Management and the California Department of Fish and Game.
Recreation	Design new development so that the integrity of mule deer staging areas, migration corridors and key habitat is maintained. Allow the dispersed activities appropriate to Primitive, Semi-Primitive Non-Motorized, Semi-Primitive Motorized and Roaded Natural ROS classes. OHVs are permitted on

	existing designated roads and trails unless otherwise restricted. OSVs are prohibited unless otherwise indicated on the Winter Motor Vehicle Use Map.
Riparian Areas	Improve riparian areas where necessary to enhance fawning habitat.
Timber	Leave vegetation necessary for thermal and hiding cover.
Visual Resources	Meet or exceed the Partial Retention VQO.
Wildlife	Maintain habitat quality in key fawning areas, winter range, holding areas, and key migration routes. Manage vegetation on key habitat areas for optimum forage-to-cover ratios. Manage the remaining non-key winter range to provide the composition and seral stages of preferred brush species that will meet the dietary needs of mule deer. Restrict vehicular access as necessary to protect deer winter range, holding areas, and known key fawning areas. Coordinate with Bureau of Land Management's Benton-Owens Valley Management Framework Plan for seasonal road closure dates to benefit mule deer.

MANAGEMENT AREA # 7



Prescription Allocation (Rx) for Management Area #7: Upper Owens River

Number	Name	Acres
Rx 9	Uneven-aged Timber Management	6,163
Rx 10	High Level Timber Management	17,866
Rx 11	Range Emphasis	19,450
Rx 12	Concentrated Recreation Area	3,906
Rx 15	Developed Recreation Site	292
Rx 16	Dispersed Recreation	8,043
	Total	55,720

MANAGEMENT AREA #7

Upper Owens River

Upper Owens River (#7)

Description

The Upper Owens River Management Area is located immediately above and to the northwest of Lake Crowley. Included are the subdrainages of Deadman Creek, the Upper Owens River, Little Hot Creek, Dry Creek, and portions of Hot Creek. Prominent features include Lookout Mountain, Deer Mountain, Smokey Bear Flat, Little Antelope Valley and the Deadman/Inyo Craters volcanic formations.

With the exception of the land immediately adjacent to the Owens River, the remainder of the area is National Forest. A small fringe of the incorporated Town of Mammoth Lakes is located in the southern portion of the area. U.S. 395 traverses in a northwest/southeast direction and is the major access to the area.

Topography is characterized by numerous small drainages with moderate side slopes and flat ridgetops. Elevation ranges from 6,960 feet in the Hot Creek drainage to 8,796 feet atop Deer Mountain. The eastern portion contains moderately rolling rangeland with sage and bitterbrush side slopes and grassy valley bottoms. Higher elevations are characterized by the Jeffrey pine forest.

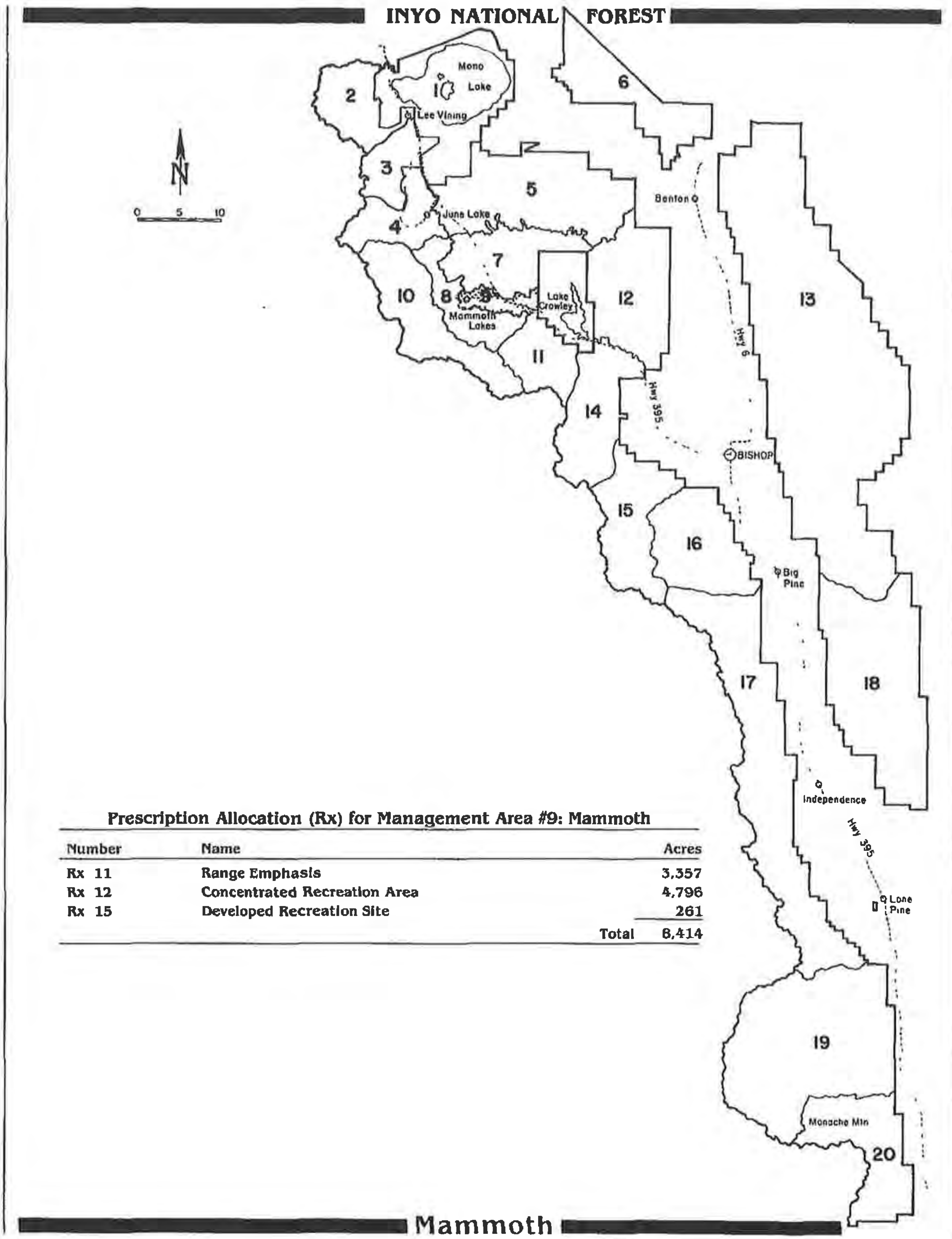
As the primary watershed for Lake Crowley, the area provides an important source for domestic water for the City of Los Angeles. The Upper Owens River is an important trout fishery.

The Management Area is within the Long Valley Known Geothermal Resource Area (KGRA). Seven lessees currently hold geothermal leases on approximately 38,190 acres of land within the Management Area. Exploration, including wells drilled to a depth of more than 6,000 feet, has been conducted by private industry and the scientific community. There is one operating 10 megawatt powerplant on private land within the Management Area. Commercial developers have applied to Mono County for the rights to build two additional power plants on private land. Commercial developers have applied to the Bureau of Land Management to build a single power plant on National Forest System land.

All or part of seven grazing allotments are located in the management area. Recreational use is primarily of a dispersed nature. The Inyo Craters, a popular day-use site, focuses on the interpretation of geologic history. Deadman, Lower Deadman, Glass Creek, and Big Springs Campgrounds provide overnight camping facilities.

Timber stands include nearly pure red fir; mixed stands of red fir, white fir, lodgepole and Jeffrey pine; pure stands of lodgepole; and a pure stand of Jeffrey pine. Because of logging activity, numerous single-lane and two-lane dirt and gravel roads bisect the area. Logging debris and dead and down wood form an important source of firewood for the adjacent Town of Mammoth Lakes and numerous other communities as far south as Lone Pine, California. There is commercial fuelwood harvesting on the area.

MANAGEMENT AREA #9

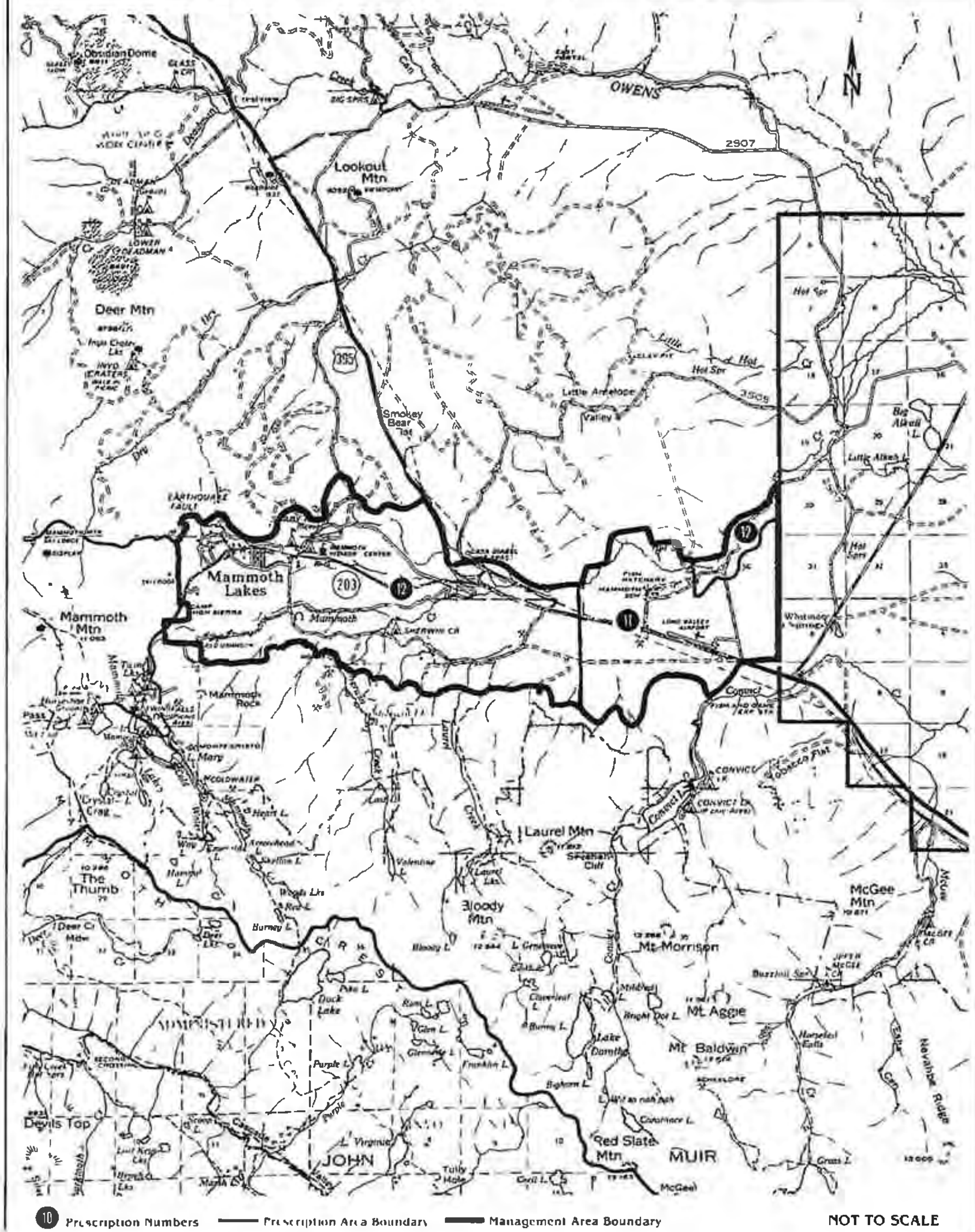


Prescription Allocation (Rx) for Management Area #9: Mammoth

Number	Name	Acres
Rx 11	Range Emphasis	3,357
Rx 12	Concentrated Recreation Area	4,796
Rx 15	Developed Recreation Site	261
	Total	8,414

MANAGEMENT AREA #9

Mammoth



Mammoth (#9)

Description

The Mammoth Management Area contains private land within the Town of Mammoth Lakes, National Forest System land, and land owned by the City of Los Angeles. The Mammoth/June Lake Airport, Hot Creek Fish Hatchery, Hot Creek, and Sherwin Creek Campground are important features in this Management Area.

The area contains the administrative facilities of the Mammoth Ranger District. Facilities include a major visitor center and District Office complex, a warehouse building, a housing area with six government-owned houses and fifteen trailer pads for private house trailers, a grazing pasture and tack facilities.

Topography is predominately moderately rolling terrain in the Mammoth Creek drainage. The western portion of the area contains red fir and Jeffrey pine forest, with the eastern portion comprised primarily of a grass/bitterbrush/sage vegetative type.

Recent land exchange efforts have consolidated land ownership within the Town of Mammoth Lakes leaving only two parcels of National Forest System lands remaining in the Town. These lands are identified as the Shady Rest and Woodstock parcels. Land exchange efforts in the past have been oriented primarily toward consolidation of ownership and providing lands for community needs such as school and hospital sites, industrial park sites for community and private needs, and land for affordable housing development. Because of the current growth emphasis of the newly incorporated Town, it is anticipated that future land exchanges will be proposed by the community to seek to provide amenity facilities in support of the current destination resort philosophy.

Because of the proximity to the Town of Mammoth Lakes, many National Forest land uses are directly related to the support of this popular resort community. Uses include the facilities of the Mammoth County Water District, Southern California Edison major power transmission lines, the Mammoth/June Lake Airport, Continental Telephone communication facilities, a community park, and the Hot Creek Fish Hatchery operated by the State of California. In addition to the private land, the City of Los Angeles also owns several parcels in the eastern portion of the area.

The area contains portions of two grazing allotments.

The area is important as a mule deer migration route and staging area in the fall and spring.

Recreation use is heavy at Sherwin Creek Campground, Shady Rest and Old Shady Rest Campgrounds immediately adjacent to the Town of Mammoth Lakes, and at Earthquake Fault Interpretive Site. Heavy dispersed use also occurs along Mammoth Creek and on Forest lands immediately adjacent to private land in the Town. Hot Creek Interpretive Site, a popular day-use area, focuses on the interpretation of the geologic resource.

Base Lodge II and the proposed Base Lodge VII, important access points for the Mammoth Mountain Ski Area, are also located within the Management Area. Because of its proximity to the proposed Sherwin Bowl Ski Area, the western portion of the unit will play an important part in the development of base and other complementary facilities if Sherwin Bowl is developed.

The visual corridors along U.S. 395, a designated scenic highway, and State Route 203, the primary entry point for the Town of Mammoth Lakes, are important viewsheds to the traveling public.

Management Area Direction

Cultural Resources

- Maintain and enhance cultural resource interpretive sites such as Mammoth Creek cabin, VIS cabin, Indian Caves.

Facilities

- Allow development of new ski base areas commensurate with local transportation system planning.

Fish

- Maintain productivity of the Hot Creek fishery in Section 25, Township 3 South, Range 28 East.

- Maintain resources affecting Hot Creek Fish Hatchery.

- Study Laurel Pond for introduction of fish in coordination with California Department of Fish and Game.

- Manage according to Hot Creek Wild Trout Management Plan of 1986.

Geology

- Continue to cooperate with and coordinate geophysical exploration and research with the scientific community.

- Encourage continued geologic exploration and research relating to post-caldera formation, seismic and volcanic activity and the prediction of future seismic activity and volcanic eruptions.

- Where appropriate emphasize geothermal resources at interpretive sites or in guides that cover the area.

Lands

- Exchange Forest Service lands into the private sector for community expansion when:

  1. The most appropriate use of the National Forest lands over the long term is in the private sector;

2. State, county, local and Forest Service planning processes identify and support conveying ownership of the parcel from National Forest System status to the private sector; and

3. The use intended for the federal land being exchanged meets the intent of the current approved Community General Plan.

- Allow no federal land exchanges north of State Route 203 with the Mammoth Lakes community during this planning period.

- Present proposed developments on National Forest System lands to other governments for their comment when those governments have a vested interest in the proposal.

- Allow development on National Forest System land when it is clearly demonstrated that the infrastructure of a community can support the demands of the proposed development and benefits from development outweigh adverse impacts on the community.

Recreation

- Provide trail interface opportunities with the community of Mammoth Lakes.

- Maintain open-space areas adjacent to the Town of Mammoth Lakes for passive recreation use.

- Prohibit dispersed camping throughout the Management Area.

- Prohibit development of Shady Rest Park beyond existing perimeter roads, and north of the powerline rights-of-way.

- Allow development of Mammoth Creek Park by the Town of Mammoth.

- Identify and program the expansion potential of the Shady Rest and Sherwin Creek Campground complexes and develop as funds become available.

- Fully develop the interpretive potential of the Hot Creek geologic site as funds become available.

Visual Resources

- Develop a corridor viewshed analysis and plans that include State Route 203 and U.S. 395.

- Mitigate the visual impacts of existing major uses in the area seen from U.S. 395 and State Route 203 east of the Town, as this is the major gateway to the Mammoth area.

Water

- Allow development on National Forest System lands in the Mammoth/June area where adequate water is available after natural resource needs are met. Allow for the exploration and development of new water sources on

National Forest System lands for community purposes only when such opportunities have been exhausted on private lands.

- Support state water quality control requirements and local ordinances to mitigate adverse impacts of urban runoff onto National Forest System lands.

Wildlife

- Continue to enhance and maintain waterfowl habitat at Laurel Pond.

- Maintain the integrity of key winter ranges, holding areas, migration routes, and fawning areas for mule deer.

EXHIBIT A

Scott Cashen, M.S.—Independent Biological Resources and Forestry Consultant

January 28, 2013

Bureau of Land Management
Bishop Field Office
Attn: Collin Reinhardt
351 Pacu Lane, Suite 100
Bishop, CA 93514

Great Basin Unified Air Pollution Control District
Attn: Jan Sudoimer
157 Short Street
Bishop, CA 93514

Subject: Comments on the Draft Environmental Impact Statement and Draft Environmental Impact Report for the CD-IV Project

Dear Mr. Reinhardt and Ms. Sudoimer:

This letter contains my comments on the Draft Environmental Impact Statement and Draft Environmental Impact Report ("DEIS/DEIR") prepared for ORNI 50, LLC's ("Applicant") proposed CD-IV Project ("Project"). The Project involves the construction, operation, and eventual decommissioning of a new 33 net megawatt (MW) binary power plant. The Project also involves expanding the geothermal well field; constructing pipelines to bring the geothermal brine to the power plant and to take the cooled brine to injection wells; and installing an electric transmission line to interconnect the power plant to the Southern California Edison Substation at Substation Road.

I am an environmental biologist with 20 years of professional experience in wildlife ecology, forestry, and natural resource management. To date, I have served as a biological resources expert for over 50 projects, the majority of which have been renewable energy facilities. My experience in this regard includes assisting various clients with evaluations of biological resource issues, and testifying before the California Energy Commission and California Public Utilities Commission. My educational background includes a B.S. in Resource Management from the University of California at Berkeley, and a M.S. in Wildlife and Fisheries Science from the Pennsylvania State University.

I have gained particular knowledge of the biological resource issues associated with the Project through my work on other projects in the Sierra Nevada. The comments contained herein are based on this knowledge, as well as my review of the environmental documents prepared for the Project, a review of scientific literature pertaining to biological resources known to occur in Mono County, consultations with numerous biological resource experts, and the knowledge and experience I have acquired during more than 20 years of working in the field of natural resources management

PROJECT DESCRIPTION

The DEIS/DEIR Lacks a Decommissioning Plan

The Applicant has yet to provide a Decommissioning Plan (also referred to as a Site Abandonment-Reclamation Plan) for the Project. Indeed, it is unclear when such a plan would be prepared. In one instance the DEIS/DEIR indicates the plan would be prepared prior to operation of the Project, whereas in other instances it indicates the plan would not be prepared until the end of power plant operations.[1] I9-75

Returning the Project site to pre-development conditions will require a dedicated effort that removes any degrading factors (e.g. soil erosion or contamination) and repairs the physical and/or chemical environment (as needed). The actions that are required to accomplish these tasks have the potential to cause significant impacts to biological resources. Because decommissioning is an anticipated phase of the Project, the Bureau of Land Management ("BLM") and the Great Basin Unified Air Pollution Control District ("GBUAPCD") must describe decommissioning activities so that Project impacts and the mitigation proposed in the DEIS/DEIR can be properly evaluated. I9-76

EXISTING CONDITIONS

The BLM, USFS, and GBUAPCD Do Not Have the Data Needed to Evaluate Project Alternatives

The BLM and U.S. Forest Service ("USFS") have identified Alternative 3 as the Preferred Alternative, and the GBUAPCD has identified Alternative 3 as the environmentally superior alternative.[2] The DEIS/DEIR indicates Project Alternatives 1, 2, and 3 would all have similar impacts on biological resources.[3] The BLM and GBUAPCD do not appear to have the basis for these conclusions because site-specific studies have not been conducted for Alternative 3, and they have not been completed for Alternative 2.[4] I9-77

The DEIS/DEIR's Description of the Jeffrey Pine Vegetation Community Is Too Vague to Understand Existing Conditions and Habitat Suitability for Sensitive Species

According to the DEIS/DEIR, wildlife habitats were categorized using the CDFG's *A Guide to Wildlife Habitats* (Mayer and Laudenslayer 1988).[5] This statement is not reflected in the habitat descriptions provided in the DEIS/DEIR. Mayer and Laudenslayer (1988) identify 24 distinct habitat stages of the Jeffrey Pine vegetation I9-78

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[1] DEIS/DEIR, pp. 2-45, 4.3-8, 4.8-6.
[2] *Ibid*, p. 2-74.
[3] *Ibid*, Table 2-4.
[4] *Ibid*, Table 3.3-1.
[5] *Ibid*, p. 3.4-2.

community.[6] The DEIS/DEIR does not describe the habitat on the Project site according to this classification system. Instead, the DEIS/DEIR's description of the Jeffrey Pine vegetation community (one of the two dominant vegetation communities in the Project are) is limited to the statement that:

> Jeffrey pines (*Pinus jeffreyi*) exist in the Project area as the dominant overstory species, occurring in pure stands of various size second-growth, as well as scattered individual trees of various sizes.[7]

This description of the Jeffrey Pine vegetation community is too vague to convey the habitat types present on the Project site. For example, the Pacific fisher occurs in intermediate to large-tree stages of coniferous forests and deciduous-riparian habitats with a high percent canopy closure.[8] Based on the DEIS/DEIR's description of the Jeffrey Pine vegetation community, it is impossible to determine the extent of large and dense stands of Jeffrey pine on the Project site, and thus the extent of Project impacts to habitat for the Pacific fisher. The DEIS/DEIR must be revised such that it describes the specific habitat stages present on the Project site, as well as the abundance and distribution of the specific habitat types associated with the special-status species identified in Table 3.4-1 of the DEIS/DEIR.

I9-78 cont.

The DEIS/DEIR Fails to Provide a Sufficient Description of Sensitive Botanical Resources

The Applicant's consultant conducted special-status plant and noxious weed surveys within the immediate footprint for the geothermal power plant site, the geothermal well sites, and a 300-foot wide survey corridor for the pipeline routes.[9] Botanical surveys for the new access roads have not been conducted, although the DEIS/DEIR indicates they will be conducted during the spring and summer of 2013.[10]

I9-79

Most special-status plant species have specific microhabitat requirements. The Project has the potential to alter the microhabitat conditions near the Project site through shading, wind deflection, and changes to the local hydrology (among other possible changes).[11] It also has the potential to indirectly impact botanical resources through accidental trampling, vehicular activity, intrusion of non-native species, and fuel and chemical spills (among other potential indirect impacts). Focused botanical surveys of the buffer zones surrounding the potential power plant sites are essential to evaluating the potential indirect impacts of the Project on sensitive biological resources. The BLM and GBUAPCD's failure to document the presence, abundance, and distribution of special-

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[6] McBride JR. 1988. Jeffrey Pine. In: Mayer KE, WF Laudenslayer Jr., editors. A Guide to Wildlife Habitats of California. State of California, Resources Agency, Department of Fish and Game Sacramento, CA. 166 pp.

[7] *Ibid.*

[8] California Wildlife Habitat Relationships System. 2005. California Department of Fish and Game. California Interagency Wildlife Task Group. CWHR version 8.1 personal computer program. Sacramento (CA).

[9] DEIS/DEIR, p. 3.3-1.

[10] *Ibid.*

[11] Smith SD, DT Patten, RK Monson. 1987. Effects of artificially imposed shade on a Sonoran Desert ecosystem: microclimate and vegetation. Journal of Arid Environments 13:65–82.

status plant species in the Project buffer areas precludes the ability to fully evaluate Project impacts, and the ability to formulate appropriate mitigation. I9-79 cont.

The DEIS/DEIR Fails to Provide a Sufficient Description of Special-Status Wildlife

I9-80

Several special-status wildlife species have the potential to occur on the Project site.[12] Nevertheless, focused biological surveys for special-status wildlife were not conducted for the Project.[13] Without a proper description of use of the site by special-status species, it is impossible to assess the Project's impacts, the various alternatives, and the adequacy of the proposed mitigation measures. The BLM and GBUAPCD must require protocol-level surveys for special-status wildlife and provide the survey results in a revised DEIS/DEIR.

Northern Goshawk

I9-81

Focused surveys for the northern goshawk were not conducted for the Project, even though the Project site is within a protected activity center ("PAC") and five known northern goshawk nest sites have been identified in a portion of the Project area.[14] The Biological Evaluation that was prepared for the Project indicates northern goshawk "calls and nest surveys" were conducted during the spring and summer of 2010. The value of these surveys cannot be evaluated because the Biological Evaluation provides almost no information on the survey effort, including whether the surveys adhered to the USFS survey protocol. Furthermore, the DEIS/DEIR lacks the information needed to evaluate the severity of Project impacts on the northern goshawk because it does not provide baseline information on (a) the local and regional status of the northern goshawk; and (b) the number and status of PACs in the Inyo National Forest.

Greater Sage-Grouse

I9-82

The Project area contains suitable habitat for the greater sage-grouse.[15] According to the DEIS/DEIR, sage-grouse habitat on the Project site is of "marginal quality due to the low density of the sagebrush, the presence of interspersed Jeffrey pines and the lack of herbaceous cover," and that "[s]age-grouse typically prefer dense, contiguous stands of sagebrush with little to no overstory."[16] These statements are unsubstantiated. They are also inconsistent with the DEIS/DEIR's description of the sagebrush scrub vegetation community on the Project site, with information provided by the Applicant's biological resources consultant, and with published literature pertaining to sage-grouse habitat.[17]

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[12] DEIS/DEIR, Table 3.4-1.
[13] *Ibid*, p. 3.4-4.
[14] *Ibid*, p. 3.4-13.
[15] *Ibid*, p. 4.4-10.
[16] *Ibid*.
[17] *Ibid*, p. 3.3-4. See also Paulus J. 2001 Jun 18. Plant communities found at the Basalt Canyon Geothermal Exploration Survey Area. Letter to S. Kerns, Wildlands Resource Managers. Available from Mono County Planning Division. See also Connelly JW, ST Knick, MA Schroeder, SJ Stiver. 2004. Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats. Western Association of Fish and Wildlife

For example, sage-grouse leks do not occur in dense stands of sagebrush. Instead, they are typically adjacent to sagebrush at a location that is characterized by low, sparse vegetation and higher amounts of bare ground than adjacent sites.[18]

There have been nine consistently counted active sage-grouse leks in Long Valley.[19] Conelly et al. (2000) suggests that for all non-migratory populations of sage-grouse, habitat within 3.2 km of known leks should be given a high priority for protection.[20] The Project's consistency with this recommendation cannot be evaluated because the DEIS/DEIR does not identify the distance between known leks and the Project site.

I9-82 cont.

Sage-grouse have been observed within a 0.25-mile distance from the southern edge of the Project area.[21] According to the DEIS/DEIR, surveys for possible sage-grouse nest and lek sites were conducted in June 2010, and no signs of sage-grouse were observed during those surveys. The DEIS/DEIR fails to provide any information pertaining to the surveys, including the survey methods and area. Consequently, it is impossible to assess the value of the surveys in providing evidence that sage-grouse were absent from the Project site in 2010.

American Marten

The Project site provides suitable habitat for the American marten, and the species has been detected in the vicinity of the Shady Rest Park in association with Jeffery pine stands.[22] According to the DEIS/DEIR, however, "the lack of dense, multi-storied, multi-species late seral conditions (abundant downed logs, snags and large diameter trees) make it unlikely marten use the area for denning, resting and/or sustained foraging."[23] This statement conflicts with the Management Indicator Species Report prepared for the Project, which indicates the Project site contains "Late Seral Closed Canopy Coniferous Forest" habitat, and that the Project would directly or indirectly affect habitat for the American marten.[24]

I9-83

The Biological Evaluation for the Project provides additional confusing information pertaining to the Project site's suitability as marten habitat. It states: "[m]arten are typically associated with true fir habitats with associated brush fields. Such habitat exists

Agencies. Unpublished Report. Cheyenne, Wyoming. Available at: http://www.ndow.org/wild/conservation/sg/index.shtm.

[18] Connelly JW, ST Knick, MA Schroeder, SJ Stiver. 2004. Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, Wyoming. Available at: http://www.ndow.org/wild/conservation/sg/index.shtm.

[19] Bi-State Sage-grouse Conservation Team. 2004. Greater sage-grouse conservation plan for Nevada and eastern California. First edition. Available at: http://www.ndow.org/wild/sg/plan/SGPlan063004.pdf

[20] Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage-grouse populations and their habitats. Wildlife Society Bulletin. 28:967-985.

[21] DEIS/DEIR, p. 3.4-14.

[22] *Ibid*, Table 3.4-1. See also Biological Evaluation, p. 25.

[23] *Ibid*, p. 4.4-11.

[24] MACTEC. 2010. Draft Project Management Indicator Species Report: Casa Diablo IV Geothermal Development Project, Table 1.

only in the northwestern edge of the Project area."[25] This statement is not substantiated by a citation, and I am unaware of any literature that has concluded marten are typically associated with true fir habitats and brush fields. According to the California Department of Fish and Wildlife ("CDFW"): (a) "[i]mportant habitats [for marten] include red fir, lodgepole pine, subalpine conifer, mixed conifer, Jeffrey pine, and eastside pine;" and (b) there is "[l]ittle information available on the interspersion of habitats required by this species."[26] I9-83

The inconsistent and incorrect information presented in the DEIS/DEIR and accompanying documents make it impossible to understand the amount and quality of American marten habitat in the Project area.

Sierra Nevada Red Fox and Pacific Fisher

The Sierra Nevada red fox is listed as threatened under the California Endangered Species Act. The Pacific fisher is a candidate for listing under the federal Endangered Species Act. Both of these species have the potential to occur on the Project site.[27] I9-84

Special survey techniques are required to detect the presence of the Sierra Nevada red fox, Pacific fisher, and American marten.[28] The Applicant did not implement these survey techniques. As a result, one must assume these species occur on the Project site.

Pallid Bat

The DEIS/DEIR provides inconsistent information on the potential for pallid bat roosts on the Project site. It first states that "[s]uitable foraging habitat exists across the Project site and suitable roosting habitat exists within the Jeffery pine forest along the northern boundary of the Project site. The species is thought to be present in the vicinity of the Project site based on habitat suitability."[29] However, it subsequently states "[s]uitable roosting habitats such as cliffs (pallid bat) and caves (Townsend's big-eared bat) are not found within the project area."[30] According to the Biological Evaluation, "[t]he key components of habitat for the pallid bat consist of open foraging opportunities in combination with suitable roost areas in association with water."[31] These conditions are present in the Project area. The lack of any focused surveys for bat roosts, in conjunction with the inconsistent information provided in the DEIS/DEIR and supporting documents, I9-85

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[25] CD-IV Biological Evaluation, p. 43.
[26] California Wildlife Habitat Relationships System. 2005. California Department of Fish and Game. California Interagency Wildlife Task Group. CWHR version 8.1 personal computer program. Sacramento (CA).
[27] DEIS/DEIR, Table 3.4-1.
[28] Zielinski WJ, TE Kucera [technical editors]. 1995. American marten, fisher, lynx, and wolverine : survey methods for their detection. U.S. Dept. of Agriculture, Forest Service, Pacific Southwest Research Station. Albany, California.
[29] DEIS/DEIR, p. 3.4-15.
[30] *Ibid*, p. 4.4-10.
[31] Biological Evaluation, p. 23.

makes it impossible to evaluate Project impacts to the pallid bat and other special-status bat species. I9-85 cont.

The DEIS/DEIS Fails to Accurately Disclose Wetlands and Jurisdictional Waters

Dr. Paulus, the Applicant's consultant, conducted an assessment of wetlands and riverine resources at the Project site in 2012. The DEIS/DEIR misrepresents the information presented in Paulus's assessment, and the extent of jurisdictional waters in the Project area. I9-86

First, the DEIS/DEIR indicates, "[a] total of 1.89 acres of potentially jurisdictional wetlands were mapped within the Project area, all in close proximity to the existing power plant facilities."[32] This statement is incorrect. Paulus mapped 1.89 acres of wetland vegetation alliances, which do not necessarily reflect the total extent of jurisdictional wetlands in the Project area.[33] I9-87

Second, the DEIS/DEIR incorrectly reports the Riparian Conservation Area ("RCA") corridors in the Upper Basalt and Basalt Canyon areas do not support stream channels.[34] Although discontinuous, stream channels are present in the Upper Basalt and Basalt Canyon areas.[35] Indeed, Paulus reported a channel that originates at Shady Rest Park.[36] One of the pipelines proposed for the Project would cross that channel.[37] I9-88

Third, the DEIS/DEIR states "[t]he assessment performed by Paulus (Paulus, 2012) determined that the 'blue line' drainages were likely not jurisdictional under the CWA [Clean Water Act] except for in the area of the existing power plants."[38] The U.S. Army Corps of Engineers makes each jurisdictional determination on a case-by-case basis considering the facts and circumstances of the case and consistent with applicable statutes, regulations, and case law. The actual extent of waters of the U.S. cannot be determined until Paulus's wetland delineation has been verified by the U.S. Army Corps of Engineers. I9-89

Finally, and most importantly, the DEIS/DEIR fails to map or otherwise disclose the extent of other waters of the U.S. (i.e., "(a)(3) waters"), waters of the State, and aquatic habitats subject to regulation under Section 1602 of Fish and Game Code. These features appear to be present in the Project area. For example, the DEIS/DEIR indicates erosion control measures will be implemented where sediment run-off threatens "Waters of the State," and Paulus reported the presence of wetland vegetation and hydrology at an I9-90

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32 DEIS/DEIR, p. 3.3-11.
33 Paulus J. 2012. Investigation of Riverine Resources Including Wetlands at the Proposed CD4 Project, Mammoth Lakes, California, Table 1.
34 DEIS/DEIR, p. 3.3-18.
35 Paulus J. 2012. Investigation of Riverine Resources Including Wetlands at the Proposed CD4 Project, Mammoth Lakes, California, p. 12 and Appendix D.
36 *Ibid.*
37 *Ibid.*
38 DEIS/DEIR, p. 3.3-11.

internally drained basin 600 ft north of proposed well pad 34-25.[39] The BLM and GBUAPCD must prepare a revised DEIS/DEIR that identifies, quantifies, and maps the presence of all jurisdictional features in relation to Project infrastructure so that the public and decision makers can evaluate Project impacts, the adequacy of the proposed mitigation, and the Project's compliance with state and federal water quality regulations. I9-90 cont.

The DEIS/DEIR Fails to Establish Baseline Conditions with Respect to the Owens Tui Chub

The Owens tui chub is a subspecies of fish that is listed as endangered under the state and federal Endangered Species Acts. It is an extremely rare subspecies that is known to occur at only six isolated locations.[40] The headwaters of Hot Creek above the Hot Creek Fish Hatchery is one of only two locations where the Owens tui chub occurs in its native habitat (the remaining four populations are located in manmade impoundments).[41]

The Hot Creek Headsprings (or Headwaters) site consists of two springs, "AB Spring" and "CD Spring." It is located approximately two miles east of the Project site, and it is one of two sites that the U.S. Fish and Wildlife ("USFWS") has designated as critical habitat for the subspecies.

The DEIS/DEIR provides a generalized description of the habitat and biology associated with the Owens tui chub. However, it fails to provide three critical pieces of data:

1. Population data. The BLM and GBUAPCD's fail to establish the current size and trend of the Owens tui chub populations in the Hot Creek Headsprings. This precludes the ability to analyze the population's response to Project-induced changes in habitat (e.g., water temperature). It also precludes the ability to devise an objective and meaningful trigger for adaptive management. I9-91
2. Hydrologic data. The United States Geological Survey ("USGS") has been collecting hydrologic monitoring data at Hot Creek since the 1980s. Some of these data pertain to habitat conditions in the Hot Creek Headsprings. To establish existing conditions, the BLM and GBUAPCD must disclose these data in a revised DEIS/DEIR.
3. Habitat data. Several habitat variables are believed to influence Owens tui chub populations. These include the prey base, cover, water quality, water chemistry (e.g., pH, dissolved gases), and presence of predators (among other variables). The DEIS/DEIR does not quantify existing conditions pertaining to these habitat variables. This precludes the ability to determine whether a change in the Owens tui chub population is due to a Project-induced change in habitat (e.g., water temperature), or a change in habitat that is unrelated to the Project (e.g., increase in predator density).

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[39] *Ibid*, p. 4.3-18. See also CD IV Wetlands, Appendix D, Plate D-18.
[40] US Fish and Wildlife Service. 2009. Owens Tui Chub: 5-Year Review and Evaluation.
[41] *Ibid.*

The DEIS/DEIR's failure to disclose and incorporate fundamental baseline data results in significant flaws with the DEIS/DEIR's description of the environmental setting and its analysis of Project impacts to biological resources. Indeed, Mono County has acknowledged comprehensive baseline data are needed to evaluate proposed geothermal development projects. Specifically, the Mono County General Plan states: "[t]he applicant for a geothermal development permit shall prepare a baseline data report to be included as part of the hydrologic and biologic resource monitoring plans that identifies all significant hydrologic and biologic baseline information available for the project area."[42]

I9-91 cont.

The DEIR Fails to Disclose or Address the Project's Potentially Significant Impacts on Tree-Kills

Since 2006, scientists with the USGS have been conducting research at tree-kill sites near Casa Diablo. Their research has led them to the following inferences and conclusions:

1. "[m]any of these kills occurred during the mid-1990s and were associated with early power-plant operations at Casa Diablo (Bergfeld and others, 2006)."[43]
2. "[o]ur findings indicate that the [new tree-kill] areas have developed as a response to changes in the shallow hydrologic system. Some of the changes are likely related to fluid production at the power plant, but at distal sites the changes are more likely related to seismicity and uplift of the dome."[44]
3. "changes in the size of kill zones, increases in soil temperatures or steam discharge, and changes in CO_2 emissions most likely reflect the response of the shallow hydrothermal system to geothermal fluid production at the Casa Diablo power plant."[45]
4. "[o]ur early work (Bergfeld and others, 2006) indicated that about 8.7 metric tonnes of CO_2 per day (t/d) were emitted from these kill zones, with the highest discharge occurring in areas within a few km of the Casa Diablo geothermal power plant, and that most of the kill zones developed as a response to changing conditions in the shallow hydrothermal system."[46]
5. "[w]ithout sufficient pressure support, the shallow hydrothermal system [at Shady Rest] would respond to the 2006 onset of fluid production at the 5725

I9-92

[42] County of Mono Community Development Department. 2010. Mono County General Plan. Bridgeport, CA. (Drafted July 1997 and Revised 2010). Conservation /Open Space Element-2010, p. V-41. [emphasis added].

[43] Bergfeld D, WC Evans. 2011, Monitoring CO_2 emissions in tree kill areas near the resurgent dome at Long Valley Caldera, California: U.S. Geological Survey Scientific Investigations Report 2011-5038, p. 5.

[44] Bergfeld D, WC Evans, JF Howle, CD Farrar. 2006. Carbon Dioxide Emissions from Vegetation-Kill Zones Around the Resurgent Dome of Long Valley Caldera, Eastern California USA. Journal of Volcanology and Geothermal Research 152 (2006): 140-156. Abstract available at: www.sciencedirect.com/science/article/pii/S0377027305003550.

[45] Bergfeld D, WC Evans.2011, Monitoring CO_2 emissions in tree kill areas near the resurgent dome at Long Valley Caldera, California: U.S. Geological Survey Scientific Investigations Report 2011-5038, p. 1.

[46] *Ibid.*

and 6625 wells. Variations in CO_2 emissions since that time may reflect adjustments in the shallow reservoir to the fluid production."[47]

6. "[t]he presence of isobutane in gas samples at Basalt Canyon shows that volatiles from the injectate have reached the underlying area. The pressure support provided by the injectate would stabilize the depth of boiling in the reservoir and, consequently, would control the upflow of steam and CO_2, producing more constant CO_2 emissions."[48]
7. "[t]he presence of isobutane in gas samples from sites in and around Basalt Canyon suggests that geothermal fluid production directly effects fluid upflow in the region close to the power plant."[49]
8. "[t]he appearance of this gas [H_2S] at the surface may signal increased drawdown of water levels near the geothermal productions wells."[50]

Based on the information provided above, there is ample scientific evidence that the Project would contribute to additional tree kills. Specifically, because the continued expansion of the tree-kill sites has been highly correlated with geothermal resource extraction, one can infer that an increase in geothermal resource extraction would contribute to additional expansions of the tree-kills (and possibly new tree-kill sites). The DEIS/DEIR fails to disclose, analyze, or provide mitigation for this potentially significant impact. I9-92 cont.

PROJECT IMPACTS

The DEIS/DEIR Lacks An Accurate Assessment of Project Impacts During Decommissioning

The DEIS/DEIR concludes there would be no impacts to special-status plants and wildlife due to decommissioning activities.[51] This conclusion is unjustified. As the DEIS/DEIR acknowledges, potential direct and indirect effects to biological resources during decommissioning are similar to those associated with the construction phase of the Project. These effects include ground disturbance, noise, light, fugitive dust, and the introduction or spread of noxious weeds.[52] I9-93

Decommissioning activities have the potential to cause significant impacts to any special-status plant and animal species that colonize or re-colonize the Project site during the 30-year lifespan of the Project. Focused plant and animal surveys prior to decommissioning are required to determine the potential for significant impacts to special-status species during the decommissioning process.

[47] *Ibid*, p. 9.
[48] *Ibid*, p. 8.
[49] *Ibid*, p. 1.
[50] *Ibid.*
[51] DEIS/DEIR, pp. 4.3-9 and 4.4-20.
[52] *Ibid*, p. 4.3-10 and 4.4-8.

Vegetation Resources

Invasive Plants

The DEIS/DEIR does not consider chemical control as a means of containing and controlling noxious weeds at the Project site because, according to the DEIS/DEIR, "site specific information on target weed species are not known at this time."[53] The stated rationale is confusing because noxious weed surveys were conducted for the Project.[54] Nevertheless, there are two implications of the DEIS/DEIR not considering chemical control methods. I9-94

First, herbicides can have direct and indirect impacts on non-target organisms. If herbicides may be used for the Project, the DEIS/DEIR must identify the specific herbicides that will be (or may be) used, and it must analyze the potentially significant impacts of those herbicides on the environment. I9-95

Second, application of herbicides may be the only feasible means of controlling some noxious weed species. If herbicides will not be used, the DEIS/DEIR must establish the efficacy of other methods (e.g., manual removal) in controlling the noxious weed species that occur (or may occur) in the Project area. I9-96

The maintenance of access roads both within and outside the Project site boundary has the potential to introduce invasive plant species into disturbed areas and facilitate the spread of noxious weeds.[55] Vehicles and crews inadvertently could track in clinging seeds and/or parts of noxious weeds, thus facilitating their spread.[56] However, the DEIS/DEIR concludes the application of PDMs BIO-4, BIO-5, BIO-6, BIO-7, and BIO-8 would reduce these impacts.[57] The DEIS/DEIR lacks the basis for this conclusion because the referenced mitigation measures apply to the Project construction phase only, and they do not address the spread of noxious weeds during the operation and maintenance phase, or during decommissioning. I9-97

Special-Status Plants

The significance of Project impacts to special-status plants cannot be evaluated until focused botanical resources surveys have been completed for all areas that may be directly or indirectly affected by the Project. This includes the areas that may be directly or indirectly affected by Alternative 3, the new and reconstructed access roads, and the buffer zones surrounding the potential power plant sites. Although the DEIS/DEIR suggests some of these surveys will be conducted during the spring and summer of 2013, it does not incorporate the surveys as a required mitigation measure, and it does not A9-98

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[53] *Ibid*, p. 2-55.
[54] *Ibid*, p. 3.3-1.
[55] *Ibid*, p. 4.3-10.
[56] *Ibid.*
[57] *Ibid.*

identify the mitigation measures that would be implemented if special-status species are detected during the surveys. I9-98 cont.

The DEIS/DEIR Fails to Disclose and Assess Impacts from the Project's Sump Pits

A dead northern goshawk was found at a well site in the Project area. According to the Project's Biological Evaluation, the goshawk apparently died from drowning in the well pad sump pit.[58] The DEIS/DEIR goes on to suggest the goshawk drowned because the steep slopes of the sump pit trapped the goshawk.[59] It is extremely unlikely that a bird species adept at flying would become trapped in the sump pit. Instead, it is much more likely the goshawk died due to contact with chemicals in the pit.

Hydraulic fracturing fluids and other hazardous materials will be used at the Project well sites, and presumably they have been used at the existing well sites.[60] These materials include (or may include) diesel fuel-powered equipment, drilling mud additives such as gel, polymers and slurry (which may contain small quantities of crystalline silica), miscellaneous lubricants, and solvents.[61] Hydraulic fracturing fluids can contain chemicals (e.g., surfactants, hydrochloric acid, caustic potash, and diesel fuel) that may enter the sump pit where they are harmful to wildlife.[62] Insects entrapped in sump pit fluids attract songbirds, bats, amphibians, and small mammals.[63] The struggling birds or small mammals in turn attract hawks and owls to the pit.[64] I9-99

The sump pits create an attractive hazard on the site because birds and other wildlife will mistake the sump pits for bodies of water.[65] If the sump pits contains oil, condensates, or other hydrocarbons or hydraulic fracturing fluids, the risk of bird mortality is very high.[66] The sticky nature of oil entraps birds in the sump pits, where they die from exposure and exhaustion.[67] Birds that manage to escape die from starvation, exposure, or the toxic effects of oil ingested during preening.[68] Birds ingesting sublethal doses of oil can experience impaired reproduction.[69] Cold stress can kill the animal if oil damages the insulation provided by feathers or fur.[70] Animals not killed in the sump pits can suffer ill effects later from contact with the oil and chemicals in the pits.[71] If they absorb or ingest oil in less than acutely lethal amounts they may suffer a variety of systemic effects and

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[58] CD-IV Biological Evaluation, p. 17.
[59] DEIS/DEIR, pp. 4.4-9 and -10.
[60] *Ibid*, p. 3.13-2.
[61] *Ibid.*
[62] Ramirez P Jr. 2009. Reserve Pit Management: Risk to Migratory Birds. U.S. Fish and Wildlife Service Region 6, Cheyenne, Wyoming. 32 pp.
[63] *Ibid.*
[64] *Ibid.*
[65] *Ibid.*
[66] *Ibid.*
[67] *Ibid.*
[68] *Ibid.*
[69] *Ibid.*
[70] *Ibid.*
[71] *Ibid.*

may become more susceptible to disease and predation.[72] During the breeding season, birds can transfer oil from their feet and feathers to their eggs.[73] In some cases, a few drops of oil on an eggshell can kill the embryo.[74]

The DEIS/DEIR must disclose these hazards to the public and decision makers. It also must identify the specific chemicals that may enter the sump pits so the hazard to wildlife can be properly assessed, and so effective mitigation strategies can be devised.

I9-99 cont.

Special-Status Wildlife

Northern Goshawk

The DEIS/DEIR fails to identify the location of Project activities (e.g., tree removal and road construction) in relation to the five northern goshawk nest sites that occur in the Project area. This information is essential to evaluating the types and severity of Project impacts to the species.

Northern goshawks exhibit ecological characteristics of species that may be particularly sensitive to forest management practices that reduce or fragment habitat.[75] Nevertheless, the DEIS/DEIR lacks any discussion or analysis of the effects of habitat fragmentation on the northern goshawk. Forest management that fragments and reduces the extent and area of stands suitable for nesting in a breeding area may result in its less consistent use for nesting over time.[76] In addition, increased forest fragmentation will likely increase competition and predation on goshawk populations. Habitat generalists and species better adapted to more open woodlands such as corvids and other raptors (hawks and owls) can displace goshawks, compete for nesting structures, deplete the prey base, and depredate nests and adults.[77]

I9-100

The Biological Evaluation concluded that the Project may affect an individual goshawk's ability to forage in the area of construction, primarily in the northwest portion, but is not likely to result in a trend toward federal listing or loss of viability.[78] This is not a

[72] *Ibid.*
[73] *Ibid.*
[74] *Ibid.*
[75] US Forest Service, Pacific Southwest Research Station. 2011. Northern Goshawk: Habitat Conservation Assessment for California [research project summary]. Available at: http://www.fs.fed.us/psw/topics/ecosystem_processes/sierra/bio_diversity/biodiversity_sub6/northern_goshawk.shtml.
[76] Woodbridge, B. and P.J. Detrich. 1994. Territory occupancy and habitat patch size of northern goshawks in the southern Cascades of California. Studies in Avian Biology 16: 83-87. See also Desimone, S.M. 1997. Occupancy rates and habitat relationships of northern goshawks in historic nesting areas in Oregon. M.S. Thesis, Oregon State University, Corvallis, OR.
[77] Crocker-Bedford, D. C. 1998. The value of demographic and habitat studies in determining the status of Northern Goshawks (*Accipiter gentilis atricapillus*) with special reference to Crocker-Bedford (1990) and Kennedy (1997). Journal of Raptor Research 32: 329-336. See also Patla, S. M. 1997. Nesting ecology and habitat of the Northern Goshawk in undisturbed and timber harvest areas on the Targhee National Forest, Greater Yellowstone Ecosystem. M. S. thesis, Idaho State University, Pocatello, Idaho.
[78] DEIS/DEIR, p. 4.4-9.

meaningful comparison due to massive differences in the two scopes of analysis (i.e., the local impact in relation to the national population). The DEIS/DEIR must assess the significance of Project impacts to the northern goshawk at the local or regional level, and then evaluate how impacts to the local or regional population may affect the statewide or national population. Furthermore, any analysis of the Project's contribution toward federal listing or loss of viability must consider the cumulative projects within the entire country (i.e., the projects that may cumulatively result in federal listing).

The Project will impact a goshawk PAC by causing habitat loss and fragmentation. The DEIS/DEIR lacks any compensatory mitigation for this impact. As a result, the Project would have an unmitigated, significant impact on the northern goshawk.

I9-100 cont.

Greater Sage-Grouse

The DEIS/DEIR concludes direct effects to nesting sage-grouse would be minimal due to the marginal quality and limited availability of suitable nesting habitat in the Project area.[79] As discussed previously, scientific literature and Paulus's survey reports do not indicate habitat is "marginal" or "limited."

The Biological Evaluation concluded that the Project may affect individual sage-grouse, but it would not likely result in a trend toward federal listing or loss of viability.[80] Similarly, the Management Indicator Species Report concluded that the Project is not expected to have a significant direct, indirect or cumulative effect on greater sage-grouse habitat in the Project Area.[81] It stated the loss of approximately 39.56 acres of sagebrush habitat will not alter the existing bioregional trend for sagebrush habitat in the Project area nor will it lead to a change in the distribution of greater sage-grouse across the Sierra Nevada bioregion.[82] These conclusions lack scientific support.

I9-101

First, the loss and fragmentation of sagebrush habitats has been cited as a primary cause for the decline of sage-grouse populations.[83] Mechanisms for declining populations from habitat fragmentation, which is largely a result of human activities, include reductions in lek persistence, lek attendance, population recruitment, yearling and adult annual survival, female nest site selection, nest initiation, and complete loss of leks and winter habitat.[84] Functional habitat loss also contributes to habitat fragmentation as greater sage-grouse avoid areas due to human activities, including noise, even though sagebrush remains intact.[85] In an analysis of population connectivity, Knick and Hanser (2011) demonstrated that in some areas of the sage-grouse range, populations are already

I9-102

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[79] *Ibid*, p. 4.4-10.
[80] *Ibid.*
[81] *Ibid.*
[82] *Ibid.*
[83] See literature cited <u>in:</u> Sage-Grouse Conservation Objectives Team. 2012 Aug 1. Sage-Grouse Conservation Objectives Draft Report. Available at: http://www.fws.gov/mountain-prairie/species/birds/sagegrouse/.
[84] *Ibid.*
[85] Blickley, J. L., D. Blackwood and G. L. Patricelli. 2012. Experimental evidence for the effects of chronic anthropogenic noise on abundance of greater sage-grouse leks. Conservation Biology 26:461-471.

isolated and at risk for extirpation due to genetic, demographic, and stochastic (i.e., unpredictable) events.[86] Habitat loss and fragmentation contribute to the population's isolation and increased risk of extirpation. As the DEIS/DEIR acknowledges, "[t]he highways and existing geothermal development are now significant barriers to [sage-grouse] emigration from the known local use areas."[87] Additional development due to the Project would exacerbate these issues and would increase the risk of local extirpation. I9-102 cont.

Second, the DEIS/DEIR's impact assessment fails to consider the effects of the Project's transmission line, roads, and fencing. The construction of transmission lines, roads, and fences are known to be risks to sage-grouse in the South Mono PMU (Population Management Unit), and these features affect habitat quantity and populations on a yearlong basis.[88] I9-103

Third, the Project's effect on the distribution of greater sage-grouse across the entire Sierra Nevada bioregion it is not a meaningful level of analysis. The DEIS/DEIR must assess the significance of Project impacts to the South Mono PMU. I9-104

Ultimately the DEIS/DEIR concludes that the implementation of Mitigation Measure WIL-7 (pre-construction surveys for leks) would ensure that there are no residual impacts to sage-grouse.[89] I disagree with this conclusion because the mitigation measure does nothing to mitigate (a) the loss and degradation of sage-grouse habitat; or (b) the adverse effects of the Project's transmission line, roads, and fencing. I9-105

Forest Carnivores

The Project has the potential to cause the direct take of the Sierra Nevada red fox, Pacific fisher, and American marten (e.g., through destruction of den sites). It also has the potential to cause the indirect take of these species by displacing individuals out of their home range(s). These impacts would be extremely significant, especially to the Sierra Nevada red fox and Pacific fisher, which are extremely rare. The Sierra Nevada red fox, Pacific fisher, and American marten are rarely detected unless specialized survey techniques are used (e.g., remote cameras). As a result, the pre-construction survey proposed in the DEIS/DEIR is not an appropriate take avoidance strategy. I9-106

The DEIS/DEIR states Mitigation Measure WIL-3 will improve the quality of the habitat for the American marten, and that "there should be no residual impacts to American marten habitat from construction of the Proposed Action."[90] This statement is unjustified. Mitigation Measure WIL-3 requires the Applicant to retain as many snags,

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[86] Knick, S.T. and S.E. Hanser. 2011. Connecting pattern and process in greater sage-grousepopulations and sagebrush landscapes. Pp. 383 – 406 in S.T. Knick and J.W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian biology (vol. 38). University of California Press, Berkeley,CA.

[87] DEIS/DEIR, p. 4.4-10.

[88] Bi-State Sage-grouse Conservation Team. 2004. Greater sage-grouse conservation plan for Nevada and eastern California. First edition. Available at: http://www.ndow.org/wild/sg/plan/SGPlan063004.pdf

[89] DEIS/DEIR, p. 4.4-10.

[90] *Ibid*, p. 4.4-11.

downed logs, coarse woody debris and brush piles "as possible;" it does nothing to improve habitat as stipulated in the DEIS/DEIR. To the contrary, the habitat loss, fragmentation, and anthropogenic disturbance caused by the Project would degrade habitat for the American marten and Pacific fisher. The DEIS/DEIR lacks any mitigation (i.e., habitat compensation) for this significant impact.

The DEIS/DEIR acknowledges that the Project "is anticipated to result in temporary and/or permanent impacts to individuals or habitat of northern goshawk, greater sage-grouse, pallid bat, Townsend's big-eared bat, and Sierra marten. Under CEQA, these impacts would be considered significant."[91] Because the DEIS/DEIR does not provide mitigation to offset these impacts, the Project would result in unmitigated, significant impacts to special-status wildlife.

I9-106 cont.

Pallid Bat

The DEIS/DEIR states "[n]o bat roosts are known to occur within or adjacent to the Proposed Action; therefore, impacts to bat roosts are not anticipated."[92] This statement is unfounded because focused surveys to locate bat roosts were not conducted for the Project, and the DEIS/DEIR lacks evidence that surveys for bat roosts have ever been conducted in the Project area.

I9-107

The DEIS/DEIR Does Not Provide an Accurate Assessment of Project Impacts to Wetlands and Jurisdictional Waters

The DEIS/DEIR describes the impact analysis process that was applied to wetland and other jurisdictional waters as the following:

> [t]o determine the potential for construction and operations activities to cause direct effects on federal and state jurisdictional wetlands and waters of the U.S. the proposed construction areas were compared with maps of these features. Potential indirect effects were identified through the same means.[93]

The DEIS/DEIR subsequently concludes:

> [d]irect impacts to potentially jurisdictional features in the study area are not expected. Project facilities are not planned for those areas identified during vegetation surveys that support vegetation typically associated with wetlands. RCAs in the study area will be avoided through implementation of PDM HYD-2, which requires pipelines and access roadways to be located outside of any delineated RCAs.[94]

I9-108

The DEIS/DEIR does not provide any maps of waters of the State in the Project area. It also does not provide any maps that depict the locations of Project features in relation to waters of the U.S. This makes it extremely difficult for the public and decision makers to

[91] *Ibid*, p. 4.4-19.
[92] *Ibid.*
[93] *Ibid*, p. 4.3-2.
[94] *Ibid*, p. 4.3-8.

evaluate Project impacts to jurisdictional features, or to verify the conclusions presented in the DEIS/DEIR.

I used a geographic information system to overlay the map of Project features on the maps provided in Paulus's wetland delineation report. The resulting maps do not support the statements that (a) Project facilities are not planned for areas that support vegetation typically associated with wetlands; and (b) pipelines and access roadways would be located outside of any delineated Riparian Conservation Areas ("RCAs").[95] To the contrary, the maps depict new pipelines traversing through wetland plant communities, RCAs, and potentially jurisdictional wetlands (Figure 1 and 2).

The aforementioned statements in the DEIS/DEIR also conflict with the information provided in Paulus's wetland delineation report. Specifically, Paulus identified the potential for pipelines and roads to affect streamcourses and the RCAS.[96] The DEIS/DEIR fails to describe how impacts to these features would be avoided.

The DEIS/DEIR cannot conclude there would be no impact to federal wetlands during decommissioning.[97] Wetland communities are dynamic. There is a high probability that the extent of wetlands in the Project area will change over the 30-year lifespan of the Project due to changes in the local hydrology caused by the Project, in conjunction with ongoing changes in hydrology that have occurred as a result of existing projects.

I9-108 cont.

[95] *Ibid.*
[96] See caption to Figure 1 in: Paulus J. 2012. Investigation of Riverine Resources Including Wetlands at the Proposed CD4 Project, Mammoth Lakes, California.
[97] DEIS/DEIR, p. 4.3-12.

Wetlands Figure 3 over DEIS/DEIR Figure 2-8

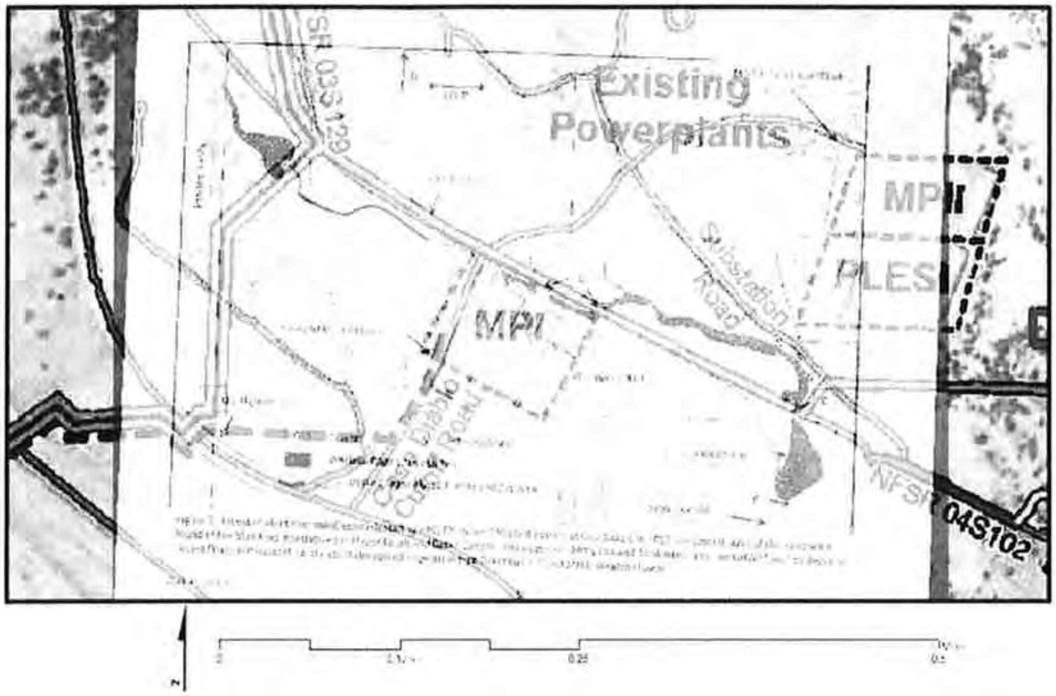
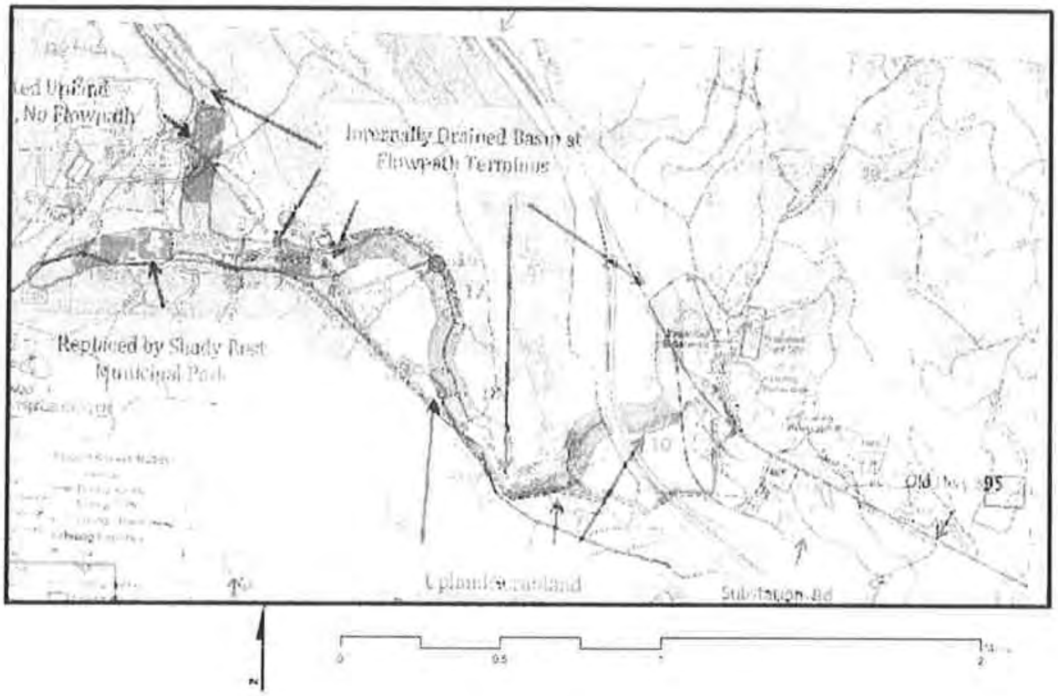


Figure 1. Project features near existing power plants in relation to wetlands mapped by Paulus. Project pipelines (turquoise lines) would pass through wetlands (dark blue polygons).

I9-108 cont.

Wetlands Figure 4 over DEIS/DEIR Figure 2-8



I9-108 cont.

Figure 2. Project features in relation to RCAs (red corridor) and blue line streamcourses. Project pipelines (turquoise lines) would pass through RCAs and potentially jurisdictional features (non-shaded portions of corridor).

The DEIS/DEIR Does Not Adequately Assess Potentially Significant Impacts to the Owens Tui Chub

When the USFWS designated critical habitat for the Owens tui chub, it identified activities that may adversely affect that critical habitat. They include "activities that decrease available water or cause a significant change in the physical or chemical properties (e.g., temperature, pH, or dissolved gases) of the water."[98]

Experiments and observations conducted after critical habitat was designated suggest that aquatic vegetation is an important ecological component of critical habitat in the Hot Creek Headsprings.[99] Another outstanding component, and one that is highly interrelated, is the constancy of the environment, primarily flow and temperature.

[98] U.S. Fish and Wildlife Service. 1985. Endangered status and critical habitat designation for the Owens tui chub. Final rule. Federal Register 50(150): 31592-31597.
[99] McEwan D. 1991. Microhabitat Selection of the Owns Tui Chub, Gila bicolor snyderi, in the Hot Creek Headsprings, Mono County, California. Proceedings of the Desert Fishes Council, Vol. XX and XXI. Desert Fishes Council, Bishop, California. pp. 11-24.

Environmental constancy, among other things, allows for the persistence of the vegetation through the winter, as well as a year-round production of the aquatic invertebrate fauna. Any management or recovery plan for the Owens tui chub in the Headsprings should recognize the importance of these two ecological components.

Physical and Chemical Properties

Owens tui chubs require aquatic vegetation for cover, foraging, and spawning, as well as gravel substrates for spawning.[100] If one or more of these elements are absent, the subspecies can be quickly extirpated from a location.

Historically, vegetation has provided abundant cover for tui chubs in the Hot Creek Headsprings. There has been a limited die-off of vegetation beds during the winter, but most of the beds persist due to the thermal characteristics of the water entering the Headsprings.

The DEIS/DEIR states "changes in hot spring inlet temperatures have not been accompanied by changes in chemistry of the water which would indicate a change in thermal inflow."[101] This statement is incorrect. At the Hot Creek Fish Hatchery, chemical-flux measurements collected by the USGS show that the thermal-water component in the springs declined by 30% to 40% between 1990 and 2000.[102] Since then the thermal-water component has declined even further.[103] The data also indicate there has been a decline in the total volume of thermal water entering the Hot Creek Headsprings since the early 1990s.[104] The DEIS/DEIR must be revised such that it accurately reports the data collected by the USGS. A revised DEIS/DEIR must also address how the reductions in thermal water have affected vegetative cover and prey resources (i.e., aquatic invertebrate fauna) for the Owens tui chub. It also must address how additional reductions in thermal water may affect these resources. Until the DEIS/DEIR establishes the physical and chemical properties that currently exist within the Hot Creek Headsprings, it will be impossible to evaluate the effects of the Project on tui chub habitat, and thus, the tui chub population. I9-109

The Applicant's consultant has predicted the Project would reduce thermal outflow in the Hot Creek Headsprings by approximately 17 percent.[105] I concur with Dudek and ICF International that "[a]ny reduction in flow from springs in the Owens Basin would result

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[100] See literature cited in: Dudek and ICF International. 2012. Desert Renewable Energy Conservation Plan. 2012 Mar 2 Draft. Species Account for the Owens Tui Chub (*Siphateles bicolor snyderi*).
[101] DEIS/DEIR, p. 4.4-13.
[102] Sorey ML. 2000. Geothermal Development and Changes in Surficial Features: Examples from the Western United States. Proceedings of the World Geothermal Congress 2000; Kyushu - Tohoku, Japan, May 28 - June 10, 2000. pp. 705-711.
[103] Howle JF, CD Farrar, K Bazar. 2012 Feb 13. Long Valley Hydrologic Advisory Committee Hydrologic Monitoring Data for the Period Ending December 2011.
[104] *Ibid.*
[105] DEIS/DEIR, p. 4.4-13.

in further reductions of habitat quality and quantity for the Owens tui chub at springs and tributaries of the Owens River."[106]

I9-109 cont.

Indeed, there is circumstantial evidence that the Owens tui chub populations in the Headsprings have already declined in response to the reduced thermal inflows. In 1988, prior to the decrease in thermal water to the springs, the population estimate for Owens tui chub in the AB Spring was 334±105, and it was 523±146 in the CD Spring.[107] In 1999, after the decrease in thermal water, the population estimate for the AB Spring was 180 to 245 individuals (no confidence interval provided), and no tui chub were detected in the CD Spring.[108] Whereas the exact cause and effect relationship is unknown, one can infer that the apparent decline in the Owens tui chub populations could be due to the decline in the thermal water component given its influence on tui chub habitat.

The DEIS/DEIR Lacks an Assessment of the Project's Contribution to Tree-Kills

I9-110

Tree-kills have broad implications on sensitive resources and the ecology of the Project region. For example, the DEIS/DEIR acknowledges that "[n]on-native annuals such as cheat grass, redstem filaree, black mustard, Russian thistle (*Salsola tragus*), and silver hairgrass (*Aira caryophyllea*) attain weedpatch dominance and up to 90 percent cover where recent thermal activity has killed native shrubs and trees."[109] The DEIS/DEIR needs to assess the potentially significant impacts associated with additional tree-kills that may occur due to an increase in geothermal operations.

The DEIS/DEIR Fails to Disclose, Analyze, or Provide Mitigation for Potentially Significant Noise Impacts to Wildlife Species

I9-111

Drilling operations would take place 24 hours per day, 7 days per week, and each geothermal well would take approximately 60 days to complete.[110] Drilling operations and construction of the power plant are expected to produce average noise levels of up to 85 dBA at 50 feet.[111] Operation of the power plant is expected to produce average noise levels of 71.5 dBA at 150 feet, 64.5 dBA at 400 feet, 54 dBA at 0.25 mile (1,320 feet), and 48 dBA at 0.50 mile (2,640 feet) from the center of the plant.[112] Noise levels from the well pumps are expected to be 58 dBA at 100 feet from the well pump.[113] Because the DEIS/DEIS provides the average noise levels, the peak noise levels associated with the Project would presumably be higher.

The noise levels reported in the DEIS/DEIR are high enough to significantly impact wildlife. For example, Reijnen et al. (1997) concluded sound levels above 50 dBA could

[106] Dudek and ICF International. 2012. Desert Renewable Energy Conservation Plan. 2012 Mar 2 Draft. Species Account for the Owens Tui Chub (Siphateles bicolor snyderi), p. 10.
[107] US Fish and Wildlife Service. 2009. Owens Tui Chub: 5-Year Review and Evaluation, Table 1.
[108] *Ibid.*
[109] DEIS/DEIR, p. 3.3-5.
[110] *Ibid*, p. 2-25.
[111] *Ibid*, pp. 4.11-3 and -5.
[112] *Ibid,* p. 4.11-7.
[113] *Ibid.* p. 4.11-8.

be considered potentially deleterious to breeding birds within an average of 1,000 m (3,280 feet) from the source of noise.[114]

Animals rely on hearing to avoid predators, obtain food, and communicate. Noise and vibration have the potential to disrupt these activities, and otherwise reduce fitness through injury (e.g., hearing loss), energy loss (from movement away from noise source), reduction in food intake, and habitat avoidance and abandonment.[115] The DEIS/DEIR fails to disclose, analyze, or provide mitigation for potentially significant impacts of Project noise on wildlife.

I9-111 cont.

The DEIS/DEIR Fails to Disclose, Analyze, or Provide Mitigation for the Potentially Significant Impacts Associated With Soil Stabilizers

Soil stabilizers (also known as soil binders, dust suppressants, or dust palliatives) may be used at the Project site.[116] The majority of soil stabilizers are made from waste products from the manufacturing industry and many contain chemicals that are toxic to plants and animals.[117] Because soil stabilizers are generally applied over the ground surface, any vegetation or fauna on the site, including soil microorganisms, may come into direct contact with the stabilizer. Application of soil stabilizers has been associated with the browning of trees along roadways and stunted vegetation growth in forestlands, and they have caused sickness and adverse effects on reproduction in terrestrial animals.[118] The DEIS/DEIR fails to disclose, analyze, or provide mitigation for potentially significant adverse impacts associated with use of soil stabilizers at the Project site.

I9-112

The DEIS/DEIR Fails to Address the Potentially Significant Impacts Associated with Ravens, Crows, and Other Predators that May Benefit from the Project

Common ravens and American crows are nest predators of sage-grouse and other shrub-nesting birds.[119] Common ravens, American crows, and other predators benefit from anthropogenic features. For example, common ravens use power lines for nesting and as hunting perches.[120]

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[114] Reijnen R, R Foppen, G Veenbaas. 1997. Disturbance by traffic of breeding birds: evaluation of the effect and planning and managing road corridors. Biodiversity and Conservation 6: 567-581.

[115] National Park Service, 1994. Report to Congress, Report on effects of aircraft overflights on the National Park System.

[116] DEIS/DEIR, p. 2-54.

[117] U.S. Environmental Protection Agency. 2004 Mar. Potential Environmental Impacts of Dust Suppressants: Avoiding another Times Beach. In: An Expert Panel Summary, May 30-31, 2002, Las Vegas, Nevada. Available at: http://www.epa.gov/nerlesd1/cmb/pdf/dust.pdf

[118] *Ibid.*

[119] Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver 2004. Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, Wyoming. Available at: http://www.ndow.org/wild/conservation/sg/index.shtm.

[120] *Ibid.*

Common ravens and American crows often forage >10 km from nests or perches.[121] Consequently, anthropogenic features that benefit raven and crow populations can cause indirect impacts that extend a great distance. The DEIS/DEIR fails to discuss how Project features and activities may attract and subsidize unnaturally high numbers of ravens, crows, and other predators. Because the DEIS/DEIR does not provide any mitigation for this potentially significant impact, the Project may cause an unmitigated impact on sage-grouse, deer, and other prey species that occur in the Project region. I9-113

MITIGATION

Decommissioning

Sensitive plant and animal resources have the potential to colonize the Project site during the 30 years prior to decommissioning. Because the Project has the potential to impact sensitive biological resources during decommissioning, the Applicant should be required to conduct focused surveys for sensitive biological resources prior to any decommissioning activities. The Applicant should also be required to consult with the USFWS and the CDFW prior to, and during, decommissioning. I9-114

The DEIS/DEIR Improperly Defers the Preparation of Plans Fundamental to the Success of Project Mitigation

The DEIS/DEIR improperly defers formulation of the (a) Drainage and Runoff Management Plan; and (b) Weed Management Plan until after the environmental review process terminates.[122] The lack of these plans precludes the ability to evaluate their effectiveness in mitigating significant impacts of the Project.

According to the DEIS/DEIR, "the Drainage Plan shall evaluate potential changes in stormwater flow that would result from implementation of the Proposed Action."[123] Changes in stormwater flow have the potential to affect the wetlands in the vicinity of the existing power plant facilities. The DEIS/DEIR must disclose and analyze the potential for these changes to occur; it cannot defer the analysis to a forthcoming Drainage Plan. It also must identify the erosion control measures that will be installed on Project roads, and the design of stream crossings, such that the Project complies with Mammoth Lake General Plan Policy R.2.D that prohibits placing intermittent streams in culverts.[124] I9-115

Several noxious weed species are present in the Project area where topsoil has been scraped away for recent well pad or road construction.[125] This demonstrates that the Applicant has been unsuccessful in preventing the spread and colonization of noxious

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[121] Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, Wyoming. Available at: http://www.ndow.org/wild/conservation/sg/index.shtm.
[122] DEIS/DEIR, pp. 4.3-3 and -20.
[123] *Ibid*, p. 4.19-22.
[124] *Ibid*. p. 3.3-25.
[125] *Ibid*, p. 3.3-5.

weeds, and it exemplifies the need for a detailed Weed Management Plan that can be vetted by the public, resource agencies, and biologists prior to a decision on the Project. I9-115 cont.

Vegetation

Mitigation Measure VEG-1 includes measures to minimize impacts to vegetation resources. The mitigation measure, which includes implementation of erosion control practices and a Revegetation Plan, is not adequate because it fails to identify (a) the monitoring methods and schedule; (b) the adaptive management or remedial action plan if success criteria are not met; and (c) an enforcement mechanism. I9-116

Invasive Plants

I have the following comments pertaining to Mitigation Measure VEG-2 (Weed Management Plan): I9-117

1. The DEIS/DEIR indicates "[b]aseline weed conditions shall be assessed during the pre-construction phase of the CD-IV Project, during pre-construction surveys and staking and flagging of construction areas."[126] The pre-construction phase may not be the appropriate time of year to determine the presence, abundance, and distribution of weeds. The timing for baseline weed surveys should be dictated by the phenology of potentially occurring weed species and not by the timing of the Project.
2. The DEIS/DEIR indicates, "[a] stratified random sampling technique shall be used to identify and count the extent of weeds on the site."[127] This technique cannot be evaluated because the DEIS/DEIR does not identify the sampling intensity and area.
3. According to the DEIS/DEIR "[m]onitoring shall take place each year during construction, and annually for the lifespan of the Project following the completion of construction."[128] The DEIS/DEIR needs to identify the monitoring methods.
4. Decommissioning activities will result in conditions that promote the colonization and/or spread of weeds. As a result, weed monitoring and control activities need to extend at least three years past the end of decommissioning.
5. The DEIS/DEIR indicates, "[c]ontrol methods shall be implemented when measurable weed increases, as well as visually verified increases, are detected during monitoring."[129] This condition is too vague. The DEIS/DEIR needs to identify the metric that will be used to identify "measurable weed increases" (e.g., relative abundance, density, or distribution).

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[126] *Ibid*, p. 4.3-20.
[127] *Ibid.*
[128] *Ibid.*
[129] *Ibid*, p. 4.3-21.

6. Mitigation Measure VEG-2 establishes a remedial action trigger for all non-native weed species already present in the Project area, except cheatgrass. As the DEIS/DEIR acknowledges, cheatgrass may pose the biggest threat to vegetation resources in the Project area.[130] As a result, the Project's contribution to an increase in cheatgrass appears to be unmitigated. The DEIS/DEIR needs to clarify and justify (a) the areas where cheatgrass will be controlled; (b) the areas where cheatgrass will be eradicated; and (c) the areas where cheatgrass will be left untreated.
7. The Project has the potential to promote the colonization and spread of weeds throughout its lifespan and until the site has been successfully restored following decommissioning. However, the DEIS/DEIR indicates the success of the Weed Management Plan will be determined after the first three years of monitoring and reporting.[131] This eliminates an enforcement mechanism that ensures weeds are controlled for the remaining 27 years of the Project. The proposed success criteria and reporting measures should be required for the life of the Project, and for at least three years following decommissioning.

I9-117 cont.

Sump Pits

Mitigation Measure WIL-2 for the Project is:

> [w]ater which may accumulate in geothermal well site basins from precipitation shall be removed to a standing depth of 2 inches from the respective basins on a daily basis or as soon as operationally feasible; and liquids deposited into the basins shall either be removed daily to a standing depth of 2 inches, or the basins shall be made wildlife escapable by creating earthen ramps at slopes of 1:3 or less at intervals of 100 feet apart or less around the perimeter of the standing depth of the liquid stored in the basin. The basins shall be monitored during well drilling to determine if these measures are effective. If monitoring determines that these measures are ineffective in preventing wildlife from drowning in the basins, an alternative deterrent or escape structure such as netting will be implemented. Alternatives for providing equally effective measures which would allow wildlife to escape unharmed from the well site basins may be authorized subject to USFS, USFS, and CDFG approval.[132]

I9-118

The DEIS/DEIR concludes this mitigation measure will prevent wildlife from becoming trapped in the lined well site basins, and that it will help reduce impacts to special-status wildlife to a less-than-significant level.[133] I disagree with these conclusions for several reasons.

First, removal of water and other fluids from the basins is conditioned on feasibility, which the DEIS/DEIR fails to define or discuss. Consequently, implementation of the mitigation measure is uncertain, and its effectiveness is unreliable.

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[130] *Ibid*, p. 4.3-16.
[131] *Ibid*, p. 4.3-21.
[132] *Ibid*, p. 4.4-30.
[133] *Ibid*, pp. 4.4-10 and –19.

Second, organisms that fall into the basin can suffer ill effects as soon as they come into contact with fluids in the basin. Even if the organisms are able to locate and swim to the escape ramps, the escape ramps do not mitigate the adverse effects to a less-than-significant level. Presumably the purpose of lining the basins is to prevent hazardous fluids from contaminating the soil and groundwater. It is unclear how the Applicant would be able to install earthen ramps that enable wildlife to escape, yet do not expose soil and groundwater resources to hazardous fluids.

Third, the DEIS/DEIR provides no evidence that the proposed mitigation measures would be effective. Indeed, the DEIS/DEIR suggests it may not be. This issue is confounded because the DEIS/DEIR fails to define the monitoring methods, schedule, and duration. In addition, it fails to establish success criteria, triggers for remedial actions, a reporting program, or a mechanism for enforcement.

Several states require netting or screening of sump pits containing oil to prevent access by wildlife. This measure is feasible, and it should be required for the Project.

I9-118 cont.

Wildlife

The Project may have a significant impact on wildlife movement.[134] The DEIS/DEIR concludes the implementation of Mitigation Measure PDM BIO-1 would reduce the impact to a less-than-significant level. PDM BIO-1 requires a qualified wildlife biologist to walk the pipeline route once each year for the first three years following completion of construction to survey for any signs that the pipeline is impeding wildlife movement. The DEIS/DEIR fails to justify how the proposed measure might be effective. It is unforeseeable that a biologist "walking" the pipeline route a total of three times, to accomplish a mitigation measure without any performance standards or triggers, would be able to determine if the pipeline is impeding wildlife movement. The mitigation measure needs to be redesigned to incorporate remote cameras or other specialized techniques that would provide data on wildlife movement in the vicinity of the Project pipelines. In addition, deer in both the Round Valley and Casa Diablo herds have been fitted with radio-telemetry collars. Data from the radio-telemetry collars should be incorporated into the analysis of potential impacts to wildlife movement.

I9-119

The PDMs and Mitigation Measures proposed in the DEIS/DEIR have been formulated to avoid or minimize impacts to special-status wildlife. However, they do nothing to compensate for impacts to individuals and their habitat, which the DEIS/DEIR identifies as a significant impact.

I9-120

For right-of-way applications that are longer than one mile or that would disturb more than two surface acres, it is the BLM's policy to require measures that minimize impacts to sage-grouse habitat.[135] In addition to this kind of onsite mitigation, the BLM has

I9-121

[134] *Ibid*, p. 4.4-20.
[135] US Department of the Interior, Bureau of Land Management. 2012 Nov 16. Wildlife: Greater sage-grouse conservation [internet]. Available at: http://www.blm.gov/id/st/en/prog/wildlife-botany-

indicated it will develop and consider offsite mitigation measures in cooperation with the applicant, USFWS, BLM State Director, and the Director of the CDFW.[136] The DEIS/DEIR provides no evidence that this coordination has occurred, or will occur. In my professional opinion, habitat compensation is required to mitigate Project impacts to the greater sage-grouse, northern goshawk, American marten, and other special-status wildlife species. I9-121 cont.

Nesting Birds

Mitigation Measure WIL-1 requires pre-construction surveys for bird nests within 250 feet of areas potentially affected by construction activities.[137] The results of the surveys then would be emailed to CDFW, USFS, and USFWS at least three days prior to construction.[138] If any nests are detected, the Applicant would be required to establish a no-work buffer zone around the nest.[139] The size of the no-work buffer zone would be determined in consultation with the CDFW, USFS, and USFWS, although a 500-foot buffer would be used when possible.[140]

Research indicates nest finding is labor intensive and can be extremely difficult due to the tendency of many species to construct well-concealed or camouflaged nests.[141] In general, bird nests are located when a variety of search techniques are used and considerable time is devoted to the effort.[142] As a result, the DEIS/DEIR needs to establish the minimum standards for locating nests and minimizing human-induced disturbance. It also needs to establish that pre-construction surveys for the northern goshawk should adhere to the survey guidelines issued by the USFS.[143] I9-122

The DEIS/DEIR establishes 500 feet as the minimum buffer size around active bird nests. However, it only requires nesting bird surveys within 250 feet of areas potentially affected by construction activities. The Applicant would be unable to establish a 500-foot buffer around all nests if the survey efforts extend only 250 feet beyond the construction area.

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forestry_pgm/wildlife-pgm/BLM-sensitive-species_Idaho/greater-sagegrouse_pgm/conservation_2011/ROWs.html.

[136] US Department of the Interior, Bureau of Land Management. 2012 Nov 16. Wildlife: Greater sage-grouse conservation [internet]. Available at: http://www.blm.gov/id/st/en/prog/wildlife-botany-forestry_pgm/wildlife-pgm/BLM-sensitive-species_Idaho/greater-sagegrouse_pgm/conservation_2011/ROWs.html.

[137] DEIS/DEIR, pp. 4.4-29 and -30.

[138] *Ibid.*

[139] *Ibid.*

[140] *Ibid.*

[141] DeSante DF, GR Geupel. 1987. Landbird productivity in central coastal California: the relationship to annual rainfall and a reproductive failure in 1986. Condor. 89:636-653. See also Baicich PJ, CJ Harrison. 1997. A guide to the nests, eggs, and nestlings of North American Birds. 2nd ed. London: Academic Press.

[142] Martin TE, C Paine, CJ Conway, WM Hochacka . 1996. BBIRD field protocol. Montana Cooperative Wildlife Research Unit, Missoula (MT).

[143] See Woodbridge, B.; Hargis, C.D. 2006. Northern goshawk inventory and monitoring technical guide. Gen. Tech. Rep. WO-71. Washington, DC: U.S. Department of Agriculture, Forest Service. 80 p.

Some species of birds can build a nest and initiate egg-laying in less than 14 days. The mitigation measure should be revised to require pre-construction surveys no more than seven days prior to construction.

The DEIS/DEIR fails to justify why the resource agencies would not be notified of the survey results until as few as 3 days prior to construction, especially because it is feasible to notify them shortly after the surveys are completed (i.e., within 24 to 48 hours). The buffer size needed to protect a bird nest from disturbance is highly dependent on site-specific conditions. Emailing the survey results to the CDFW, USFS, and USFWS three days prior to construction may not be enough time for the agencies to coordinate a site visit with the Applicant's biologist to determine the appropriate buffer size(s). I9-122 cont.

Offsite Aquatic Habitat

According to the DEIS/DEIR, existing monitoring programs under the oversight of the Long Valley Hydrologic Advisory Committee would be expanded to include monitoring for the Proposed Action, in accordance with PDM GEO-5, which is:

> ORNI 50, LLC commits to continuing to operate the existing geothermal projects in conformance with the Plans of Operation for Development, Injection and Utilization, approved by the BLM and USFS, as well as in conformance with monitoring through the Long Valley Hydrologic Advisory Committee, and remedial action programs, which are designed to prevent, or mitigate, potential hydrothermal impacts to the Owens tui chub critical habitat, Hot Creek Hatchery and Hot Creek Gorge springs from geothermal operations conducted on federal geothermal leases in the Mono-Long Valley area. ORNI 50, LLC also commits to operating the proposed geothermal project in conformance with these requirements. I9-123

The DEIS/DEIR concludes this mitigation measure will ensure impacts to the Owens tui chub and its critical habitat would be less than significant.[144] There are several flaws with the DEIS/DEIR's conclusion.

First, the DEIS/DEIR fails to provide adequate information pertaining to the existing monitoring program. I obtained the hydrologic monitoring data that the USGS has collected for the Long Valley Hydrologic Advisory Committee. These data are limited to graphs depicting the relationship between a dependent variable (e.g., water temperature) and an independent variable (e.g., year). There does not appear to have been any statistical analysis of the data or any analytical interpretation of the results. The monitoring program has little value unless the data are analyzed and interpreted.

Second, the value of the proposed mitigation measure cannot be evaluated until the BLM and GBUAPCD identify:

1. the variables that will be monitored. Research indicates variables other than temperature may affect tui chub habitat. As a result, the original hydrologic monitoring program (i.e., for PLES I) may no longer be sufficient.

[144] DEIS/DEIR, p. 4.4-19.

2. the party(ies) responsible for analyzing and interpreting the data.
3. the statistical techniques that are (and will be) used to analyze the data, and the corresponding confidence levels that are (and will be) used in the statistical tests.
4. the specific details of the remedial action program, including the specific monitoring results that would trigger remedial actions.
5. an enforcement mechanism that ensures remedial actions are implemented and successful.
6. how the existing monitoring programs "would be expanded to include monitoring for the Proposed Action."
7. how the Long Valley Hydrologic Advisory Committee will be able to distinguish whether changes in the response variables are due to the CD-IV Project; other geothermal projects in Casa Diablo; naturally occurring events; or an interaction among these factors. As the DEIS/DEIR acknowledges, "it is difficult to identify the smaller effects of geothermal development on the Hatchery springs relative to natural climatic effects because climatic variations and geothermal reservoir changes have both occurred simultaneously."[145]

I9-123 cont.

Third, past experience demonstrates the monitoring program has been ineffective. Specifically, the monitoring program has been ineffective in reversing the decline of thermal water to the Hot Creek Headsprings that began in 1993, or in preventing the significant decline in the Owens tui chub populations that corresponded with the decline in thermal water.

Lastly, the hydrologic and biologic monitoring and mitigation program proposed for the Project may be inconsistent with USFWS Recovery Plan for the Owen tui chub. In particular, Recovery Task 2.4.2 is:

> Protect spring discharge. Geothermal development and groundwater pumping in Long Valley may alter aquifer dynamics. Springs supporting Hot Creek should be protected from adverse impacts of decreased discharge, and changes in the thermal and chemical characteristics of water. Monitoring programs should be [designed to] determine characteristics (temporal, chemical, physical) of natural spring discharge, if spring discharge is being affected, and the location of activities causing adverse effects. Actions should be taken to protect discharge at 1998 levels.[146]

Based on my review, the hydrological and biological monitoring program has not ensured consistency with the Recovery Task (i.e., it has not prevented potential adverse impacts associated with changes in the thermal and chemical characteristics of water in AB Spring and CD Spring), or that actions are, have been, or will be taken to protect discharge at 1998 levels.

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[145] *Ibid*, p. 4.4-13.

[146] U.S. Fish and Wildlife Service. 1998. Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties, California. Portland, Oregon. [emphasis added].

Recommended Mitigation

The loss of the Owens tui chub populations in Hot Creek Headsprings would be an extremely significant impact that would jeopardize the continued existence of the subspecies. As a result, mitigation imposed by the BLM and GBUAPCD should be expanded to include: (a) a management plan for the Owens tui chub populations in the Hot Creek Headsprings; and (b) a reintroduction plan that will be implemented if the populations in the headsprings drop below the minimum viable population level. I9-124

Tree-Kills

The DEIS/DEIR lacks any mitigation for the Project's contribution to tree-kills. Non-native plants colonize sites where recent thermal activity has killed native shrubs and trees.[147] As a result, the Applicant should be required to control and eradicate weeds in the tree-kill areas.

To be consistent with Mono County's General Plan, the Applicant needs to prepare a written analysis of the impacts that the Project and other development projects may individually or cumulatively have on tree-kills.[148] The Applicant should then develop a monitoring plan subject to review by the BLM, GBUAPCD, USFS, County, CDFW, USGS, and other relevant resource agencies. Specific triggers for additional mitigation should be established in conjunction with the monitoring plan. Once Project operations commence, the tree-kills should be monitored to determine the extent of additional impacts to vegetation and other biological resources. If the monitoring indicates geothermal operations have contributed to additional tree kills, the Applicant should take the actions necessary to reduce any adverse effects to less-than-significant levels. I9-125

Sincerely,

Scott Cashen, M.S.
Senior Biologist

[147] DEIS/DEIR, p. 3.3-5.
[148] County of Mono Community Development Department. 2010. Mono County General Plan. Bridgeport, CA. (Drafted July 1997 and Revised 2010). Conservation /Open Space Element-2010, Goal 1.

Scott Cashen, M.S.
Senior Biologist / Forest Ecologist
3264 Hudson Avenue, Walnut Creek, CA 94597. (925) 256-9185. scottcashen@gmail.com

Scott Cashen has 20 years of professional experience in natural resources management. During that time he has worked as a field biologist, forester, environmental consultant, and instructor of Wildlife Management. Mr. Cashen currently operates an independent consulting business that focuses on CEQA/NEPA compliance issues, endangered species, scientific field studies, and other topics that require a high level of scientific expertise.

Mr. Cashen has knowledge and experience with many taxa, biological resource issues, and environmental regulations. This knowledge and experience has made him a highly sought after biological resources expert. To date, he has been retained as a biological resources expert for over 40 projects. Mr. Cashen's role in this capacity has encompassed all stages of the environmental review process, from initial document review through litigation support and expert witness testimony.

Mr. Cashen is a recognized expert on the environmental impacts of renewable energy development. He has been involved in the environmental review process for 28 renewable energy projects, and he has been a biological resources expert for more of California's solar energy projects than any other private consultant. In 2010, Mr. Cashen testified on 5 of the Department of the Interior's "Top 6 Fast-tracked Solar Projects" and his testimony influenced the outcome of each of these projects.

Mr. Cashen is a versatile scientist capable of addressing numerous aspects of natural resource management simultaneously. Because of Mr. Cashen's expertise in both forestry and biology, Calfire had him prepare the biological resource assessments for all of its fuels treatment projects in Riverside and San Diego Counties following the 2003 Cedar Fire. Mr. Cashen has led field studies on several special-status species, including plants, fish, reptiles, amphibians, birds, and mammals. Mr. Cashen has been the technical editor of several resource management documents, and his strong scientific writing skills have enabled him to secure grant funding for several clients.

AREAS OF EXPERTISE

- CEQA, NEPA, and Endangered Species Act compliance issues
- Comprehensive biological resource assessments
- Endangered species management
- Renewable energy
- Forest fuels reduction and timber harvesting
- Scientific field studies, grant writing and technical editing

EDUCATION

M.S. Wildlife and Fisheries Science - The Pennsylvania State University (1998)
B.S. Resource Management - The University of California, Berkeley (1992)

PROFESSIONAL EXPERIENCE

Litigation Support / Expert Witness

As a biological resources expert, Mr. Cashen reviews CEQA/NEPA documents and provides his client(s) with an assessment of biological resource issues. He then prepares written comments on the scientific and legal adequacy of the project's environmental documents (e.g., EIR). For projects requiring California Energy Commission (CEC) approval, Mr. Cashen has submitted written testimony (opening and rebuttal) in conjunction with oral testimony before the CEC.

Mr. Cashen can lead field studies to generate evidence for legal testimony, and he can incorporate testimony from his deep network of species-specific experts. Mr. Cashen's clients have included law firms, non-profit organizations, and citizen groups.

<u>REPRESENTATIVE EXPERIENCE</u>

Solar Energy Facilities
- Abengoa Mojave Solar Project
- Avenal Energy Power Plant
- Beacon Solar Energy Project
- Blythe Solar Power Project
- Calico Solar Project
- Calipatria Solar Farm II
- Carrizo Energy Solar Farm
- Catalina Renewable Energy Project
- Fink Road Solar Farm
- Genesis Solar Energy Project
- Heber Solar Energy Facility
- Imperial Valley Solar Project
- Ivanpah Solar Electric Generating
- Maricopa Sun Solar Complex
- Mt. Signal and Calexico Solar
- San Joaquin Solar I & II
- Solar Gen II Projects
- SR Solis Oro Loma
- Vestal Solar Facilities
- Victorville 2 Power Project

Geothermal Energy Facilities
- East Brawley Geothermal
- Mammoth Pacific 1 Replacement
- Western GeoPower Plant and

Wind Energy Facilities
- Catalina Renewable Energy Project
- Ocotillo Express Wind Energy
- San Diego County Wind Ordinance
- Tres Vaqueros Repowering Project
- Vasco Winds Relicensing Project

Biomass Facilities
- Tracy Green Energy Project

Development Projects
- Alves Ranch
- Aviano
- Chula Vista Bayfront Master Plan
- Columbus Salame
- Concord Naval Weapons Station
- Faria Annexation
- Live Oak Master Plan
- Napa Pipe
- Roddy Ranch
- Rollingwood
- Sprint-Nextel Tower

Project Management

Mr. Cashen has managed several large-scale wildlife, forestry, and natural resource management projects. Many of these projects have required hiring and training field crews, coordinating with other professionals, and communicating with project stakeholders. Mr. Cashen's experience in study design, data collection, and scientific writing make him an effective project manager, and his background in several different natural resource disciplines enable him to address the many facets of contemporary land management in a cost-effective manner.

REPRESENTATIVE EXPERIENCE

Wildlife Studies

- Peninsular Bighorn Sheep Resource Use and Behavior Study: (*CA State Parks*)
- "KV" Spotted Owl and Northern Goshawk Inventory: (*USFS, Plumas NF*)
- Amphibian Inventory Project: (*USFS, Plumas NF*)
- San Mateo Creek Steelhead Restoration Project: (*Trout Unlimited and CA Coastal Conservancy, Orange County*)
- Delta Meadows State Park Special-status Species Inventory: (*CA State Parks, Locke*)

Natural Resources Management

- Mather Lake Resource Management Study and Plan – (*Sacramento County*)
- Placer County Vernal Pool Study – (*Placer County*)
- Weidemann Ranch Mitigation Project – (*Toll Brothers, Inc., San Ramon*)
- Ion Communities Biological Resource Assessments – (*Ion Communities, Riverside and San Bernardino Counties*)
- Del Rio Hills Biological Resource Assessment – (*The Wyro Company, Rio Vista*)

Forestry

- Forest Health Improvement Projects – (*CalFire, SD and Riverside Counties*)
- San Diego Bark Beetle Tree Removal Project – (*SDG&E, San Diego Co.*)
- San Diego Bark Beetle Tree Removal Project – (*San Diego County/NRCS*)
- Hillslope Monitoring Project – (*CalFire, throughout California*)

Biological Resources

Mr. Cashen has a diverse background with biological resources. He has conducted comprehensive biological resource assessments, habitat evaluations, species inventories, and scientific peer review. Mr. Cashen has led investigations on several special-status species, including ones focusing on the foothill yellow-legged frog, mountain yellow-legged frog, desert tortoise, steelhead, burrowing owl, California spotted owl, northern goshawk, willow flycatcher, Peninsular bighorn sheep, red panda, and forest carnivores.

REPRESENTATIVE EXPERIENCE

Avian

- Study design and Lead Investigator - Delta Meadows State Park Special-Status Species Inventory *(CA State Parks: Locke)*
- Study design and lead bird surveyor - Placer County Vernal Pool Study *(Placer County: throughout Placer County)*
- Surveyor - Willow flycatcher habitat mapping *(USFS: Plumas NF)*
- Independent surveyor - Tolay Creek, Cullinan Ranch, and Guadacanal Village restoration projects *(Ducks Unlimited/USGS: San Pablo Bay)*
- Study design and Lead Investigator - Bird use of restored wetlands research *(Pennsylvania Game Commission: throughout Pennsylvania)*
- Study design and surveyor - Baseline inventory of bird species at a 400-acre site in Napa County *(HCV Associates: Napa)*
- Surveyor - Baseline inventory of bird abundance following diesel spill *(LFR Levine-Fricke: Suisun Bay)*
- Study design and lead bird surveyor - Green Valley Creek Riparian Restoration Site *(City of Fairfield: Fairfield, CA)*
- Surveyor - Burrowing owl relocation and monitoring *(US Navy: Dixon, CA)*
- Surveyor - Pre-construction raptor and burrowing owl surveys *(various clients and locations)*
- Surveyor - Backcountry bird inventory *(National Park Service: Eagle, Alaska)*
- Lead surveyor - Tidal salt marsh bird surveys (*Point Reyes Bird Observatory: throughout Bay Area*)
- Surveyor – Pre-construction surveys for nesting birds (*various clients and locations)*

Amphibian

- Crew Leader - Red-legged frog, foothill yellow-legged frog, and mountain yellow-legged frog surveys *(USFS: Plumas NF)*

- Surveyor - Foothill yellow-legged frog surveys *(PG&E: North Fork Feather River)*
- Surveyor - Mountain yellow-legged frog surveys *(El Dorado Irrigation District: Desolation Wilderness)*
- Crew Leader - Bullfrog eradication *(Trout Unlimited: Cleveland NF)*

Fish and Aquatic Resources

- Surveyor - Hardhead minnow and other fish surveys *(USFS: Plumas NF)*
- Surveyor - Weber Creek aquatic habitat mapping (*El Dorado Irrigation District: Placerville, CA*)
- Surveyor - Green Valley Creek aquatic habitat mapping *(City of Fairfield: Fairfield, CA)*
- GPS Specialist - Salmonid spawning habitat mapping *(CDFG: Sacramento River)*
- Surveyor - Fish composition and abundance study (*PG&E: Upper North Fork Feather River and Lake Almanor*)
- Crew Leader - Surveys of steelhead abundance and habitat use *(CA Coastal Conservancy: Gualala River estuary)*
- Crew Leader - Exotic species identification and eradication *(Trout Unlimited: Cleveland NF)*

Mammals

- Principal Investigator – Peninsular bighorn sheep resource use and behavior study (*California State Parks: Freeman Properties*)
- Scientific Advisor –Study on red panda occupancy and abundance in eastern Nepal *(The Red Panda Network: CA and Nepal)*
- Surveyor - Forest carnivore surveys *(University of CA: Tahoe NF)*
- Surveyor - Relocation and monitoring of salt marsh harvest mice and other small mammals *(US Navy: Skagg's Island, CA)*
- Surveyor – Surveys for Monterey dusky-footed woodrat. Relocation of woodrat houses (*Touré Associates: Prunedale*)

Natural Resource Investigations / Multiple Species Studies

- Scientific Review Team Member – Member of the science review team assessing the effectiveness of the US Forest Service's implementation of the Herger-Feinstein Quincy Library Group Act.
- Lead Consultant - Baseline biological resource assessments and habitat mapping for CDF management units *(CDF: San Diego, San Bernardino, and Riverside Counties)*

- Biological Resources Expert – Peer review of CEQA/NEPA documents (*Adams Broadwell Joseph & Cardoza: California)*
- Lead Consultant - Pre- and post-harvest biological resource assessments of tree removal sites *(SDG&E: San Diego County)*
- Crew Leader - T&E species habitat evaluations for Biological Assessment in support of a steelhead restoration plan *(Trout Unlimited: Cleveland NF)*
- Lead Investigator - Resource Management Study and Plan for Mather Lake Regional Park *(County of Sacramento: Sacramento, CA)*
- Lead Investigator - Biological Resources Assessment for 1,070-acre Alfaro Ranch property *(Yuba County, CA)*
- Lead Investigator - Wildlife Strike Hazard Management Plan *(HCV Associates: Napa)*
- Lead Investigator - Del Rio Hills Biological Resource Assessment *(The Wyro Company: Rio Vista, CA)*
- Lead Investigator – Ion Communities project sites (*Ion Communities: Riverside and San Bernardino Counties*)
- Surveyor – Tahoe Pilot Project: Validation of California's Wildlife Habitat Relationships (CWHR) Model *(University of California: Tahoe NF)*

Forestry

Mr. Cashen has five years of experience working as a consulting forester on projects throughout California. Mr. Cashen has consulted with landowners and timber operators on forest management practices; and he has worked on a variety of forestry tasks including selective tree marking, forest inventory, harvest layout, erosion control, and supervision of logging operations. Mr. Cashen's experience with many different natural resources enable him to provide a holistic approach to forest management, rather than just management of timber resources.

REPRESENTATIVE EXPERIENCE

- Lead Consultant - CalFire fuels treatment projects *(SD and Riverside Counties)*
- Lead Consultant and supervisor of harvest activities – San Diego Gas and Electric Bark Beetle Tree Removal Project *(San Diego)*
- Crew Leader - Hillslope Monitoring Program *(CalFire: throughout California)*
- Consulting Forester – Forest inventories and timber harvest projects *(various clients throughout California)*

Grant Writing and Technical Editing

Mr. Cashen has prepared and submitted over 50 proposals and grant applications. Many of the projects listed herein were acquired through proposals he wrote. Mr. Cashen's clients and colleagues have recognized his strong scientific writing skills and ability to generate technically superior proposal packages. Consequently, he routinely prepares funding applications and conducts technical editing for various clients.

PERMITS

U.S. Fish and Wildlife Service Section 10(a)(1)(A) Recovery Permit for the Peninsular bighorn sheep

CA Department of Fish and Game Scientific Collecting Permit

PROFESSIONAL ORGANIZATIONS / ASSOCIATIONS

The Wildlife Society (Conservation Affairs Committee member)

Cal Alumni Foresters

Mt. Diablo Audubon Society

OTHER AFFILIATIONS

Scientific Advisor and Grant Writer – *The Red Panda Network*

Scientific Advisor – *Mt. Diablo Audubon Society*

Grant Writer – *American Conservation Experience*

Scientific Advisor and Land Committee Member – *Save Mt. Diablo*

TEACHING EXPERIENCE

Instructor: Wildlife Management - The Pennsylvania State University, 1998

Teaching Assistant: Ornithology - The Pennsylvania State University, 1996-1997

California Wildlife Habitat Relationships System
California Department of Fish and Game
California Interagency Wildlife Task Group

Jeffrey Pine

Joe R. McBride

Vegetation

Structure-- The structure of the Jeffrey pine forest varies over its distribution. A single tree layer is characteristic of Jeffrey pine stands on moderately dry sites, giving an impression of openness, limited leaf area, light, and heat. On moist and mesic sites a second tree layer exists which is composed of deciduous hardwood species, whereas on dry sites evergreen hardwood species form the second tree layer. Conifer species provide the second tree layer on xeric sites. The single (or upper) tree layer ranges from 30 to 50 m (98 to 164 ft) in height, but in some stands this layer may exceed 65 m (213 ft) (Fowells 1965). The second tree layer, where it exists, varies from 5 to 10 m (16 to 33 ft) in height. Complete (100 percent) crown cover is seldom encountered in Jeffrey pine habitats. Most stands have typically between 40 and 70 percent crown cover in the uppermost tree layer and usually less than 50 percent crown cover in the second layer, except on moist sites where Aspen cover may approach 100 percent. In southern California a krummholz form, where trees are only a few meters tall, is found at higher elevations near timberline.

A sclerophyllous shrub layer is common to most Jeffrey pine stands except on serpentine soils, extremely xeric sites where the shrub layer is absent (Jenkinson 1980), and where the krummholz form exists. Height and crown cover of the shrub layer varies with site characteristics. For example, taller shrub layers up to 2 m (6 ft) with significant crown (>70 percent) are common on more mesic sites.

Composition-- Jeffrey pine is the dominant species found in the upper tree layer. It usually forms pure stands but may have as its associates ponderosa pine, Coulter pine, sugar pine, lodgepole pine, timber pine, white fir, red fir, incense-cedar, and black cottonwood. Jenkinson (1980) suggests that any stand in which Jeffrey pine makes up the majority of the stocking should be recognized as Jeffrey pine. Dominant species composition of the second tree layer consists of aspen on moist sites, California black oak on mesic sites, and pinyon pine and western juniper on dry sites. Shrub species composition varies between geographical regions. In the Klamath Mountains, huckleberry, scrub oak, manzanita, Fremont silktassel and coffeeberry dominate the shrub layer. Shrubs common to the Jeffrey pine type on the western slope of the Sierra Nevada include huckleberry oak, manzanita, and mountain misery. East of the Sierra-Cascade crest, the dominant shrub layer species include squaw currant, snowbush, and greenleaf manzanita at higher elevations, and antelope bitterbrush, rabbitbrush, and sagebrush at lower elevations. The shrub layer of Jeffrey pine stands in southern

California is dominated by scrub oak, ceanothus, Sierra chinquapin, manzanita, Parish snowberry, and cherry. Herbaceous species common to the Jeffrey pine type in southern California include rockcress, birdbeak, buckwheat, fritillary, groundsmoke, ivesia, lupine, rock melic, Bridge's penstemon, penstemon and needlegrass (Thorne 1977). Species common to Jeffrey pine stands along the east slope of the Sierra Nevada include squirreltail, blue wildrye, slender hairgrass, western needlegrass, woolly wyethia, and pennyroyal.

Other Classifications-- Jeffrey pine has been included in the broad yellow pine forest type of Munz and Keck (1949-50); pine-Douglas-fir, pine-fir, and pine-Douglas-fir-fir of Jensen (1947); Jeffrey pine of Parker and Matyas (1981), SAF (Eyre 1980), and Cheatham and Haller (1975); the upper montane mixed conifer forest of Cheatham and Haller (1975); and type 42 - evergreen forest land of Anderson et al. (1976). Jeffrey pine is divided into two classes -northern Jeffrey pine forest and southern Jeffrey pine forest - by Küchler (1977). Paysen et al. (1980) includes Jeffrey pine in the Ponderosa/Jeffrey Pine Series of the Conifer Forest Subformation. Horton (1960) divides it between the pine forest type and the sugar pine-white fir forest type, while Thorne (1975)(No Thorne 1975 Cite. There is a 1976 Cite. None placed in Lit Cite at end.) includes it in the yellow pine forest.

Habitat Stages

Vegetation Changes-- 1;2-5:S-D. Old-growth Jeffrey pine stands exhibit an uneven-aged structure. Analysis of fire scars and age structure suggests that prehistoric fires played an important role in regeneration without destroying the overstory (McBride and Laven 1976); however, in southern California fires have recently eliminated large areas of Jeffrey pine forest overstory because of accumulated surface fuels. The successional pattern following these fires involves an initial fireweed stage, followed by a shrub stage dominated by ceanothus and manzanita. Where canyon live oak is present in the second tree layer, an oak stage develops instead of the more common shrub stage (Minnick 1976). In time, Jeffrey pine succeeds the shrub or oak stage to restore the original vegetation.

Duration of Stages-- Jeffrey pine stands are self-perpetuating under a regime of periodic surface fires. Typical old-growth stands in southern California support trees up to 450 years old. The age structure of these stands suggests that regeneration has occurred about every 40 to 60 years (Laven 1982). Where crown fires have created openings, the fireweed stage lasts for 2 to 3 years, followed by the shrub stage which persists for 15 to 20 years. Extensive areas of ceanothus and manzanita (i.e., montane chaparral) and canyon live oak woodland, resulting from large crown fires occurring in the last 70 years in the San Bernardino Mountains, show no evidence of reestablishment of Jeffrey pine, and further succession of these areas to Jeffrey pine is problematical. Forest harvesting using selective cutting and sanitation-salvage methods has converted Jeffrey pine stands to oak woodlands or montane chaparral in the San Bernardino Mountains (Minnick 1976)(Listed as Minnich in Lit Cite?). Where clearcutting or group selection cutting was followed by planting Jeffrey pine, the type has been successfully maintained.

Biological Setting

Habitat-- The Jeffrey pine habitat is associated with Douglas-fir at its lower elevations and subalpine conifer at its higher elevations in the Klamath Mountains. East of the Sierra-Cascade crest it occurs between subalpine conifer at higher elevations and pinyon-juniper or sagebrush at lower elevations. On the west side of the Sierra Nevada, Jeffrey pine is generally found above Sierra: Nevada mixed conifer and below the subalpine conifer or alpine dwarf shrub. On ultramafic soils at mid-elevations, Jeffrey pine is surrounded by mixed conifer (Sierra Nevada and Klamath-enriched). In southern California, Jeffrey pine is situated above ponderosa pine or blue oak-foothill pine on the southern side of the Transverse and the southwestern side of the Peninsular Ranges. At higher elevations in these mountains it gives way to subalpine conifer. At lower elevations on the northern side of the Trans verse Range it adjoins pinyon-juniper. On the northeastern side of the Peninsular Range, it is adjacent to the desert scrub or pinyon-juniper. Areas of Jeffrey pine forest in the Peninsular Range east of San Diego are surrounded by chamise (redshank) or are adjacent to pinyon-juniper type.

Wildlife Considerations-- Jeffrey pine is intermediate in species richness between warmer forests- at lower elevations and colder forests at higher elevations in the Klamath Mountains and on the west side of the Sierra Nevada. Its species richness exceeds that of the adjacent upper elevation forests and lower elevation woodland and scrub types in both the Transverse and Peninsular Ranges.

The value of the Jeffrey pine forest type as a habitat for wildlife is due in large part to the food value of the Jeffrey pine seeds. Pine seeds are included in the diet of more wildlife species than any other genus except oak (Light 1973). The bark and foliage also serve as important food sources for squirrels and mule deer. Jeffrey pine provides vital nesting cover for several species such as nuthatch, brown creeper, woodpecker, and northern flying squirrel. The southern rubber boa, a species listed as rare by the State of California and sensitive by the U.S. Forest Service, is reported to occur in the Jeffrey pine forest type in southern California (Cunningham 1966).

Physical Setting

Jeffrey pine occurs in a variety of physical settings throughout its extensive range. The tolerance of its dominant species to low temperatures allows the type to occupy the borders of topographic frost pockets and high cold ridges (Haller 1959). It is commonly found on soils developed from granite and lava flows, but can also develop as a type on ultramafic soils (Walker 1954). Its distribution in northern California west of the Sierra-Cascade crest is limited to such soils (Jenkinson 1980). Jeffrey pine is not restricted by aspect or slope.

Distribution

Jeffrey pine ranges from 150 to 2900 m (500 to 9500 ft), the actual range depending upon latitude. The habitat covers extensive areas in the Klamath Mountains, North Coast Range, Cascade Range, Modoc Plateau, Sierra Nevada, Transverse Range, and the Peninsular Range in California. It also occurs in Oregon, Nevada, and Baja California.

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CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS SYSTEM
WOODED HABITAT SAMPLING DATASHEET

Date:______________ Sample Crew:_______________________________ Plot Number:______ Location:____

Visual estimate at plot center before sampling: CWHR habitat type, size class and canopy closure class:____
Structure: Even-structure:__________________,or Uneven-structure:__________________

Standards For Tree Size				
CWHR Code	CWHR Size Class	Conifer Crown Diameter	Hardwood Crown Diameter	DBH
1	Seedling tree	n/a	n/a	<1.0"
2	Sapling tree	n/a	<15.0'	1.0"-5.9"
3	Pole tree	<12.0'	15.0'-29.9'	6.0"-10.9"
4	Small tree	12.0'-23.9'	30.0'-44.9'	11.0"-23.9"
5	Medium/large tree	>24.0'	>45.0'	>24.0"
6	Multi-layered tree	A distinct layer of size class 5 trees over a distinct layer of size class4 and/or 3 trees, and total tree canopy of the layers > 60% (layers must have > 10.0% canopy cover and distinctive height separation)		

Standards For Canopy Closure		
CWHR Code	CWHR Closure Class	Veg. Cover (Canopy Closure)
S	Sparse Cover	10.0-24.9%
P	Open cover	25.0-39.9%
M	Mod. Cover	40.0-59.9%
D	Dense Cover	>60.0%

Uneven-structure = >3 CWHR size classes, or if only 2 classes present, then the classes must skip an intervening class (e.g, 5 and 3 present but not 4) with distinctive height separation. Plots are even-structured if they do not meet uneven-structure definition.

Record species and dbh from all live woody stems > 5.0" dbh in a 0.1-acre circular plot (37.2 ft radius). Crown diameter and height are from 1 tree/cardinal compass quarter with point-centered quarter for a total of 4 trees/plot. Overstory trees include pre-dominants and dominants, and generally co-dominants. Intermediate trees may be overstory or understory trees depending on relative crown position, while suppressed trees should always be understory trees.

Stem #	Species	Over/ under	dbh (0.1 in) in) in	Crown diam (ft)	Ht (ft)	pt-ctr 1/4 quad quad	Stem #	Species	Over/ under	dbh (0.1 in)	Crown diam (ft)...	Ht (ft)	pt-ctr 1/4 quad
1							26						
2							27						
3							28						
4							29						
5							30						
6							31						
7							32						
8							33						
9							34						
10							35						
11							36						
12							37						
13							38						
14							39						
15							40						
16							41						
17							42						
18							43						
19							44						
20							45						
21							46						
22							47						
23							48						
24							49						
25							50						

OVERSTORY CANOPY COVER MEASUREMENT

Overstory cover hits (+) and misses (0) measured through a sighting tube at 6.2 ft. intervals beginning at the North stake and proceeding along the N-S axis for 13 readings, then from the East stake along the E-W axis for 12 readings and skipping the center stake. Take readings with tube held over the 6.2 ft. interval.

Percent Cover = (_____ (no. hits)/25)) * 100.

N-S:__ __ __ __ __ __ __ __ __ __ __ __ __ E-W:__ __ __ __ __ __ __ __ __ __ __ __

(Center stake)

California Wildlife Habitat Relationships System
California Department of Fish and Game
California Interagency Wildlife Task Group

FISHER *Martes pennanti*
Family: MUSTELIDAE Order: CARNIVORA Class: MAMMALIA
M155

Written by: G. Ahlborn
Reviewed by: M. White
Edited by: M. White, G. Ahlborn

DISTRIBUTION, ABUNDANCE, AND SEASONALITY

Uncommon permanent resident of the Sierra Nevada, Cascades, and Klamath Mts.; also found in a few areas in the North Coast Ranges (Grinnell et al. 1937). Occurs in intermediate to large-tree stages of coniferous forests and deciduous-riparian habitats with a high percent canopy closure (Schempf and White 1977).

SPECIFIC HABITAT REQUIREMENTS

Feeding: Fishers are largely carnivorous. Eat rabbits and hares, especially snowshoe hares, and rodents (mice, porcupines, squirrels, mountain beavers), shrews, birds, fruits, and carrion. Prey on ground surface and in trees. Fishers are opportunistic; they search for small mammals, and pounce on, or chase prey. Also dig out prey. Grenfell (1979) reported that the most important food item in the stomachs of 8 fishers was false truffle, a subterranean fungus.

Cover: Fishers use cavities in large trees, snags, logs, rock areas, or shelters provided by slash or brush piles. Dense, mature stands of trees also provide cover, especially in winter.

Reproduction: Fishers den in a variety of protected cavities, brush piles, logs, or under an upturned tree. Hollow logs, trees, and snags are especially important.

Water: May require drinking water.

Pattern: Suitable habitat for fishers consists of large areas of mature, dense forest stands with snags and greater than 50% canopy closure.

SPECIES LIFE HISTORY

Activity Patterns: Active yearlong. Mostly nocturnal and crepuscular, some diurnal activity.

Seasonal Movements/Migration: Non-migratory.

Home Range: In Ontario, Canada, home ranges were estimated at 38 km^2 (10 mi^2) (deVos 1952). In Massachusetts, home ranges averaged 19.2 km^2 (74 mi^2), and varied from 6.6 to 39.6 km^2 (2.5 to 15.3 mi^2). Home ranges usually smaller in summer than in winter (Kelly 1977). The long axis of home range tends to parallel valleys. Home ranges of 3 adult males in Trinity Co. averaged 14 km^2 (5.4 mi^2) (Buck et al. 1979). The fishers in Trinity Co. appeared to have regularly used travel routes within the home ranges (Buck et al. 1979)

Territory: Fishers appear to be territorial (Powell 1981b).

Reproduction: Females breed a few days after parturition; implantation of the embryo is delayed until the following winter. Post-implantation active growth lasts about 30 days (Powell 1981b). Young born February through May. Litter size averages 2.7, and ranges from 1-4, rarely 5. Young remain with female until late autumn. Males and females become sexually mature in the first or second yr (Powell 1982).

Niche: Few animals prey on fishers other than humans. Fishers are one of the few specialized predators on porcupines. Have been transplanted into Oregon, West Virginia, and other states for porcupine control (Hooven 1971, Powell 1981a, 1981b, 1982). Long-term studies suggest that fishers predominantly are terrestrial (Powell 1981b).

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Comment Letter I9

To: Steven Kerns
Wildlands Resource Managers
P.O. Box 102
Round Mountain, CA 96084

June 18, 2001

From: Jim Paulus
Consulting Botanist, EMA Associates
PO Box 244
Bishop, CA 93515

RE: Plant communities found at the Basalt Canyon Geothermal Exploration Survey Area

Dear Mr. Kerns,

I am writing to inform you of results of botanical survey work I have recently completed within the approximately 800 acre Basalt Canyon geothermal exploration area of the proposed Mammoth Pacific Geothermal Project. The botanical survey was performed to determine the presence or absence of sensitive plant species. All of the land surveyed is located west of Highway 395 north of the Highway 203 exit, near the Town of Mammoth Lakes, Mono County, California and is administered by the Inyo National Forest.

Great Basin Mixed Scrub and Jeffrey Pine Forest plant communities were found on currently undeveloped, rolling hills and steep slopes, crossed by many dirt roads and bicycle trails. "Murphy Gulch", an ephemeral stream channel, parallels Highway 203 near the southern edge of the survey area (Figure 1). No other hydrologic features (streams, seeps, wet meadows) were encountered. My survey strategy was floristic, striving to identify every species occurring along the transects. I have attached a list of the species found.

Typical dominants of the Great Basin Mixed Scrub were found at high frequencies at lower elevations, especially big sagebrush (*Artemisia tridentata*), antelope bush (*Purshia tridentata*), while tobacco brush (*Ceanothus velutinus*) and manzanita (*Arctostaphylos nevadensis* and *A. patula*) were restricted to patches on the steep slopes of the ridge west of Highway 395. Dominance by *A. tridentata* was usually 60-80%, and scrub height averaged 1 m. Perennial grasses (*Achnatherum hymenoides, A. occidentalis, A. nevadensis,* and *Leymus cinereus*) make up a significant percentage of the Mixed Scrub cover. Riparian vegetation was not found where Murphy Gulch (a conduit for runoff from impervious surfaces in Mammoth Lakes, upstream) bisected rolling hills dominated by Great Basin Mixed Scrub. However, a few patches of pine, and thick but small stands of shrubs such as bitter cherry (*Prunus emarginata*), were present to provide cover for animals. Deer sign was relatively profuse along the length of the Gulch.

Forest canopy cover is nearly monospecific Jeffrey pine (*Pinus jeffreyi*) at lower elevations. On steeper slopes near the ridge line west of Highway 395, white fir (*Abies concolor*), pinyon pine (*Pinus monophylla*), and juniper (*Juniperus occidentalis*) are mixed into the Forest canopy. Forest floor cover consisting of sometimes dense perennial grasses (mostly *Poa* *wheeleri*) and snowberry (*Symphoricarpos rotundifolia*) was found to be widespread. Habitat quality for deer in otherwise dense Forest near the eastern edge of the survey area is probably further enhanced by the high frequency of small, shrubby forest gaps.

Larger openings in the Forest canopy occur on the steeper slopes of higher elevations in the study area. Great Basin Mixed Scrub of higher diversity, ranging from nearly impassable inclusions of Tobacco Brush Chaparral to more open, herb-dominated inclusions of low Buckwheat Scrub, was found on these dry steep slopes. The frequency of the browse species *P. tridentata* occasionally increases to > 90%, and these areas were associated with high use by mule deer. Patches of desert peach (*Prunus andersonii*) showed similar relatively high usage by deer.

I did not see a lot of sign of deer use in Scrub-covered lower slopes central to the Basalt Canyon study area. I saw about 15 deer during the 8 days I have spent on site, all in Murphy Gulch, at the forest/scrub interfaces on lower slopes, and in heavy scrub cover on higher slopes. I did not find any water sources on the study area at the time of the survey. I believe the nearest surface water is Sherwin Creek south of Highway 203. Ground squirrels are common in Murphy Gulch. I observed a pair of red-tailed hawks on several consecutive days near the rocky outcrop on the ridgeline west of Highway 395. Smaller migratory birds were the only other wildlife observed during this work.

I hope this helps with your wildlife assessment. Call me at (760) 873-8516 if you have any questions.

Yours truly,

James R. Paulus

James R. Paulus, Ph.D.

cc. Dwight Carey

Plant Families and Species	Habit	Scrub	Forest	Disturbed
Boraginaceae				
Cryptantha circumscissa	NAH	x		x
Cryptantha confertifolia	NPH	x		
Cryptantha echinella	NAH	x		
Cryptantha micrantha	NAH	x		
Brassicaceae				
Arabis holboellii var. *retrofracta*	NPH	x	x	
Arabis inyoensis	NPH	x		x
Arabis platysperma var. *platysperma*	NPH	XMG		
Arabis puberula	NPH	x		
Arabis pulchra var. *pulchra*	NPH	x		
Arabis sparsiflora var. *sparsiflora*	NPH	x		
Descurainia californica	NAH	x		x
Descurainia sophia	IAH	x		x
Erysimum capitatum ssp. *capitatum*	NBH	x		
Lepidium desiflorum var. *macrocarpum*	NBH	XMG		
Thelypodium milleflorum	NBH	x		
Caprifoliaceae				
Symphoricarpos rotundifolius var. *parishii*	NS		x	
Symphoricarpos rotundifolius var. *rotundifolius*	NS	x	x	
Caryophyllaceae				
Stellaria borealis ssp. *sitchana*	NPH	XMG		
Chenopodiaceae				
Chenopodium ambrosioides	IAH			x
Chenopodium foliosum	IAH			XPO
Chenopodium pratericola	NAH	x		x
Grayia spinosa	NS	x		
Salsola tragus	IAH	x		x
Ericaceae				
Arctostaphylos nevadensis	NS	x	x	
Arctostaphylos patula	NS	x		
Fabaceae				
Astragalus purshii	NPH	x		x
Lupinus albicaulis	NPH	x		
Lupinus andersonii	NPH	x		
Lupinus argenteus var. *heteranthus*	NPH	x		x
Lupinus bicolor	NAH	x		
Trifolium andersonii var. beatlyae	NPH	x		
Fagaceae				
Chrysolepis sempervirens	NS	x		
Geraniaceae				
Erodium cicutarium	IAH			XFU

List of plant species occurring in the area of the Basalt Canyon Geothermal Exploration. Habit summarizes the growth form of each species. Plants occurred in one of four habitats. Habit codes are defined below.

Plant Families and Species	Habit	Occurrence in Study Area: Scrub	Forest	Disturbed
Cupressaceae				
Juniperus occidentalis	NT	X	X	
Dryopteridaceae				
Woodsia oregana	NPH	XMG		
Pinaceae				
Abies concolor	NT		X	
Pinus contorta ssp. *murrayana*	NT	XMG		
Pinus flexilis (?, 1 ind.)	NT	XMG		
Pinus jeffreyi	NT	X	X	
Pinus monophylla	NT		X	
Dicots				
Amaranthaceae				
Amaranthus californicus	NAH			XPU
Apiaceae				
Cymopterus terebinthinus var. *petraeus*	NPH	X		
Asteraceae				
Achillea millefolium	NPH	XMG		
Ag[illegible] glauca var. *laciniata*	NPH	X		
Agoseris retrorsa	NPH	X		
Ambrosia acanthicarpa	NAH			X
Artemisia cana ssp. *bolanderi*	NS	X		
Artemisia douglasiana	NPH	XMG		
Artemisia tridentata	NS	X	X	X
Aster ascendens	NPH	X		
Chaenactis stevioides	NAH	X		X
Chrysothamnus nauseosus	NS	X		X
Chrysothamnus parryi ssp. *nevadensis*	NS	X		
Chrysothamnus teretifolius	NS	X		
Chrysothamnus viscidiflorus ssp. *puberulus*	NS	X		
Chrysothamnus viscidiflorus ssp. *viscidiflorus*	NS	X		
Crepis acuminata	NPH	X		
Machaeranthera canescens var. *canescens*	NPH	X		
Rigiopappus leptocladus	NAH			XPO
Senecio aronicoides	NPH	XMG		
Senecio integerrimus var. *exaltatus*	NPH	XMG		
Stephanomeria paniculata	NAH	X		
Stephanomeria spinosa	NPH	X		
Tetradymia canescens	NS	X		
Tragopogon dubius	IBH			X
Wyethia mollis	NPH	X		

Plant Families and Species	Habit	Scrub	Forest	Disturbed
Grossulariaceae				
Ribes cereum var. *cereum*	NS	x	x	
Hydrophyllaceae				
Nama aretioides var. *multiflorum*	NAH			x
Nama californicum	NAH			x
Nama rothrockii	NPH	x		x
Phacelia bicolor	NAH	x		
Phacelia vallis-mortae	NAH	x		x
Phacelia glandulifera	NAH	x		
Phacelia hastata ssp. *hastata*	NPH			x
Phacelia sp.	NAH	x		
Lamiaceae				
Monardella odoratissima ssp. *odoratissima*	NPH	x		
Loasaceae				
Mentzelia congesta	NAH	x		x
Mentzelia dispersa	NAH	x		x
Mentzelia veatchiana	NAH			x
Onagraceae				
Gayophytum diffusum ssp. *parviflorum*	NAH	x		x
Papaveraceae				
Argemone minuta	NPH	x		x
Polemoniaceae				
Allophyllum gilioides	NAH	x		x
Gilia brecciarum ssp. *brecciarum*	NAH	x		
Eriastrum sparsiflorum	NAH	x		x
Leptodactylon pungens	NPH	x		
Linanthus nuttallii ssp. *pubescens*	NPH	x	x	
Phlox condensata	NS	x		
Phlox gracilis	NAH	XMG		
Phlox stansburyi	NPH	x		
Polygonaceae				
Eriogonum maculatum	NAH	x		x
Eriogonum ovalifolium	NPH	x		x
Eriogonum parishii	NAH	x		
Eriogonum umbellatum	NS	x		
Eriogonum umbellatum var. *nevadense*	NS	x		
Polygonum arenastrum	IAH			x
Polygonum polygaloides	NAH	x		
Rumex crispus	IPH	XMG		
Portulacaceae				
Calyptridium monospermum	NPH	x		x
Calyptridium umbellatum	NPH			x

Plant Families and Species	Habit	Scrub	Forest	Disturbed
Rhamnaceae				
Ceanothus velutinus	NS	X		
Rhamnus sp.	NS	X		
Ranunculaceae				
Delphinium cf. *parishii*	NPH	X		
Rosaceae				
Amelanchier utahensis	NS		X	
Holodiscus microphyllus var. *microphyllus*	NS	X	X	
Prunus andersonii	NS	X		
Prunus emarginata	NS	X	X	
Rosa woodsii	NS	X		
Purshia tridentata var. *tridentata*	NS	X		
Rubiaceae				
Galium multiflorum	NPH	X	X	
Kelloggia galioides	NPH	X		
Scrophulariaceae				
Castilleja angustifolia	NPH	X		
Mimulus nanus	NAH	X		
Orthocarpus luteus	NPH	X		
Penstemon azureus var. *angustissimus*	NPH	X		
Penstemon rostriflorus	NPH	X	X	
Verbascum thapsus	IBH	XMG		
Solanaceae				
Chamaesaracha nana	NPH	X		X
Nicotiana acuminata var. *multiflora*	IAH			XFU
Violaceae				
Viola purpurea ssp. venosa	NPH	X		
Monocots				
Cyperaceae				
Carex douglasii	NPGL	X		X
Carex microptera	NPGL	XMG		
Carex raynoldsii	NPGL		X	
Cyperus laevigatus	NPGL			XFU
Juncaceae				
Juncus mexicanus	NPGL			XPO
Liliaceae				
Allium atrorubens var. *cristatum*	NPGL	XMG		
Calochortus leichtlinii	NPGL	X		

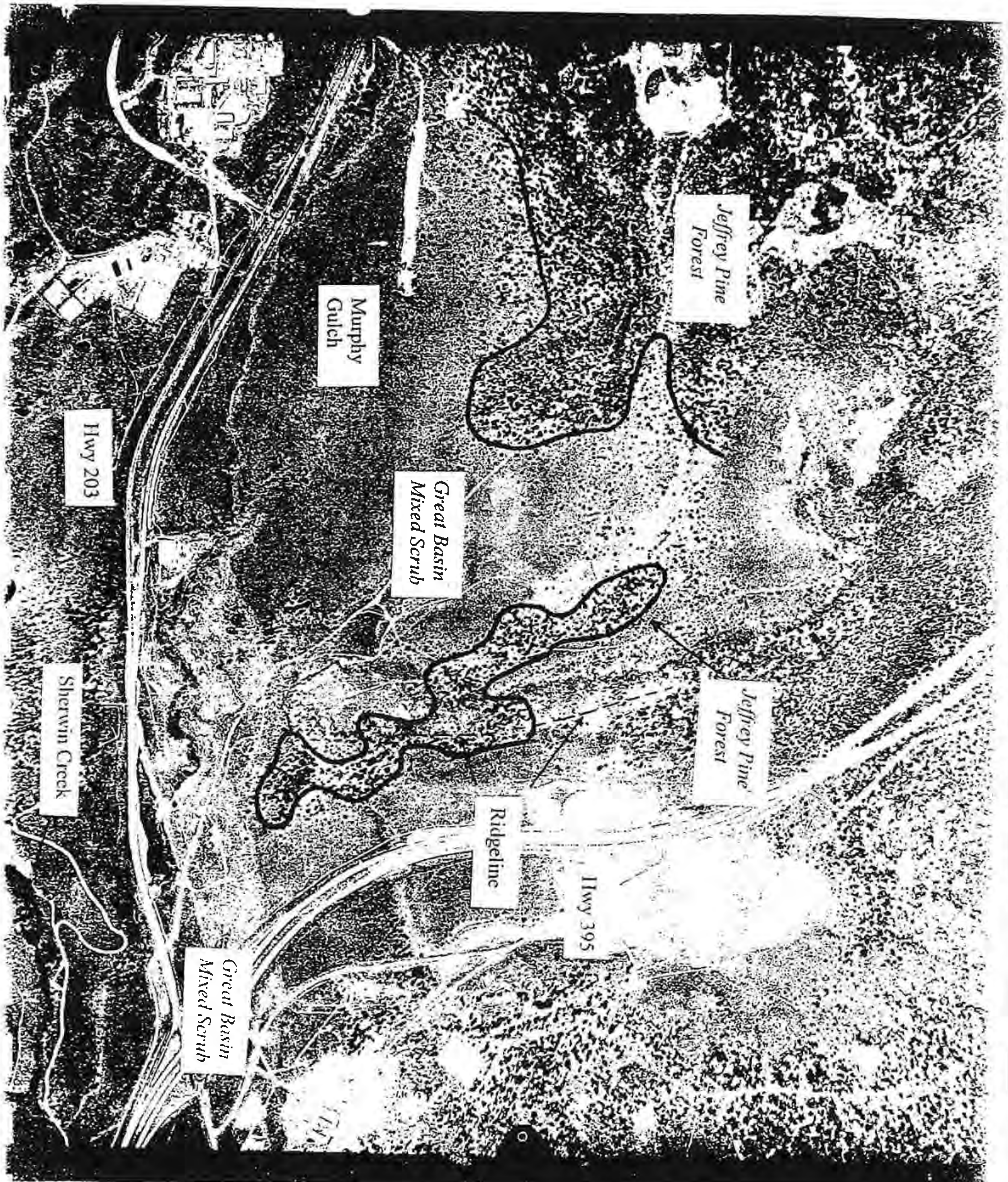
Plant Families and Species	Habit	Scrub	Forest	Disturbed
Poaceae				
Achnatherum hymenoides	NPG	x		x
Achnatherum nevadensis	NPG	x	x	x
Achnatherum occidentalis ssp. *californicum*	NPG	x		
Achnatherum occidentalis ssp. *pubescens*	NPG	x		
Agropyron desertorum	IPG			x
Bromus laevipes	NPG	x		
Bromus madritensis ssp. *rubens*	IAG	x	x	x
Bromus suksdorfii	NPG	x		
Bromus tectorum	IAG	x	x	x
Cynodon dactylon	IPG			xPO
Dactylis glomerata	IPG	xMG		
Elymus elymoides ssp. *elymoides*	NPG	x		x
Hesperostipa comata ssp. *comata*	NPG	x		
Hordeum brachyantherum ssp. *brachyantherum*	NPG	x		
Hordeum jubatum	NPG	x		
Leymus cinereus	NPG	x	x	
Leymus triticoides	NPG			xPO
Melica stricta	NPG	x	x	
Muhlenbergia richardsonis	NPG			
Poa fendleriana ssp. *longiligula*	NPG	x		
Poa palustris	IPG	xMG		
Poa pratensis	IPG	x	x	
Poa wheeleri	NPG		x	
Pseudoroegneria spicata ssp. *spicata*	NPG	xMG		

key to growth habit codes:

A	annual
B	biennial
G	grass
GL	grass-like
H	herb
HS	half-shrub
I	introduced
N	native
P	perennial
S	shrub

key to occurrence codes:

MG	restricted to channel at Murphy Gulch
FU	restricted to disturbed fumarole areas
PO	restricted to disturbed ponding basin at extreme eastern tip of survey area



Plant community boundaries are broadly depicted at the Basalt Canyon Geothermal Exploration Area. Aerial photo taken June 1993

NORTH

Basalt Canyon Geothermal Surveys
Sensitive Species Search

June 2004

Greater Sage-Grouse Conservation Plan for the Bi-State Plan Area of Nevada and Eastern California

First Edition

Prepared by:
The Bi-State Local Planning Group

In Conjunction with:
The Nevada Governor's Conservation Team

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Appendices - To be added

List of Figures - To be added

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PREFACE

The Bi-State Planning Group consists of local biologists, land managers, land users, and others who share a common concern for the Greater Sage-Grouse in western Nevada and Eastern California. The *Greater Sage-Grouse Conservation Plan for the Bi-State Plan Area of Nevada and Eastern California* -FIRST EDITION- represents more than two years of collaborative analyses and planning. Still, with much that has been accomplished, our work is not done.

The Bi-State Planning Group remains intact and committed to:

- Completing risk assessments and conservation action planning;
- Verifying and expanding existing baseline data,
- Implementing conservation actions;
- Monitoring the results of our efforts; and
- Revising this plan as we learn more about our sage-grouse populations.

The extensive effort that has been given to this process speaks to the value and energy of local planning and the *en Libra* process. The members of the Bi-State Planning Group wish to express our gratitude to Governor Kenny Guinn for the opportunity to participate in this important project that either directly or indirectly affects us all.

1.0 INTRODUCTION

1.1 Background

Sage-grouse populations in Nevada have been in decline for the last two decades. In some areas their habitat has been degraded or decreased by both human and natural causes. The decline has placed the species in jeopardy, and a listing under the Endangered Species Act is under consideration.

In recognition of the importance of sage-grouse conservation, Nevada Governor Kenny Guinn appointed a task force which became known as the "Governor's Sage-grouse Conservation Team." In August 2000 the Governor's Team was organized and included representatives from industry, Native Americans, conservation organizations, land management agencies, legislators, and professional biologists. This team prepared a sage-grouse conservation strategy that offered tools, resources, and current scientific information to local planning groups to formulate a statewide Sage-grouse Conservation Plan.

Local planning groups were charged with developing **workable solutions to specific on-the-ground challenges.** Local groups were asked to consider alternatives, develop strategies, and implement plans for natural resource management actions that will enhance and benefit sage-grouse. The local plans are intended to form the cornerstones of a statewide conservation agreement.

1.2 Purpose

The purpose of this plan is to report the conservation strategies developed by the Bi-State Planning group. This plan addresses important plan components recommended by the US Fish and Wildlife Service (USFWS) Policy for Evaluation of Conservation Efforts when Making Listing Decisions (PECE Policy) including agreements among agencies, implementation schedules, adaptive management, and financial strategies to implement the plan.

The goals of the Governor's Sage-grouse Conservation Team are as follows:

1. Create healthy, self-sustaining sage-grouse populations throughout the species' historic range by:

   - Maintaining and restoring ecologically diverse, sustainable, and contiguous sagebrush ecosystems, and
   - Implementing scientifically sound management practices.

2. Have locally functional, well-informed groups throughout sage-grouse range in Nevada, empowered to actively contribute to sage-grouse conservation while balancing habitat, bird, and economic considerations.

2.0 CONSERVATION ASSESSMENT APPROACH

2.3 Genetic Background for the Bi-State Sage-grouse Populations

In the late 1990s the Western Association of Fish and Wildlife Agencies (WAFWA), Sage-grouse and Columbian Sharp-tailed Grouse Technical Committee solicited a research proposal to facilitate a better understanding of gene flow, genetic diversity and evolutionary history between greater sage-grouse populations across their range and to determine the validity of the eastern and western subspecies. The research effort initiated by the University of Denver included collection, processing, and analysis of DNA extracted from tissue samples taken from greater sage-grouse across their range. Each western state wildlife agency within the range of the greater sage-grouse contributed funds towards this effort. The results from this research are reported in Benedict et al. (2003) and Taylor (2001).

The initial research by Benedict et al. (2003), sequenced a rapidly evolving portion of the mitochondrial control region in 332 birds from 16 populations across the greater sage-grouse range. This research did not find genetic evidence to support the delineation of the eastern and western subspecies. However, this research did reveal that the Greater sage-grouse population(s) within the Bi-State Conservation Planning Area contain an unusually high proportion of unique haplotypes (genetic markers). Benedict et al. (2003) concluded that geographic isolation and lack of gene flow within neighboring populations has been extensive enough to allow populations within the Bi-State Planning Area to develop an unusually large amount of genetic distinctiveness.

Research conducted by Sonja Taylor (2001) used nuclear DNA markers instead of mitochondrial DNA markers as were used in Benedict et al. (2003). Mitochondrial DNA is maternally inherited and is relatively small compared to the nuclear genome. Nuclear data can often uncover additional variation in the male genetic contribution. Taylor's (2001) research using nuclear DNA further supported the hypothesis that geographic isolation and genetic drift have caused the Mono County (CA) and Lyon County (NV) populations to become genetically distinct from other greater sage-grouse. Taylor (2001) explains in her thesis that although Mono/Lyon populations may be considered a *Management Unit* as defined by Moritz (1994) because significant divergence of alleles at nuclear and mitochondrial loci have been demonstrated, these populations would not be considered an *Evolutionary Significant Unit* (Moritz 1994). Although the uniqueness of mitochondrial haplotypes in the Mono/Lyon sage-grouse suggests that interbreeding with neighboring populations has not occurred in recent history, based on the number of haplotypes found, there is no evidence of any recent genetic bottlenecks within these populations (Taylor 2001).

General observations indicate that there are no obvious physical or morphological differences in the Mono/Lyon population that distinguish it from other greater sage-grouse populations. Young et al. (1994) did find some level of difference between California and Colorado populations while studying behavioral characteristics of sage-grouse across their range. This observation, along with the previous research, led to the development of a cooperatively funded research project, in the spring of 2001. The principle researcher was Sonja Taylor (UOD) funded by CDFG, BLM, and Quail Unlimited, Inc. This study was designed to compare male sage-grouse strut displays from Lassen County (CA) and Nye

County (NV) with the strut displays from Mono County (CA) and Lyon County (NV) and to compare morphological measurements as well. Preliminary results for the behavioral analysis indicates that there are no significant differences in male sage-grouse strut displays between birds within the Bi-State Conservation Planning Area and Lassen County (CA) and Nye County (NV) birds. (Taylor and Young unpublished results) However, due to a lack of morphometric samples, the morphological comparison portion of this study (measurements of bill, tarsus, wing cord, and weight) was not completed. Additional sampling is proposed below to answer genetic questions surrounding the Mono/Lyon populations.

Conservation Action: Genetic Research and Sampling

Risk: Lack of information on the genetic status of the Mono/Lyon sage-grouse populations.

Objective: Determine the spatial extent of this genetically unique population and further describe the genetic uniqueness of the greater sage-grouse in the Bi-State area. If the Mono/Lyon sage-grouse are found to be an Evolutionary Significant Unit, determine the population boundary to facilitate management planning and actions by identifying critical conservation linkages.

Rationale: Comparison of genetic markers between adjacent PMUs should help define the edges or boundaries of this population, and evidence of genetic integration with adjacent populations.

Project Description: Sage-grouse blood, tissue, or feathers will be collected in conjunction with ongoing sage-grouse telemetry study captures and as specifically needed for this study. Samples will be analyzed for genetic characterization that will determine the genetic uniqueness of the Mono/Lyon sage-grouse populations.

Table 2.1 lists areas that have been sampled and areas that remain to be sampled for genetic markers that would support or refute the finding of an Evolutionary Significant Unit. Figure 2-1 shows sampling locations.

Legal Authority: CDFG, NDOW, BLM, USFS, NRCS, BIA, USGS, USFWS

Procedural Requirements: NDOW and/or CDFG certification of field personnel to assure proper handling of sage-grouse and proper collection and handling of sample specimens.

Funding Source: USFWS research grant (potential).

Implementation Process:
1. Agency staff (CDFG, NDOW, BLM, USFS, NRCS, BIA, USGS, USFWS) will develop a 'research needed' proposal to be reviewed by the Bi-State Conservation Planning group.
2. The proposal will be used to solicit contract bids from several universities with genetic research facilities (i.e. UNR, UOD, UCB, UC Davis).
3. The interagency team will search for grant funds.
4. In the interim, the interagency team will continue to collect and store blood, tissue, or feathers when feasible.
5. All future captures within the Bi-State planning area will gather morphometric samples to facilitate the completion of this portion of the study.

Level of Partnership Commitment: The interagency team acknowledges the incredible effort made by Mr. Steve Pellegrini and his students (Yerington High School Science Instructor) who have trapped, sampled, and marked many sage-grouse within Nevada PMUs in coordination with NDOW. The interagency team will continue to coordinate these efforts and provide assistance as needed to insure consistent handling, sampling, and marking protocols are followed throughout the Bi-State planning area.

Table 2-1 Greater Sage-Grouse DNA Sampling: Bi-State Sage-grouse Conservation Planning Area, September 2003.

Geographic Area or Managerial Boundaries	Tissue/ Blood Samples Collected	Tissue/ Blood Samples Needed	Sample Status (Analyzed/ Not Analyzed)	Details	Contacts
Spanish Springs Reserve	6	14	Not Analyzed	Within Washoe/Modoc Planning Unit but needed to determine the Bi-State potential DPS extent.	Steve Pellegrini holds 6 unanalyzed samples. Mike Dobel (NDOW) - sage-grouse location information.
Palomino Valley	1	19	Not Analyzed	Within Washoe/Modoc Planning Unit but needed to determine the Bi-State potential DPS extent.	Steve Pellegrini holds 1 unanalyzed sample. Mike Dobel (NDOW) - sage-grouse location information.
Virginia Range	0	20	N/A	To be added to Bi-State Planning Area. Steve Pellegrini will talk to landowners to determine the potential to trap and sample sage-grouse.	Steve Pellegrini - sage-grouse location information.

Pine Nut PMU	0	20	N/A	Need to collect 20 samples in approx. 3 areas along the Pine Nut Range and to discuss sampling on Reservation Land.	John Axtel (BLM), Walt Mandeville (NDOW, retired), Steve Pellegrini – sage-grouse location information.
Desert Creek/Fales PMU	20 DC 10 SW 16 JA 10W/ B	0	Not Analyzed	20 samples collected by Steve Pellegrini et al. in the Desert Creek area and 10 collected in the northern Sweetwater – both Nevada locations. 16 samples collected in Jackass by CDFG and USGS, and 10 collected in Burcham/Wheeler area by USGS et al.	Steve Pellegrini holds 20 unanalyzed samples. Walt Mandeville (NDOW, retired) sage-grouse location information. Mike Casazza (USGS) holds 22 unanalyzed samples (12 from Jackass, 10 from Burcham/Wheeler; Sonja Taylor (UOD) holds 3 from Jackass and 1 from Wheeler.
Mt. Grant PMU	15	10	Not Analyzed	15 samples collected by Steve Pellegrini et al. in the southwestern portion of the PMU. Need to sample in the Mt. Grant area and to the north of Mt Grant within the PMU	Steve Pellegrini holds approx. 15 unanalyzed samples; Walt Mandeville (NDOW, retired) coordinated sage-grouse location information; Sonja Taylor (UOD) 18 analyzed, taken from the wing tissue collected by NDOW for both Mineral and Lyon counties.
Bodie Hills Hunt Zone	26	0	20+ analyzed	20+ samples were collected via wing samples within the North Mono Hunt Zone which comprises the majority of the PMU. These samples were analyzed by UOD and results are included in Benedict et al. and Sonja Taylor's Masters Thesis. 6 additional samples have been collected by USGS et al.	Sonja Taylor (UOD) 20+ analyzed, holds some unanalyzed samples from the wing tissue. Mike Casazza (USGS) holds 6 unanalyzed samples.

South Mono Hunt Zone and South Mono PMU	31	0	20+ analyzed	20+ samples were collected via wing samples within the South Mono/Inyo Hunt Zone which comprises the majority of the South Mono PMU and the CA portion of the White Mtns PMU. These samples were analyzed by UOD and results are included in Benedict et al. and Sonja Taylor's Masters Thesis. Based up hunter permit data, these wing samples most likely came from Long Valley. 12 samples were taken during trapping operations in the Parker area outside the hunt zone but within the PMU .	Sonja Taylor (UOD) – 20+ analyzed samples, holds some unanalyzed samples from the wing tissue and 2 from resent trapping in the Parker area. Mike Casazza (USGS) – holds 10 unanalyzed samples from the Parker area.
White Mtns PMU	1	19	1 analyzed	1 sample collected by NDOW et al. in the northern Whites and analyzed by UOD and found to be a novel haplotype. Need additional samples in this area. Also need samples from CA side of the Whites and the Truman Meadows area of NV.	Tom Dunn NV BLM Gary Milano (USFS) - sage-grouse location information
Churchhill County NV	18	0	18	18 samples were collected via wing samples taken in Churchhill Co. NV. These samples were analyzed by UOD and results are included in Benedict et al.	Mike Dobel (NDOW) collection Sonja Taylor (UOD)
Nye County NV	20	0	20	20 samples were collected via wing samples taken in Nye Co. NV. These samples were analyzed by UOD and results are included in Benedict et al.	Mike Dobel (NDOW) collection Sonja Taylor (UOD)

Note: Sonja Taylor (UOD) – Holds a total of 181 samples from California. Of those 96 are from Mono and Inyo counties. UOD have extracted DNA from 43 of the 96 samples, approximately 20 each from the Bodie Hills and Long Valley Hunt Zones. CDFG sent 6 additional samples to UOD in February 2003 from Jackass, Wheeler, Parker Bench, Parker Meadows areas.

INSERT FIGURE 2-1

2.4 Risk Assessment and Conservation Strategy Approach

The Bi-State Planning Group was organized into six committees to facilitate local participation, one for each PMU. Each PMU group worked independently to conduct field trips, evaluate sage-grouse habitat condition, identify risks, and formulate conservation strategies to address specific risks. A Technical Advisory Committee (TAC) consisting of professional biologists, land users, and land managers provided direction and definition to the local PMU groups, as needed, to assure consistency and a sound technical approach throughout the plan area.

The methods used for habitat condition assessment were consistent with the recommendations in the Governor's Conservation Strategy and are included in Appendix B. Each PMU group evaluated sagebrush sites and assessed habitat condition according to the Governor's Team definitions. The PMU groups used NRCS Soil Surveys and Ecological Site Descriptions, where available, to identify sagebrush-dominated ecological sites within each PMU.

The following Conservation Strategies provide an overall framework for sage-grouse conservation in the Bi-State Plan area. This framework will be used by land managers and participating private land owners to address the threats and guide the management actions at the local planning level.

1. *Ensure no net loss of sage-grouse breeding populations within the Bi-State Planning Area.*

2. *Maintain and restore (improve) sagebrush and associated habitats critical to the long-term viability of sage-grouse populations within the Bi-State Planning Area.*

3. *Identify and eliminate or substantially reduce threats to sage-grouse populations and habitats within the Bi-State Planning Area.*

4. *Identify and implement scientifically and economically sound management strategies applicable to the management of sage-grouse populations and habitats within the Bi-State Planning Area.*

5. *Identify important data gaps and implement scientific data collection efforts specific to sage-grouse populations and habitats within the Bi-State Planning Area.*

6. *Develop active, well informed local planning groups committed to the development and implementation of sage-grouse conservation actions within the Bi-State Planning Area.*

The PMU Committees identified risks for each PMU. At a minimum, each PMU group considered the population and habitat risks described in the Governor's Conservation Strategy.

The TAC developed and provided a *Risk Assessment Worksheet* to assist the PMU groups in specifying and characterizing existing and foreseeable risks to habitat, populations, local groups, and individual birds. The Risk Assessment Worksheet provided consistency in the risk evaluation between PMU groups and is included in Appendix 'C'.

When possible, risks were field verified by the PMU Committees and strategies to mitigate risks were formulated. When additional information was needed to verify risks or specify conservation actions to mitigate risks, the additional data needs were identified. In some cases, specific projects and actions have been planned at the local PMU level to address specific risks to sage-grouse and their habitat. Project descriptions are included with the corresponding risk assessment, and include the objective and rationale behind the action, project details, the implementation process, funding opportunities, and the level of partnership commitment. The Conservation Objectives are specific for each project and are quantifiable. Progress toward meeting the Conservation Objectives can be measured and the results can be used in an adaptive management strategy.

The results of the habitat condition assessment, the risk assessment, and the conservation strategies are described for each of the Bi-State PMUs in the following sections.

3.0 PINE NUT PMU

3.1 PMU Description

3.1.1. Location and Boundary

The Pine Nut PMU encompasses the Pine Nut Mountains and is the northernmost PMU in the Bi-State Plan Area, totaling approximately 575,000 acres. The majority of the PMU is east of Highway 395. The PMU boundary follows the Carson River from Carson City east to Highway 95; Highway 95 south to Wabuska; along the Churchill Canyon Road to Lincoln Flat and south to the West Walker River. The south boundary extends into California, encompassing Slinkard Valley to the ridge of the Sierra Nevada Mountains near Woodfords, California. The west boundary extends north to the east side of Gardnerville, Nevada; east of Prison Hill; and back to the Carson River.

3.1.2 Land Ownership and Regulatory Jurisdictions

Land ownership within the Pine Nut PMU is mixed, as shown in Table 3-1. Approximately 79 percent of the PMU lies within portions of Douglas, Lyon, and Carson City Counties in Nevada. The remaining 21 percent is within Alpine and Mono Counties, California. The majority of the area, approximately 60 percent, is public land managed by the Bureau of Land Management Carson Field Office. Approximately one-forth (25 percent) of the PMU is private land that includes approximately 60,000 acres of private Indian Allotment Land. Approximately 12 percent of the PMU is within the Humboldt-Toiyabe National Forest managed by the Bridgeport and Carson Ranger Districts. Two percent is California state land.

Table 3-1. Land ownership within the Pine Nut PMU.

LAND MANAGER OR OWNER	PMU TOTALS		NEVADA		CALIFORNIA	
	Acres	Percent	Acres	Percent	Acres	Percent
Total PMU Acres	**574,373**	100	**454,249**	**79**	**120,124**	**21**
National Forest	70,492	12	14,082	3.1	56,410	47
Private	144,798	25	127,644	28.1	17,154	14
Bureau of Land Management	344,791	60	312,069	68.7	32,722	27
State and County Land	13,758	2	136	< 1	13,622	11

Private Indian Allotment Land – There are approximately 385 individual private Indian allotments within the Nevada portion of the Pine Nut PMU that encompass approximately 60,000 acres. Individual private allotments are approximately 160 acres in size. Fractional ownership is common whereby many allotments have more than 100 owners. These lands are held in trust by the United States Government and managed by the Bureau of Indian Affairs. The BIA Superintendent is the designated Trustee in most cases and is responsible for managing grazing and other natural resources on behalf of the owners. The BIA will be involved with development of sage-grouse conservation activities proposed for allotment lands and will contact the appropriate land owners for approval of specific actions. At the end of a ___response period, the BIA Superintendent can authorize decisions for approval of the final conservation plan and implementation on behalf of the owners. This process can take up to 24 months to complete (Spaulding, 2003).

The Washoe Tribe of Nevada and California has the majority ownership on two Pine Nut allotments. Fish and game law enforcement and hunting on all of the Indian allotment lands is contracted to and managed by the Washoe Tribe Hunting and Fishing Commission.

Wild and Free Roaming Horses - Herd Management Area (HMA) - The Pine Nut Wild Horse Herd Management Area (HMA) lies immediately east of Carson City and is approximately 98,580 acres in size. Approximately 90,900 acres are public land; 7,680 acres are private land. The appropriate herd management level (AML), established in 1995 to maintain a thriving natural ecological balance and multiple use, was determined to range between 118 and179 horses. The population estimate for March 2003 was 439 horses, or more than 270 percent higher than the lower AML limit (BLM 2003). Horses have been routinely observed outside of the HMA. Over the last 20 years, the BLM has removed approximately __horses from inside and outside the HMA as summarized in Table 3-2. During the most recent wild horse gather, July 2003, ___ horses were removed, primarily from the Dayton-Carson City-Fish Springs portions of the HMA, on the west slope of the Pine Nut range (Axtel 2003, personal communication).

Table 3-2. Number of Wild Horses Gathered and Removed from the Pine Nut Herd Management Area.

Year	Number of Horses Gathered	Number of Horses Removed
1977	186	186
1980	140	140
1984	235	235
1985	325	325
1989	208	208
1995	629	410
2003		
TOTAL		1,504 + 2003 horses

The majority of the Pine Nut HMA is not fenced and the southern portion of the HMA overlaps with the northwest corner of the Pine Nut PMU. Five of the seven sage-grouse leks for the north Pine Nut breeding population are included within the unfenced Pine Nut HMA boundary.

Domestic Livestock- Livestock grazing has been a traditional use within the Pine Nut PMU dating back to the 1800s. Recent trends in livestock grazing include:

- Decrease in permitted grazing permits
- Conversion of permits from sheep to cattle
- Completion of allotment management plans

Currently, grazing of domestic livestock is managed by the BLM on public lands and by the BIA on private Indian allotment lands. A summary of current grazing allotment use is given in Table 3-2.

Table 3-2. Grazing Allotments in the Pine Nut PMU

Allotment Name	Sage Grouse Seasonal Habitat1	Land Manager	Class of Livestock	Livestock Season of Use
Adrienne Valley		BLM	Cattle	3/1-2/28
Artesia		BLM	Cattle	1/1-2/1*
Buckeye		BLM	Cattle	03/1-2/28*
Buckeye		BLM	Sheep	NA
Churchill Canyon		BLM	Cattle	11/1-5/15
Clifton		BLM	Cattle	1/1-5/31
Clifton Flat		BLM	Cattle	11/1-3/31
Eldorado		BLM	Sheep	11/1-2/28
Fort Churchill		BLM	Cattle	4/1-7/31
Hackett Canyon		BLM	Cattle	3/15-6/30
Hackett Canyon		BLM	Sheep	3/15-6/30
Indian Creek		BLM	Cattle	5/15-11/1
Lincoln Flat		BLM	Cattle	11/1-12/31
Mill Canyon		BLM	Sheep	11/1-3/31*
Pine Nut		BLM	Sheep	6/01-6/30; 7/01-8/31; 11/1-11/30
Rawe Peak		BLM	Cattle	11/1-3/31
Red Burbank		BLM	Sheep	5/1-7/15
Red Burbank		BLM	Cattle	NA
Spring Gulch		BLM	Sheep	3/1-8/15; 12/15-2/28
Sunrise		BLM	Cattle	3/15-6/15
		BIA	The BIA grazing permits are currently expired and are being revised and updated. Grazing on BIA allotments is expected to resume in ____.	
		BIA		
		BIA		
		BIA		
		BIA		
		BIA		

1 Sage-grouse seasonal habitat in each allotment will be verified during the summer of 2005.

Livestock grazing has not occurred within the north sage-grouse breeding habitat since 1987. Sheep grazing occurs in the vicinity of the south breeding habitat during late summer, after the sage-grouse breeding and nesting seasons. Sheep are trailed across the ridges during August. Current sheep herding practices no longer include traditional nighttime bedding grounds, eliminating the concentrated use areas that once were common on sheep ranges (Fulstone 2003, personal communication).

3.1.3 Topography and Climate

The elevation within the Pine Nut PMU ranges from 1,277m (4,190 feet) to 2,879m (9,446 feet). The majority of the PMU (approximately two-thirds) is below 1,981m (6,500 feet). The mountainous terrain is highly dissected with steep canyons. More than half of the PMU is characterized by steep slopes ranging between 15 and 50 percent slope (10^0 - 35^0). All four primary aspects (north, east, south, west) are approximately equally represented within the PMU boundary.

3.1.4 Vegetation Communities and Distribution

The Nevada portion of the Pine Nut PMU is included in portions of the Lyon County, Douglas County, and Carson City Soil Surveys. Ecological site descriptions for Nevada ecological sites are covered under Major Land Resource Areas (MLRAs) 26 and 27. More information can be obtained from the Natural Resources Conservation Service (http//:www.nv.nrcs.usda.gov). The vegetation in the Pine Nut PMU varies from salt desert shrub at the lower elevation to alpine vegetation at the highest elevation.

The salt desert shrub is found at the lower elevations on the north and northeast portion of the PMU starting at about 1,300 meters (4,100 feet). Vegetation includes shadscale *(Atriplex confertifolia)*, Bailey greasewood *(Sarcobatus baileyi)*, bud sagebrush *(Artemisia spinescens)*, Indian ricegrass *(Achnatherum hymenoides)*, bottlebrush squirreltail *(Elymus elymoides*), lupine *(Lupinus* sp.*)*. In the deeper, mesic soils, typically in the drainages, big sagebrush *(Artemisia tridentata tridentata)* community with an understory of Basin wildrye *(Leymus cinereus)* can be found.

As elevation and precipitation increase, the dominate shrubs become Wyoming sagebrush *(Artemisia tridentata wyomingensis)* on the deeper soils and Lahontan sagebrush (*A. arbuscula longicaulis*) on the shallow soils. Associated species with these sites are Anderson peach *(Prunus andersonii)*, Mormon tea *(Ephedra* sp.), Thurber needlegrass *(Achnatherum thurberianum*), desert needlegrass *(A. speciosa),* antelope bitterbrush *(Purshia tridentata)*, phlox *(Phlox* sp.*)*, biscuit root *(Lomatium* sp.*)* and lupine. In a few locations with shallow soils to a calcareous hard pan, black sagebrush (*A. nova*) occurs.

Above 1,875 meters (6,000 foot) in elevation, Lahontan sagebrush transitions to low sagebrush *(A. arbuscula)* on the shallow soils. On the deeper, mesic soils the Wyoming sagebrush transitions into mountain sagebrush *(A. tridentata vaseyana)*. Associated species on these sites include Antelope bitterbrush, snowberry *(Symphoricarpos* sp.*)* currant *(Ribes* sp.*)*, mountain brome *(Bromus marginatus)*, bluegrass *(Poa* sp.*)*, Idaho fescue *(Festuca idahoensis)*, and needlegrass species. A few of the forbs found include balsamroot *(Balsamorhiza* sp.*)*, buckwheat (*Eriogonum* sp.), locoweed, (*Astragalus* sp.) Indian paintbrush (*Castilleja sp.*) phlox *(Phlox* sp.) and lupine.

Scattered among the sagebrush are stands of curlleaf mountain *mahogany (Cercocarpus ledifolius)* found on the dry rocky sites.

Woodlands found in the PMU include single leaf pinyon *(Pinus monophylla)* and Utah juniper *(Juniperus osteosperma)* ranging from the lower elevations up to 2,500 meters (8,000 feet). The pinyon-juniper woodland exceeds its historical distribution and density in the Pine Nut mountains. This especially is the case at the lower and mid elevation where the woodlands continue to encroach into the sagebrush communities. This expansion and an increase in the stand density has resulted in a reduction of the understory herbaceous vegetation component.

In the Carson Range, Jeffrey pine *(Pinus jeffreyi)*, white fir *(Abies concolor)*, and western juniper *(J. occidentalis)* woodland are found as elevation increases up to 2,700 meters (8,700) feet.

Interspersed are small reservoirs, creeks, wet and dry meadows, springs and seeps and seasonal dry lakes. Vegetation associated with these areas includes stands of aspen (*Populus tremuloides*), willows *(Salix* sp.*)* and cottonwoods *(Populus* sp.*)* Other species include sedges *(Carex* sp.*)*, lupine, clovers *(Trifolium* sp.*)*, wild iris *(Iris* sp.*)* and other associated species.

There are several crested wheatgrass seedings in the PMU. These were either seeded after wildfires, or done in conjunction with Pinyon Juniper chainings. The seedings are found around Sunrise pass and China Springs.

The area has had numerous burns, varying from a few acres to several thousand. Some of the larger burns can be found west of Walker and Coleville, CA., China Springs, Topaz Ranch Estates, Sunrise Pass, and Buckeye Creek, NV. Most of these burns have occurred in Pinyon Juniper vegetation.

3.2 Sage-grouse Habitat Description and Condition Assessment.

Two recent wildfires burned big sagebrush range sites on the east slope of the Pine Nut Mountains, south of Mount Como. The Como fire burned between October 18 and October 31, 2000 and affected 1,767 acres of rangeland. Of the total acres, 400 acres were within the prescribed burn project area designed to reduce fuel loading, increase species diversity, and improve wildlife habitat. The burned area was rehabilitated with a seeding of native and naturalized grasses, forbs, and shrubs including big sagebrush.

The Sunrise fire occurred on the fourth of July 1996 and covered approximately 3,230 acres including approximately 215 acres of interior unburned islands. The majority of the burn occurred on mixed sagebrush rangeland. The burned area was rehabilitated with native and naturalized grasses and forbs. Sagebrush seed was not included in the seed mixture.

3.2.1 Breeding Habitat.

Biologists have identified two distinct breeding populations within the Pine Nut PMU. A large expanse of pinyon and juniper separates the north and south lek sites. It is not know if birds move between the north and south breeding and brood habitat sites or within additional habitat areas that have not yet been specifically identified. There are no distinct barriers that would prevent bird movements between the Pine Nut PMU and the adjacent Desert Creek

PMU to the south. Habitat condition ratings are described in Appendix __. The distribution of sagebrush habitat condition in active breeding habitat is shown on Map 3-__.

The North Pine Nut Breeding Habitat consists of eight leks east of Rawe Peak. Six were relocated and verified in 1993, and two were discovered in 2001. Seven of the eight leks are within approximately one and one-half mile of each other. The eighth lek is within three miles, but is not currently active. Lek number NOPN 7 has been designated as the primary trend lek for the north breeding habitat. The remaining seven leks recorded in the North Pine Nut are believed to be satellite leks, possibly used by subordinate males.

Much of the north breeding habitat area is steep (15-50 percent slope) and rocky, characterized as extremely stony loam, rubble land, and rock outcrop. The suitability of these range sites for sage-grouse nesting and the potential for habitat improvement is limited by stones and cobbles on the surface that would interfere with the use of mechanical equipment (USDA1984).

Flatter areas in the vicinity of the north leks, ranging from 2 to 8 percent slope, are dominated by low sagebrush, with a diversity of forbs and grasses including phlox, aster, buckwheat, groundsel, hawksbeard, milk vetch, mustard, bluegrass, and bottlebrush squirreltail (PMU Committee field trip notes 5/19/02). These low sage sites were rated as key sage-grouse habitat (R0). The majority of the big sage/low sage communities on the east slope of Rawe Peak are characterized by light to heavy encroachment of pinyon and juniper (R3).

The BLM Carson Field Office in cooperation with NDOW and a group of volunteers conducted an intensive field reconnaissance of the north lek area in the spring of 2001. Four nests were found and recorded in low sagebrush habitat. Two nests were within less than one mile of the NOPN4 and NOPN7 leks; one nest was within one mile of the NOPN1 lek; and one nest was within two miles of the NOPN1 lek.

The South Pine Nut Breeding Habitat consists of two documented lek locations, and a third sighting of birds during the breeding season that has not been confirmed as a lek. The south breeding habitat is north of Minnehaha Canyon and west of Red Canyon. No recent strutting activity has been observed in the south breeding habitat area.

Sagebrush habitats west of the leks around Bald Mountain and west to Blossom Spring are a mosaic of big and low sagebrush considered to be key sage-grouse habitat (R0). Northeast of the leks the terrain is steep, dissected and rocky low sagebrush that does not provided desirable nesting conditions. The big sagebrush sites in the vicinity of Mill Canyon and Thompson Canyon are characterized by extensive pinyon juniper encroachment (R3). To the southeast of the leks, in the vicinity of Minnehaha Canyon, sagebrush is lacking as a result of the Holbrook fire (R1).

3.2.2 Summer – Late Brood Habitat.

The Pine Nut PMU is characterized by numerous springs and wet meadows that provide active and/or potential late brood habitat for sage-grouse during the summer, which are briefly described below.

Headwaters Minnehaha Canyon - The meadows in this area are in mixed ownership between BLM public lands and BIA-administered private Indian Allotment lands. Unauthorized livestock grazing has been identified as a concern affecting existing habitat condition.

Mineral Valley Meadows – This area is managed as a grazing allotment by the BIA. Concerns for these meadows include off road vehicle use, pinyon-juniper encroachment, unauthorized grazing by wild horses, stream channel incisement, and the existing road alignment.

Buckeye Meadows / Winter's Mine – This series of stringer meadows runs south from Slater's Mine at the south end of Pine Nut Valley to Winter's Mine. The intermittent meadows are associated with Buckeye Creek and numerous springs east of Mount Siegel. This meadow complex is under mixed ownership that includes private lands, public lands, and Private Indian Allotment land administered by the BIA. BLM manages sheep grazing in this area as portion of the Pine Nut Allotment. The BIA historically managed the area as part of a cattle allotment. Portions of two separate meadows are protected by fenced exclosures that are closed to livestock grazing. The lower exclosure is south of Slater's Mine. The upper exclosure encompasses a portion of the meadow at Winters Mine. Concerns for this area include wild horse use outside of the herd management area, unauthorized grazing, off road vehicle use, and poaching.

Upland areas adjacent to the meadows are a mosaic of big and low sagebrush that appeared on initial evaluation to comprise key sage-grouse habitat (R0).

Sagebrush recovery has not been documented at this time.

Red Canyon – This area is included in the BLM Red Canyon Allotment, which has not been grazed for the last 5 years. The steep topography in this area and woody riparian vegetation brings to question the value of this area as sage-grouse brood habitat.

Blossom Meadow – This area is under mixed ownership that includes BLM public land and private Indian allotment land. The BLM manages cattle grazing in this area on the Buckeye Allotment. There is some concern that the sagebrush perimeter around this meadow is too dense and decadent for optimal sage-grouse habitat. Other concerns for this area include off road vehicle use and the existing road alignment adjacent to the spring.

Big Meadow - This area is public land managed by the BLM. Cattle grazing is managed as part of the Churchill Canyon Allotment. The Big Meadow supports a good diversity of grasses, sedges and forbs including yarrow, milk vetch, dandelion, milkweed, and monkey flower. Concerns for this meadow include the relative composition of wiregrass (*Juncus balticus)* and wild iris (*Iris missouriensis)* and the presence of Canada thistle (Cirsus *canadensis*), a noxious weed. The BLM is currently using herbicide treatments for control of Canada thistle. This area is monitored annually during the sage-grouse brood counts. NDOW has documented an upward trend in the number of birds seen at this location over the last 10 years. However, monitoring has not been sufficient at this site to estimate mean brood size for the population, or make inferences regarding nesting success. Biologists speculate that the birds using this meadow may have bred and nested in the north breeding habitat area.

Sagebrush cover adjacent to the Big Meadow is lacking on the west perimeter as a result of the recent Como and Sunrise fires. These burned areas have been reseeded but are currently lacking sagebrush cover (R1). Sagebrush sites on the unburned east side of the meadow are providing required escape cover and summer roosting habitat. However, these sagebrush stands appeared to be aging beyond the optimal conditions for sage-grouse habitat and should be evaluated for their potential to respond to habitat improvement treatments.

3.2.3 Winter Habitat.

The sage-grouse wintering areas for the Pine Nut PMU are currently unknown. Observations of grouse at high elevations such as Bald Mountain have been documented during October and November. Sightings between December through February have included Jack Wright Summit.

3.3 Sage-grouse Populations

Data generally used to estimate population size and demographics are lacking for the Pine Nut PMU. Strutting grounds were first recorded and inventoried in the Pine Nut Mountains in 1993. However, since then, lek counts have not been regularly or systematically conducted until recently.

3.3.1 Historical Trends

Hunting has not occurred consistently in the Pine Nut PMU since 1971, and harvest data are limited. There have been only twelve open hunting seasons over a thirty-year period. Only limited harvest data for the south breeding population have been compiled as summarized in Table 3-3.

Table 3-3. Hunter success from the Douglas County portion of the Pine Nut PMU between the 1970s and the 1990s.

NUMBER OF HUNTING SEASONS PER DECADE		MEAN HARVEST PER SEASON	MEAN NUMBER OF REPORTED HUNTERS PER SEASON	MEAN NUMBER OF BIRDS PER HUNTER PER SEASON
1970s	5 Seasons	132	`120	1.1
1980s	2 Seasons	99	86	1.2
1990s	4 Seasons	23	34	0.7

The limited harvest data available cannot be used to derive even a vague description of the historic population trend. No comparison of hunter success between the decades has been analyzed. Numerous factors could affect hunter success in addition to the bird population status. These should be considered with the harvest data prior to drawing conclusions. Some of the covariant variables that are inherent in the harvest data include climate, duration and timing of the hunting season, and age and experience of the hunter, to name a few.

Brood survey data for the Pine Nut PMU are also limited as summarized in Table 3-4. Inconsistent survey intensity, climate, and other factors affect the interpretation of population trend from the existing brood data. The overall average number of birds observed during brood surveys between the 1960s and the 1990s is 35 birds and an overall ratio of 2.1 chicks per hen.

Table 3-4 Brood Survey Data from the Pine Nut PMU between the 1970s and the 1990s.

NUMBER OF YEARS SURVEYED PER DECADE		MEAN NUMBER OF BIRDS OBSERVED	MEAN NUMBER OF CHICKS PER HEN
1960s	3	27 or 23?	4 or 6.8 ?
1970s	5	21	1.9
1980s	8	52	2.5
1990s	4	39	1.6

3.3.2 Current Distribution

The most recent population estimate from Nevada Division of Wildlife (NDOW) for the north population is 260-450 birds. These estimates are based upon 2-year average lek count data from the years 2002 and 2003. The procedures used by NDOW to estimate the population from the lek data are included in Appendix E. Current data for this PMU are showing that the north Pine Nut population is stable, showing signs of upward trends, but still well below historic levels. NDOW credits wise range management as benefiting the North population.

NDOW observations indicate that there is also a viable breeding population at the south end of the Pine Nut Range. The south end of the range is generally inaccessible during the strutting period and lek count data are minimal. Brood surveys conducted in this area are evidence that the population exists. However, consistent data are insufficient to reliably estimate the population size of the south breeding population.

The earliest lek monitoring data for the North Pine Nut date back to 1993 when six leks were counted from a helicopter on one day in late April. The number of birds per lek ranged between 4 and 10 males. The most birds seen at one lek was 15 (mixed sexes).

The next recorded lek count occurred in mid-April 2002. None of the six leks previously counted in 1993 were active. In 2001, two new leks were discovered in the North Pine Nut with 8 males on NOPN 8 and one male on NOPN7. During the last two years, the leks in the north breeding habitat have been monitored by NDOW, BLM, and volunteers. The historic lek count record for the Pine Nut PMU is given in Table 3-5.

Table 3-5 Historic Lek Count Data from the Pine Nut PMU between1993 and 2003.

LEK ID NUMBER	YEAR DISCOVERED	COUNTY	ACTIVITY WITHIN THE LAST 5 YEARS
NOPN1	1993	Lyon	Unknown
NOPN2	1993	Lyon	Unknown
NOPN3	1993	Lyon	Unknown
NOPN4	1993	Lyon	Unknown
NOPN5	1993	Lyon	Unknown
NOPN6	1993	Lyon	Unknown
NOPN7	2001	Lyon	Active
NOPN8	2001	Lyon	Unknown
NOPN9	2003	Lyon	Active
NOPN10	2003	Lyon	Active
SOPN1	1993	Douglas	Unknown
SOPN2	2002	Douglas	Active

** "ACTIVE" leks are those where male birds have been observed during the strutting season within the last 5 years.

3.4 Pine Nut PMU Risk Assessment and Conservation Actions

Existing and foreseeable risks for the Pine Nut PMU include pinyon-juniper encroachment, wildfire, predation, power lines, urbanization, off-road vehicle use, wild horses, livestock grazing, poaching, and pronghorn antelope grazing. Each risk is discussed in detail below.

3.4.1 Pinyon-Juniper Encroachment

Pinyon-juniper encroachment onto sagebrush range sites is occurring throughout the Pine Nut PMU. Many of the ecological sites that support big sagebrush have been converted to pinyon-juniper woodlands over the last 100 years. Of particular concern is the replacement of needed big sagebrush habitat on the west slope of Rawe Peak near the North Lek Area, throughout Pine Nut Valley, and the area around Thompson and Mill Canyons in the vicinity of the South Lek Area. Pinyon-juniper encroachment affects sage-grouse habitat quality and habitat quantity. In the Pine Nut PMU, it is impacting potential nesting and early brood habitat in multiple sites by reducing the availability of big sagebrush near leks. Pinyon–juniper encroachment may also be affecting the connectivity between the north and south breeding populations.

The impacts are predicted to become permanent and irreversible without appropriate management. If pinyon-juniper encroachment is not managed in these areas, a permanent change of the site potential can occur that would alter plant successional pathways and preclude the natural recovery of the sagebrush ecosystem. If sagebrush and its associated herbaceous understory are replaced, recovery of sagebrush sites to desirable sage-grouse habitat will require significant human intervention and expense.

Additional Data Needs to Verify and Further Characterize the Risk:

- On-site inventories are needed to rank the "stage" of encroachment and identify sites with the highest potential for recovery if trees are removed.

- Coordination is needed with the Bureau of Indian Affairs, the private Indian allotment owners and the Washoe Tribe to evaluate the potential for tree reduction treatments on private Indian allotment lands. The Washoe Tribe has expressed interest in fuel reduction in the past for protecting old growth pinyon stands in the Pine Nut range. The Washoe Tribe Environmental Protection Department is currently implementing a BIA woodland grant project to remove infected trees and improve woodland health on two private Indian allotments at the south end of the Pine Nut Range.

- Coordination is needed with Carson City and local businesses that are developing biomass utilization plants to identify biomass disposal alternatives.

- Coordination with the Nevada Division of Forestry is needed to evaluate the efficiency of using inmate crews to treat areas and remove pinyon-juniper.

Conservation Action: Pinyon And Juniper Tree Removal

Risk: Optimal nesting habitat in the vicinity of leks is limited by lack of big sagebrush sites due to habitat type conversion from big sagebrush to woodland.

Objective: Reestablish big sagebrush habitat for nesting and early brood-rearing on sites that can and previously did support big sagebrush vegetation. Reestablish a big sagebrush habitat corridor between the north and south breeding areas.

Action: Reclaim approximately 30,000 acres of sagebrush habitat over a 15-year period. Treatments will be phased spatially and temporally to produce a mixed-age mosaic of sagebrush habitats.

Rationale:

Legal Authority: BLM Carson Field Office and Indian Allotment owners, and the Bureau of Indian Affairs.

Procedural Requirements: BLM

1. Field-verify and survey project area to delineate sagebrush ecological sites, stage of Pinyon- Juniper encroachment, and existing understory composition of forbs and grasses.
2. Comply with NEPA requirements to analyze the pinyon-juniper tree removal project and potential project alternatives.
3. Develop biomass utilization plan.
4. Schedule and implement treatments over a 15-year period.

Procedural Requirements: BIA

1. All of the above, plus...

2. Notify all allotment owners of proposed action.
3. Obtain approval from owners or BIA Supervisor.

Level of Partnership Commitment:

Funding Source: BLM ; conservation grants
Funding opportunities will be identified to coordinate with ongoing, funded programs such as the Healthy Forest Initiative and biomass- energy development initiatives.

Implementation Process:
1. Project Planning: 2003 for 2005 budget
2. Project Implementation Spring 2005
3. Project Monitoring: 3-year intervals

Project Area Locations:
Public Land bound by T 13 N to T 15 N and R 21 E to R 23 E
Public Land bound by T 12 N to T 14 N and R 21 E to R 23 E
Indian Allotment Land bound by T 11 N to T 13 N and R 21 E to R 23 E

3.4.2 Predation

Increases in predator populations over the past several decades have been attributed to reduced professional predator management, reductions in the commercial fur trapping industry, and protection of predator species. One example of this trend is the common raven. Boarman and Berry (1995) reported that raven populations had increased from 500 to 7,600 percent in some areas of the Western United States from 1968 to 1992 Large predators, including mountain lions and black bears, are commonly seen throughout the Pine Nut PMU. While these large predators species may not directly impact sage-grouse, additional pressure on the prey populations affects all predator species (Mandeville 2003). Some of the predators in the Pine Nut PMU that commonly prey on the birds and/or consume their eggs include foxes, coyotes, bobcats, badgers, skunks, raccoons, ground squirrels, and multiple avian species (corvids and raptors).

Direct evidence of coyotes and ravens hunting on the north lek was recorded by lek surveyors during the strutting season in 2003 (J. Alexander, NDOW Volunteer, 2003). While it is true that sage-grouse are a natural prey species for indigenous predators, the seriously low sage-grouse population in the Pine Nut range is much more susceptible to the loss of adult birds and low juvenile recruitment to the population.

Sage-grouse predation can occur in several ways and from a host of species, especially during their most vulnerable time of year, breeding through brood-rearing. Sage-grouse can be easily detected and killed on leks. Females can be sighted leaving and returning to nests during incubation. Nests can be robbed of eggs. Young chicks are easily detected and killed during the first few weeks of their lives.

Nesting and early brood-rearing habitat within three miles of the north lek complex is primarily low sagebrush. While this ecological site produces abundant forbs in years with good spring moisture, the structural character of the sagebrush is limiting. The mean sagebrush height in this area is approximately 9-inches (RCI 2003). Changes in management will not result in taller shrubs.

Big sagebrush sites within the nesting range of the north lek are encroached with pinyon and juniper. Improvement of these encroached sites to reestablish optimal nesting habitat will take a minimum of 5 to 20 years to become established and be available as high quality nesting habitat for sage-grouse.

Conservation Action: Species Protection

Risk: Currently low sage-grouse population levels and marginal nesting habitat in the vicinity of the north lek complex increase the impacts of predation on the sage-grouse population. Losses of individual adult and juvenile bird have a direct impact on population viability.

Objective: Assist the sage-grouse population during the breeding and early brood rearing periods to, at a minimum, maintain their current level by providing sage-grouse protection from predation for the interim period until habitat improvement projects become established.

Rationale: The long term solutions to minimizing the impacts of sage-grouse predation are 1) increase the population size, and 2) provide more secure nesting and early brood-rearing habitat. However, even if habitat improvement projects are implemented immediately, there will be a delay of years or decades before desirable habitat is reestablished. During that time the population may continue to decline as a result of adult mortality and low recruitment. In the interim, controlling targeted predators (when predator populations have been monitored, and if control has been demonstrated to benefit sage-grouse during the vulnerable time of year, March through June), will reduce the exposure of birds to high levels of predation. The anticipated result would be maintenance or possible increase of the population size.

Project Description: The sage-grouse protection project would take place on the Nevada side of the Pine Nut PMU, and would be implemented across all land ownerships and jurisdictions. The project will be supervised and implemented by professional animal damage control biologists. USDA Wildlife Services (WS), the nation's leading agency in wildlife damage control to protect species of special concern, will be contracted to manage the Pine Nut project. NDOW and the Washoe Tribe Wildlife Commission will oversee the project and approve annual plans. Each year of the project, prior to initiating protection and throughout the protection season, WS will conduct predator surveys to identify target predator populations and monitor predator population trends.

WS will submit the results of this project to the Washoe Tribe Wildlife Commission and to NDOW in their annual report at the end of the protection season. NDOW will make the results available to the public in their annual Predator Management Plan. This information will be used in conjunction with ongoing sage-grouse population monitoring to determine the effectiveness in stabilizing or improving sage-grouse population trends.

As a pilot project, the sage-grouse protection project will be implemented for an initial 5-year period. Data compiled during this pilot period will include sage-grouse population trend, predator population trend (annual and seasonal), and habitat improvement success.
At the end of the 5-year trial pilot period, the effectiveness of meeting the project objectives will be evaluated. If successful and necessary, the project will continue until habitat restoration objectives are met.

Legal Authority: NDOW, Washoe Tribe Wildlife Commission, BLM, private land owners.

Procedural Requirements: - insert information from WS here –

Funding: Funding would be pursued from private wildlife interest groups, NDOW, and others.

Implementation Process: (To be further developed with WS and NDOW)

1. Write the detailed implementation and monitoring plans in conformance with other species protection projects conducted by NDOW.
2. Formalize proposals to NDOW and Washoe Tribe Wildlife Commission.
3. Contract with WS to implement the Pine Nut Sage-grouse Protection Project.
4. Report annual results.
5. Determine the need for continuing or terminating the project.

Level of Partnership and Commitment:
Bureau of Indian Affairs - in progress.

3.4.3 Urbanization (Residential Development)

Increased human presence in sage-grouse habitat occurs with urban expansion and increases risks to habitat quality, habitat quantity, and sage-grouse populations. Carson City, the Johnson Lane area of Douglas County, Fish Springs, Topaz Ranch Estates, Wellington, Minden, Gardnerville, Dayton, and Smith Valley are continuing to expand. Private land values are escalating and the potential for subdivisions and residential development is increasing.

Unrestricted road access throughout the Pine Nut PMU provides the potential for increased human presence in critical habitats during critical times of the year. People particularly affect nesting, early brood, and late brood habitat during spring through fall where critical habitats are easily accessed by vehicles. Increased human presence disrupts daily activities for individual birds and broods. Management of this risk is somewhat unpredictable due to current limitations on enforcement of existing laws.

Additional Data Needs to Verify and Further Characterize the Risk:

- Identify existing zoning and master plan elements for private lands within and adjacent to the PMU.

- Consult with the BIA and Washoe Tribe to determine if there are any foreseeable plans for development on the private Indian allotment lands. Consult with BIA to determine the possibility of establishing conservation easements on Indian allotments.

- Consult with private land owners within the PMU to determine their interest in conservation easements and other USFWS conservation programs for private land owners.

Conservation Strategy - The risk of disturbance to sage-grouse from increased human presence can be mitigated in the future by developing conservation agreements, modifying zoning ordinances, and restricting seasonal access to critical habitats during critical times of the year.

Access on roads in breeding and nesting habitat should be seasonally restricted between February 1 and May 15. Substantial penalties should be invoked for unauthorized trespass on seasonally restricted roads.

Public education is an additional approach to mitigating the impact of human activity in critical habitats by increase public awareness of sage-grouse conservation. Educational programs that focus on elementary schools can have long-term benefits.

Revisions to existing zoning and master plans should be evaluated where applicable to curtail expansion of urban development into suitable sage-grouse habitats.

Conservation Action: Conservation Agreements for Late Brood Habitat and Corridors

Risk: The majority of the active late brood habitat, particularly in the vicinity of the south lek area, is private land or private Indian allotment land. The perpetuity of these critical habitat areas depends upon protecting these lands from future urban development. The connectivity between the Pine Nut PMU and the Desert Creek PMU to the south is also in potential jeopardy if urban development continues in critical linkage areas.

Objective: Secure conservation agreements with property owners that will protect the existing habitat values that are critical to sage-grouse for the late summer brood period, and areas that will preserve the connectivity between the Pine Nut and Desert Creek PMUs.

Rationale: Urban development is progressing at a rapid pace in all locations surrounding the Pine Nut PMU. The long term viability of sage-grouse in the Pine Nut PMU depends upon maintaining viable late brood habitat. Long-term viability of the Mono/Lyon population may depend upon preserving connectivity between the Pine Nut and Desert Creek PMUs.

Project Description: Secure conservation easements to maintain existing habitat values that are critical to sage-grouse for the late summer brood period including private land along Pine Nut and Buckeye Creeks, and private Indian allotment lands in the Double Springs area.

Secure conservation easements in areas that will preserve the connectivity between the Pine Nut and Desert Creek PMUs. These may include private Indian allotment lands in the Double Springs area and private land from the Walker River, north to Jacks Wright Summit.

Legal Authority: BLM, land conservancies, private land owners.

Procedural Requirements: In progress.

Funding: Private wildlife interest groups, USFWS, BLM, NRCS
Funding opportunities will be identified to coordinate with ongoing, funded programs such as the Healthy Forest, wildfire risk reduction, and biomass- energy development initiatives.

1. Implementation Process:
2. Pursue willing parties who are interested in long term sage-grouse conservation including private land owners and administrative agencies.
3. Pursue funding for Conservation Easements.

4. Negotiate agreements or transactions with private land owners to provide assurances that private property with critical habitat values are not developed or degraded.

Level of Partnership Commitment:
USFWS Conservation Agreements with Assurances:
Douglas County
Lyon County
Carson City

3.4.4 Wildfire

Lightning strikes, controlled burns, or human negligence ignite wildfires within the Pine Nut PMU nearly every year with the potential to remove critical sagebrush habitats. Big sage / low sage mosaic habitat within the Pine Nut PMU for wintering, brooding, and nesting is currently in desirable condition for sage-grouse use, but is limited. If these habitats are lost in a wildfire, successful reclamation will take an average of 10 to 20 or more years to reestablish suitable sagebrush sites for cover and food. Under worst-case conditions, burned sagebrush sites can be converted to annual grasslands dominated by cheatgrass, thus permanently impacting the potential for sagebrush reestablishment. Any further loss of big sagebrush habitat within the Pine Nut PMU will have a negative impact on sage-grouse recovery.

The risk of wildfire in the Pine Nut PMU will directly affect habitat quality, habitat quantity, and sage-grouse population. Yearlong, nesting, brood, and winter habitats can be affected at multiple sites. The risk of wildfire is seasonal, and the impacts are predictable. While lightning strikes cannot be controlled, the risk of habitat destruction can be reduced through pre-suppression strategies to create firebreaks and reduce fuels in critical habitat. Mitigation of the risk is manageable and expensive.

Additional Data Needs to Verify and Further Characterize the Risk:

- If available, historic aerial photographs should be evaluated to verify pinyon-juniper encroached sagebrush sites.
- Fire behavior modeling and risk assessments are needed in the vicinity of critical habitats to evaluate the need for and design fuel reduction treatments and firebreaks.
- Coordination is needed with Carson City Biomass initiative and local businesses that are interested in biomass utilization to identify biomass disposal alternatives.
- Coordination with the Nevada Division of Forestry is needed to evaluate the efficiency of using inmate crews to implement fuel reduction treatments.

Conservation Strategy - Initiate fuel reduction treatments and construct firebreaks in conjunction with the National Fire Plan to reduce the risk of habitat destruction and potential habitat conversion to cheatgrass. Maintain firebreaks with controlled grazing on an annual basis to control the build up of fuels.

Both natural-caused and prescribed fires should be managed to protect and optimize sage-grouse habitat to the maximum extent possible. Known critical sage-grouse habitat, particularly big sagebrush sites, should be designated for full fire suppression status.

Wildfire rehabilitation plans should emphasize sagebrush reestablishment on sagebrush ecological sites. If burns occur in sage-grouse nesting habitat, post fire management should favor reestablishment of nesting habitat.

Prescribed burns should not be allowed in Wyoming big sagebrush sites without the recommendations and approval of range ecologists as being the best alternative for recovering poor condition habitat.

Monitoring results of the existing seedings on the Como and Sunrise burns should be used to assure big sagebrush reestablishment. Inter-seeding with additional sagebrush seed should be initiated if necessary to speed the rate of sagebrush recovery.

3.4.5 Off Road Vehicle Use and Existing Road Alignments

Organized off-road vehicle races have been permitted in the past on Memorial Day and Labor Day weekends. Memorial Day race routes that have included portions of the Churchill Canyon Road in between the North Lek Area and the Big Meadow are of most concern for the sage-grouse population. Young broods are expected to be using this area during this time period. Impacts from these events can affect individual and multiple birds by direct mortality or by disturbances to broods that cause chicks to become separated from hens, also resulting in chick mortality. This risk is both manageable and predictable and can be mitigated inexpensively.

Some existing roads traverse meadow habitats causing accelerated erosion and jeopardizing the condition of late brood habitat.

Conservation Strategy - Appropriate clearance through the NEPA process for all organized racing events should include specific analysis of impacts to sage-grouse. Approved race routes should avoid critical sage-grouse habitat during critical seasons. Race courses should not be allowed in breeding and brood habitat until after June 15 and September 15, respectively.

Unorganized ORV use should be limited to existing roads and trails in sage-grouse habitat.

Conservation Action: Road Realignment – Maddy Roach Spring

Objective: Reverse the downward trend of the meadow by repairing road-caused damage, and realign the road through an upland area outside the meadow.

Rationale: The existing road is contributing to the downward trend and at-risk condition of Maddy Roach Spring. Repairing the existing damage can be accomplished without extensive engineering or inputs and at reasonable cost. Realigning the road outside of the meadow will achieve long term improvement and maintenance of late brood habitat.

Project Description**:** Realign public road on private property.

Legal Authority: Private land owner.

Procedural Requirements:
Obtain advice from professional land conservancies and Douglas? Lyon? County

Funding: NRCS, private land owner, conservation funds

Implementation Process:
1. Open negotiations with private land owner
2. Project cost estimate
3. Secure funding
4. Design
5. Environmental clearance
6. Construction

Level of Partnership Commitment:
Pending

3.4.6 Power Lines

The North Pine Nut Lek Area is bordered on two sides with existing power lines that are located within 2-3 miles of active strutting grounds and within less than one mile of an active nesting site. Existing strutting grounds and nest sites are within the hunting territory of ravens that may be nesting on existing power poles. New power lines have been requested within the Pine Nut PMU area.

The risk of power lines to sage-grouse is in terms of increasing avian predations. Ravens are know to depredate sage-grouse during the nesting and early brood stages. Ravens were observed "hunting" over active sage-grouse leks during the 2003 breeding season. The risk may be mitigated by improving existing and/or creating additional nesting and early brood habitat in areas away from potential raven nest sites (See Pinyon-Juniper Encroachment Section 3.4.1).

Conservation Strategy - Provide improved nesting habitat by rehabilitating big sagebrush sites encroached with pinyon-juniper.

Limit power line expansion to existing corridors.

3.4.7 Wild Horses

The herbaceous vegetation in this area was observed to be heavily grazed by wild horses in May 2002 when more than 40 horses were observed within a mile of the leks (Pine Nut PMU Committee). Livestock have not grazed this area (Mill Canyon Allotment) since 1987. The Pine Nut Herd has approximately two times the AML and is expanding well outside the HMA boundary.

Wild horses compete for herbaceous vegetation in the north breeding habitat, resulting in risks to habitat quality in nesting and early brood sites during the spring. This risk is manageable and predictable, but expensive and complex to address.

Conservation Strategy – The ongoing need for regular removal of wild horses from the HMA has been well documented by the BLM. Reducing the wild horse numbers to the AML and monitoring the effects of a managed horse herd on sage-grouse breeding and early brood habitat will be necessary to evaluate the effects of competition and disturbance by horses. Horses should be removed from the Pine Nut PMU by whatever means available and managed to maintain AML. Vegetation trends, particularly forb and grass composition, and sage-grouse population numbers should be monitored to evaluate the impacts of a managed horse herd on sage-grouse habitat.

3.4.8 Livestock Grazing

Both cattle and sheep graze public lands in the Pine Nut PMU in accordance with allotment management plans and permits administered by the BLM Carson city Field Office. Additional sheep and cattle grazing, primarily in the south part of the PMU is permitted on private Indian allotment lands administered by the BIA.

On private Indian allotment lands, enforcement of permit conditions, seasons of use, numbers of livestock, and trespass onto adjacent, unfenced public land has been a concern for sage-grouse summer / late brood habitat for the south population. Overgrazing on stringer meadows can affect forb availability and concealment cover for sage-grouse.

The current status of public land grazing within the PMU is managed such that it is not known to be impacting sage-grouse breeding habitat, summer / late brood habitat, or populations at this time. Grazing on private Indian allotment lands is currently being reviewed in cooperation between the BLM and Bureau of Indian Affairs (BIA).

Conservation Strategy – Maintain exclosure fences. Continue to manage livestock grazing in compliance with the Sierra Front/ Northwestern Great Basin Resource Advisory Council Standards and Guidelines to accomplish four fundamentals of rangeland health:

- Watersheds are in properly functioning condition;
- Ecological processes are in order;
- Water quality is in compliance with State Standards; and
- Habitats of protected species are in order.

Coordination between the BLM and the BIA to establish season of use and class of livestock consistencies on adjacent allotments will facilitate permit enforcement and reduce the potential for livestock trespass.

3.4.9 Poaching

Sage-grouse hunting is illegal everywhere within the Pine Nut PMU. Any take of sage-grouse from within the PMU constitutes poaching. There are no recent accounts of sage-grouse poaching within the PMU, although law enforcement has been light. It is highly suspected that poaching does occur. NDOW has documented that the risk of illegal hunting increases in close proximity to urban areas.

Conservation Strategy - Increase signage within the PMU clarifying the area to be closed to sage-grouse hunting and listing contact information for "Operation Game Watch." Substantially increase penalties for illegal take of sage-grouse. Designate that additional money collected for sage-grouse poaching fines is earmarked for sage-grouse habitat conservation.

3.4.10 Pronghorn Competition

Pronghorn antelope were recently introduced into the Pine Nut PMU. A total of 91 animals were released in 1999 and 2000. The current population is estimated at 130-160 animals.

Pronghorn eat forbs when available and have a dietary overlap with sage-grouse, particularly chicks, during the spring and summer. Pronghorn potentially compete with sage-grouse on a seasonal basis, especially during drought years when annual forb production is low.

Conservation Strategy - Competition between sage-grouse and pronghorn is not a problem at this time. Ongoing habitat monitoring programs are needed to evaluate the trend of forb composition and utilization where antelope and sage-grouse use areas overlap. Pronghorn populations should be managed to maintain population levels at the designated desired level (200) to maintain compatibility with existing multiple uses.

3.4.11 Noxious Weeds and Invasive Vegetation Species

Noxious weeds and cheatgrass are invading sagebrush and wet meadow range sites throughout the Pine Nut PMU. Of particular concern are areas consumed by wildfires, and places perpetually frequented by the public. All invasive exotic plant species negatively affect sage-grouse habitat quality and quantity by replacing desirable plants needed for forage and cover.

If ignored, the impact of invasive plants is predicted to become permanent and irreversible. Plant community succession will be altered to the point that natural recovery of native habitat would be impossible. Partial recovery of converted sites would require significant and expensive human intervention to recreate favorable conditions for sage-grouse.

Additional Data Needs to Verify and Further Characterize the Risk:

- Continuous inventories are needed across all land ownerships/jurisdictions to identify infestations with the highest potential to invade critical sage-grouse habitat.
- Continued coordination and cooperation between all agencies/owners of lands within the Pine Nut PMU to implement prompt weed eradication and Burned Area Emergency Rehabilitation (BAER) projects as necessary. Implementation of these projects would optimally give sage-grouse use areas the highest priority.
- Continued education for the public in the identification and ecological impacts associated with invasive plant species. Special emphasis should be placed on the transportation and establishment of new infestations by human behaviors and how they can be minimized.
- Coordination with the Nevada Division of Forestry to implement noxious weed eradication projects using honor camp inmate crews.

Conservation Strategy - Most major landowners and land management agencies are currently engaged in cooperative weed management practices across the Pine Nut PMU. These efforts should continue while also expanding the educational needs of the public in order to minimize noxious weed impacts to all resources and subsequent land users.

3.4.12 Energy Development - Wind

Approximately 15 percent of all the wind energy produced in the nation comes from federal lands. Thirteen sites have been authorized in Nevada for monitoring wind; three of these are in the Pine Nut range. Monitoring can take up to 1.5 years. If the conditions are favorable, turbines could be operating as early as 2007. Wind-generated power facilities are of concern to sage-grouse conservation because the infrastructure includes roads and power lines that can fragment habitat, increase human presence, and facilitate predation.

4.0 DESERT CREEK – FALES PMU

4.1 PMU Description

4.1.1 Location and Boundary

The Desert Creek - Fales PMU is approximately 568,000 acres in size and includes land in both Nevada (55 percent) and California (45 percent). The majority of the area encompasses the Sweetwater Mountains along the California/Nevada state line. The Pine Grove Mountains border the Desert Creek - Fales PMU to the east, and a portion of the Sierra Nevada Mountains denotes the west boundary. The PMU contains portions of the both the West and East Walker Rivers. The East Walker River demarks the southeast PMU boundary. Towns within the PMU include Bridgeport, California, which marks the southeast corner; Walker, California on the west boundary; and Wellington, Nevada on the northwest boundary.

4.1.2 Land Ownership, Land Uses and Regulatory Jurisdictions

The vast majority of land within the Desert Creek – Fales PMU, 87 percent, is National Forest land managed by the Humboldt-Toiyabe National Forest Bridgeport Ranger District. Most of the remaining lands within the PMU, 11.6 percent, are privately owned. The Bureau of Land Management manages one percent of the PMU. The remaining 0.4 percent of the PMU is California State and Mono County lands. The southwest corner of the PMU is within the Hoover Wilderness area. Land ownership is summarized in Table 4-1.

Table 4-1. Land ownership in the Desert Creek – Fales PMU.

LAND MANAGER-OWNER	PMU TOTALS		NEVADA		CALIFORNIA	
	Acres	Percent	Acres	Percent	Acres	Percent
Total PMU Acres	**567,992**	**100**	**310,189**	**55**	**257,803**	**45**
National Forest	493,612	87.0	278,426	90.0	215,187	83.4
Private	65,716	11.6	31,763	10.0	33,953	13.2
Bureau of Land Management	6,110	1.0			6,110	2.4
State and County Land	2,552	0.4			2,552	1.0

Land uses in the PMU include livestock grazing, recreation (motorized and non motorized), hunting and fishing, agriculture, mining/gravel, rural residential, small towns and utility and transportation corridors.

Livestock grazing of both cattle and sheep occur on portions of the National Forest lands, with the majority occurring in the Sweetwater Mountains. Grazing is mainly during the summer with a few areas available for winter grazing. Grazing also occurs on ranch lands year round. Recreation occurs as dispersed motorized and non motorized. The majority of recreation activity occurs in the portion of the PMU that is in the Sierra Mountains. Fishing is a common recreational activity that occurs along the rivers and creeks found in the PMU. Hunting includes mule deer and game birds. Sage-grouse hunting is closed in the PMU. Agriculture consists of mainly hay production and livestock grazing. Mining is a minor component. Rural residential is a growing land use in the PMU. Localized areas include Smith Valley, Sweetwater summit, Antelope Valley, Bridgeport, and Highway 395 from Bridgeport to Fales. There are two main transportation corridors, highways 395 and 338. A utility corridor also follows Highway 395.

4.1.3 Topography and Climate

Elevations range from 1,372m (4,501 feet) to 3,609m (11,840 feet). Approximately two-thirds of the PMU lies between 1,982m (6,500 feet) and 2,743m (9,000) feet. More than half of the Desert Creek – Fales PMU (55 percent) is characterized by steep slopes ranging between 10 and 35 percent. The remaining 42 percent of the area consist of gentle slopes and flats. Approximately three percent of the PMU is very steep slopes, scarps, and cliffs. The predominant aspects are north, east, and west. The two highest peaks are Wheeler Peak at 11,663 feet in the Sweetwater Mountains and Buckeye ridge at 11,849 feet in the Sierras.

4.1.4 Vegetation Communities and Distribution

The vegetation in the Desert Creek – Fales PMU varies from salt desert shrub at the lower elevation to alpine vegetation at the highest elevation.

The salt desert shrub is found at the lower elevations on the northeast portion of the Sweetwater and Pine Grove Mountains. Vegetation includes shadscale *(Atriplex confertifolia)*, Bailey greasewood *(Sarcobatus baileyi)*, bud sagebrush *(Artemisia spinescens)*, Indian ricegrass *(Achnatherum hymenoides)*, Bottlebrush squirreltail *(Elymus elymoides*), lupine *(Lupinus spp.)*. In the deeper, mesic soils, typically in the drainages, big sagebrush *(Artemisia tridentata tridentata)* community with an understory of Basin wildrye *(Leymus cinereus)* can be found.

From this vegetation zone going up in elevation and precipitation are the Wyoming sagebrush *(Artemisia tridentata wyomingensis)* on the deeper soils and Lahontan sagebrush (*A. arbuscula longicaulis*) community on the shallow soils. Associated species with these sites are Anderson peach *(Prunus andersonii)*, ephedra *(Ephedra spp.*), Thurber needlegrass *(Achnatherum thurberianum*), desert needlegrass *(A. speciosa),* antelope bitterbrush *(Purshia tridentata)*, phlox *(Phlox spp.)*, biscuit root *(Lomatium spp.)* and lupine.

Above the 6000-foot elevation the Lahontan sagebrush goes to low sagebrush *(A. arbuscula)* on the shallow soils. On the deeper, mesic soils the Wyoming sagebrush goes into Mountain sagebrush *(A. tridentata vaseyana)*. Associated species on these sites include antelope bitterbrush, snowberry *(Symphoricarpos spp.)* currant *(Ribes spp.)*, mountain brome *(Bromus marginatus)*, bluegrass *(Poa spp.)* species, Idaho fescue

(Festuca idahoensis), and needlegrass species. A few of the forbs found include wyethia *(Wyethia spp.)*, balsamroot *(Balsamorhiza spp.)*, phlox and lupine. In the more mesic soils with a seasonal high water table, silver sagebrush *(Artemisia cana)* can be found with sedges *(Carex spp.)*, bluegrass, lupine, clovers *(Trifolium spp.),* wild iris *(Iris spp.)* and other associated species.

Scattered among the sagebrush are stands of curlleaf mountain *mahogany (Cercocarpus ledifolius)* found on the dry rocky sites.

Woodlands found in the PMU include pinyon *(Pinus monophylla)* and Utah juniper *(Juniperus osteosperma)* woodlands at the lower elevations up to 8000 feet. The pinyon/juniper exceeds its historical distribution and density in the Sweetwater Area. This especially is the case at the lower and mid elevation where the woodlands continue to encroach into the sagebrush communities. This expansion and an increase in the stand density has resulted in a reduction of the understory component. Erosion rate has been accelerated due to lack of understory. Fire frequency may also be less than reference conditions due to a reduction of the fine fuel that once carried the fires.

Jeffrey pine *(Pinus jeffreyi),* lodgepole *(P. contorta)*, white fir *(Abies concolor)*, red fir *(A. magnifica)*, western juniper *(J. occidentalis)* woodland are found as elevation increases.

In the subalpine zone whitebark pine *(P. albicaulis)*, lodgepole pine *(P. contorta)*, western white pine *(P. monticola)*, limber pine *(P. flexilis)* and mountain hemlock *(Tsuga mertensiana)* are the primary tree species.

Interspersed are lakes, streams, wet meadow and dry meadows, springs and seeps. Vegetation associated with these areas includes stands of aspen (*Populus tremuloides*), willows *(Salix ssp.)* and cottonwoods *(Populus ssp.)* There are several old wheatgrass seedings found on Sweetwater summit and Wheeler flat. Other vegetation types include cultivated crops (alfalfa hay), and irrigated pastures and hay fields.

4.2 Sage-grouse Habitat Description and Condition Assessment

Sagebrush vegetation types include Lahontan sagebrush, Wyoming big sagebrush, low sagebrush, and mountain big sagebrush. Associated vegetation types include salt desert shrub, pinyon-juniper woodland, aspen, lodgepole, Mountain mahogany, native meadows, irrigated forage and crested wheatgrass seedings.

4.2.1 Breeding Habitat

There are 13 confirmed leks of which ten are active within the Desert Creek - Fales PMU. The *Desert Creek lek* is located at the south end of Smith Valley, Nevada, at an elevation of 5,200 feet. The habitat in the surrounding area is a mixture of Lahontan sagebrush and Wyoming sagebrush with encroaching pinyon woodlands. Habitat has been assessed as R0, R2 and R3.

The Sweetwater lek and surrounding area is located near Sweetwater summit at an elevation of 6800 feet on the east side of the Sweetwater Mountains. The habitat is a mixture of mountain big sagebrush and low sagebrush with encroaching pinyon/juniper trees. Portions of the area are old crested wheatgrass seedings. Habitat has been assessed as R0, R2, R3 and R0agcr.

A total of six strutting grounds have been identified in the *Fales lek* complex. These 6 strutting areas are located at 7,000 feet elevation on Burcham and Wheeler Flats in the vicinity of Sonora Junction (junction of highways 395 and 108) in northern Mono County. The habitat is a mixture mountain big sagebrush/bitterbrush with some low sage, sub-alpine sagebrush/snowberry and silver sage. There is an old crested wheatgrass seeding on Wheeler Flat. Sagebrush habitats have been assessed as R0, R2 and R0agcr. Of the 6 leks identified in the Fales area, only two (leks 2 and 3) are considered to be dependable, long term leks based on male attendance. Lek 1, which was initially counted in 1953, became inactive in 1981 and has not been surveyed since 1991. Leks 2a, 3a and 4 appear to represent satellite grounds based their intermittent use.

The Jackass lek, which was first discovered in spring 2003, is located on Jackass Flat on the northeastern flank of the Sweetwater Mountains at an elevation of approximately 8,000 feet (3,200 m). The habitat on Jackass Flat is a mosaic of mountain big sagebrush and low sagebrush with some sub-alpine sagebrush/snowberry. Habitat has been assessed as R0, R2, R3 and R1 (recent burn).

Table 4-3 lists the leks identified within the PMU and their status.

Table 4-3. Activity status of known leks in the Desert Creek – Fales PMU.

LEK NAME	STATUS**
Desert Creek 1	ACTIVE
Desert Creek 2	ACTIVE
Desert Creek 3	ACTIVE
Sweetwater 1	ACTIVE
Sweetwater 2	ACTIVE
Wiley Ditch 1	ACTIVE
Wiley Ditch 2	ACTIVE
Wiley Ditch 3	ACTIVE
Wiley Ditch 4	ACTIVE
Fales 1	INACTIVE (birds last observed in 1980)
Fales 2 (Burcham Flat)	ACTIVE
Fales 2a (Burcham Flat)	SATELLITE-INTERMITTENT USE
Fales 3 (Wheeler)	ACTIVE
Fales 3a (Wheeler Flat)	SATELLITE-INTERMITTENT USE
Fales 4	SATELLITE-INTERMITTENT USE
Jackass 1	ACTIVE

"ACTIVE" leks are those where male birds have been observed during the strutting season within the last 5 years.

4.2.2 Summer/ Late Brood Habitat

Private lands within the Desert Creek – Fales PMU are very important for summer brood habitat. The core of the summer brood habitat associated with the *Desert Creek leks* is the meadows on the Desert Creek Ranch and adjacent National Forest lands. Summer brood habitat associated with the *Sweetwater leks* includes the meadows on the Sweetwater

Ranch and adjacent ranches, and National Forest lands. Additional summer habitat has been documented on the west side of the Sweetwater range. The summer brood habitat associated with the *Fales leks* includes the meadows on Wheeler Flat and potentially some of the meadows in the Sweetwater Mountains.

4.2.3 Winter Habitat

Winter habitat in the vicinity of the *Desert Creek Leks* is the surrounding area and the Pine Grove Hills to the east. Winter habitat in the vicinity of the *Sweetwater* leks is the surrounding area and to east on the East Walker River. Winter habitat associated with the *Fales* lek has not been confirmed, but could potentially occur in the vicinity of Antelope Valley.

4.3 Sage-grouse Population

4.3.1 Historical Distribution

4.3.2 Current Distribution

Desert Creek / Sweetwater, Nevada – In 2002 the size of the Nevada population of the Desert Creek/Sweetwater population of the Desert Creek/Fales PMU stood somewhere between the low estimate of 471 birds and a high estimate of 565 birds. This estimate was produced using a population estimator created by the technical committee of the Western States Sage-grouse Team. A three-year average was used to produce this estimate. Observations from the years of 2000, 2001 and 2002 were used. An updated estimate following the 2003 census gives a low estimate of 672 and a high estimate of 807.

Trend. This population of sage-grouse has maintained relative stability over the past 50-year period. Annual observations of this population began in 1953 and continued to the present. There were some years when surveys were not conducted for a variety of reasons. However, the efforts remained fairly consistent over the years.

The highest number of observed strutting males occurred at the onset of population monitoring in 1953 when 153 strutting males were recorded. The number of strutting males remained high until 1960 when a decrease in activity was noted. The average for the 1960s was 46 strutting males. The next two decades saw an increase where ten-year-averages of 57 and 68 were recorded. The 1990s showed a decrease to a ten-year-average of 51 males observed. The average number of active males strutting has risen to 63 since 2000. The average number of strutting males observed over the 50-year period since 1953 is 65 active males. The current trend indicates an increase in activity for this population of sage-grouse.

Summer brood counts have shown the same general trend that is recorded for strutting activity. The data are showing a general seven to ten-year cycle with rises and declines in production. Climate certainly has an impact on production for this population. However the population appears to be maintaining stability at this time.

Fales Population. Annually, the Department of Fish and Game, Bureau of Land Management and other resource agencies assess the status of sage-grouse breeding populations in Mono County, California, by surveying all known leks for activity, searching for new leks, and obtaining peak counts of the number of males attending each know lek.

To date, a total of 6 strutting locations, including core leks and associated satellite leks, have been identified in the Fales breeding complex (See Section_______ for a complete description of breeding habitat). These 6 strutting areas are located on Burcham and Wheeler Flats in the vicinity of Sonora Junction (junction of highways 395 and 108) in northern Mono County. Of the 6 leks identified to date, only two (leks 2 and 3) are considered to be dependable, long term leks based on male attendance. Lek 1, which was initially counted in 1953, became inactive in 1981 and has not been surveyed since 1991. Leks 2a, 3a and 4 appear to represent satellite grounds based on their intermittent use.

Beginning in 1987, the method for conducting lek counts was standardized in attempt to obtain the annual peak high male count for all known active leks in the Fales population. Annual monitoring efforts prior to 1987 did not always involve multiple lek counts because of problems associated with personnel and weather constraints. The method used to establish the peak single day count typically involved 1 experienced person counting at each lek on at least 3 separate days conducted during the period when female and male presence was at a maximum (Connelly et al. 2003). The peak single day count was taken on the day with the highest cumulative number of males counted on all leks visited within the breeding complex. Leks were monitored for activity from early March to judge the likely period of peak lek occupation.

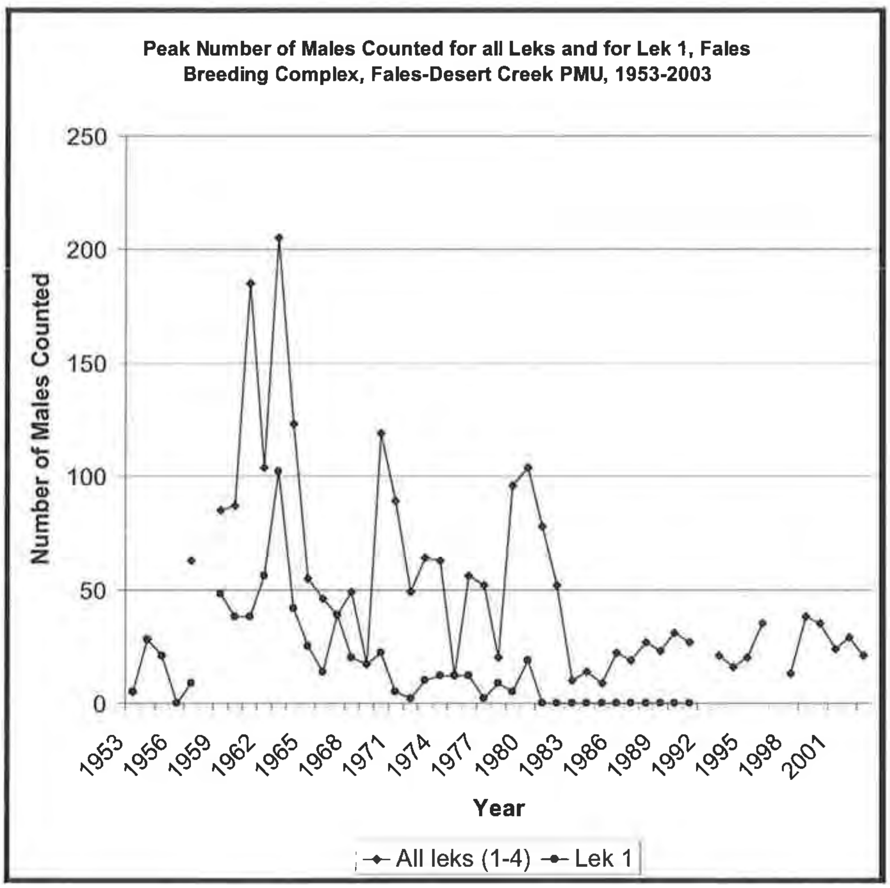
Population Estimates.
Two population expansion estimators, Emmons and Braun (1984) and Walsh (2002), were used to estimate the upper and lower limits of the most recent spring sage-grouse population in the Fales breeding complex. The low estimate (Emmons and Braun 1984) assumes that there are 2.00 hens per male, while the number of undetected males (adult males not attending leks and immature males) is 25% that of visible males. The high estimate (Walsh 2002) assumes that only 50% of all males attend leks and that there are 2.73 hens per male. The assumption that 10% of all leks in the PMU are still undetected was applied to both estimators. Based upon the average of peak lek counts conducted in the Fales breeding complex from 2000-2002, the most recent spring population estimate for the California segment of the Bodie Hills PMU was between 122 and 182 grouse

Trend. Initial population monitoring efforts in the Fales area began in 1953 with the counting of lek 1. Leks 2 and 3 were added to the survey in 1957, and lek 4 in 1961. From 1957-1980, the average number of males counted on all leks and was 78. The high peak count during this same period was 205 males in 1963 (Figure 4-1). Of these 205 males, nearly 50% were counted on lek 1, located within 50 m west of Highway 395 (Figure _____.1). Annual male attendance on lek 1 averaged 36 birds from 1957-1970; however, from 1971-1980, that use declined to an average of just 9 males. By 1981, grouse use of lek 1 had ceased entirely and no birds have been observed on this lek since that time. It was the loss of lek 1 that apparently served as the catalyst for a precipitous decline in the Fales sage-grouse population (Figure ____.1). From 1982-2003, the average number of males counted with the entire Fales breeding complex was 27 birds (Figure ____.1). The high peak count during this same period was just 38 males in 1999 (Figure ____.1).

The trend in the Fales sage-grouse populations is marked by two distinct periods (Figure ____.2). From 1957-1981, 3-year moving averages for the number of males counted fluctuated between 75% and 311% of the long-term average In some years lek surveys were not conduced or abnormally low sample sizes were obtained due to low sampling effort (e.g., one-time counts), which may account for the wide fluctuation in 3-year average lek counts. For the most part, however, average lek counts remained well above or just slightly below the LTA for the period. The Fales grouse population attained its highest level from 1959-1964, when 3-year averages ranged from 140% to 311% of the LTA (Figure 4-2).

Beginning in 1982, the Fales population began a steep, downward trend which was apparently linked to the cessation of breeding activity on lek 1 (Figure 4-2). Three year moving averages from 1982-1991 dropped from 88% of the LTA in 1982 to as low as 20-30% of the LTA from 1984-1986. From 1993-2003, three year moving averages ranged from 26-56% of the LTA. The most recent three-year average (2000-2002) indicates that the Fales sage-grouse population is maintaining a low, but stable trend at around 50% of the LTA (Figure 4-2).

Figure 4-1. Peak number of males counted for all leks and for Lek 1 from the Fales Breeding Complex in the Desert Creek – Fales PMU/



Jackass Flat Population

In spring 2003, a new sage-grouse strutting ground was located in extreme northeast Mono County, California, in the vicinity of Jackass Flat. Jackass Flat is located on the northeastern flank of the Sweetwater Mountains at an elevation of approximately 8,000 feet (3,200 m). The Jackasss Flat lek is located approximatley 11 air-miles (7 km) north of Burcham Flat, which supports the northern most lek within the Fales breeding complex. The peak high count for the Jackass Flat lek in 2003 was 10 male grouse.

4.4 Desert Creek - Fales PMU Risk Assessment and Conservation Actions

Existing and foreseeable risks for the Desert Creek - Fales PMU include pinyon juniper encroachment, conversion of rangeland to agriculture, urbanization, power lines and other infrastructure, human disturbance, predation, hunting, and livestock grazing. Each is discussed in detail below. The priority for concern for the PMU is:

1. Pinyon-juniper encroachment
2. Urbanization / Land Use
3. Human Disturbance
4. Sagebrush habitat condition
5. Power lines, roads, fences, other infrastructure
6. Livestock grazing
7. Predation
8. Hunting

4.4.1 Pinyon-Juniper Encroachment

Pinyon-juniper encroachment is occurring throughout the entire Desert Creek-Fales PMU in both upland and riparian habitats and is adversely affecting both habitat quality and quantity for sage-grouse. The replacement of sagebrush range sites with pinyon juniper woodlands is fragmenting the sagebrush habitats and diminishing habitat connectivity. Pinyon-juniper also provides additional nesting and perching habitat for predatory birds such as ravens that prey on sage-grouse chicks, particularly during the early brood stage.

The risks from pinyon-juniper encroachment are manageable and predictable, but expensive to mitigate. Christmas tree and fire wood cutting and tree mortality from insects and disease, especially during drought years are reducing tree density, but on a very small scale in comparison to the extent of the pinyon-juniper encroachment.

Additional Data Needs to Verify and Further Characterize the Risk:

- Inventories to document sagebrush, riparian and woodland sites needs to be completed throughout the PMU for both USFS and private lands.
  Who: USFS, Private, NRCS
  When: ongoing on National Forest

- Identify critical habitat areas with pinyon-juniper encroachment for potential treatment.
  Who: USFS, Private, NRCS, NDF, NDOW, CFG
  When: on going

- Monitoring bird movements with radio telemetry is needed to verify population distribution patterns in relation to habitat connectivity.
  Who: NDOW, CFG, USGS
  When: ongoing

Initial Conservation Strategy:

Establish a demonstration project at Dead Ox Spring to determine the effects of PJ removal on the site. This site is currently characterized by a closed canopy of pinyon-juniper.

Remove pinyon-juniper where it is invading known, sage grouse habitat using the appropriate treatment technique.

Photo 4.1 Proposed treatment area Number 1. Near Sweetwater Summit. Note density of pinyon in foreground and pinyon encroachment in the background to the right.

<u>Conservation Action: Pinyon Juniper Reduction</u>

<u>Risk</u>: Loss of sagebrush habitat in the Sweetwater breeding area complexes due to encroachment of pinyon-juniper.

<u>Objective</u>: Remove pinyon-juniper over story where it is encroaching into sagebrush habitat adjacent to the breeding area complexes. Treat approximately 3,380 acres.

Action: Remove pinyon-juniper over story with most appropriate technique. (Cutting, burning, chaining, herbicide.)

Rationale: Habitat in the Sweetwater Complex is a mixture of mountain big sagebrush, low sagebrush, and old crested wheatgrass seeding, with encroaching pinyon-juniper trees. Habitat has been assessed as R0, R2, R3 and R0agcr (sagebrush with crested wheatgrass). Those areas within 2 miles of the lek, that are classified as Phase I (few to many small trees not affecting understory, < 11% canopy cover) and Phase II (12-54% canopy cover, rapid tree growth, declining understory) were selected for removal of pinyon over story. Treating Phase I and Phase II is more effective than treating Phase III (tree dominance, little understory > 55% canopy cover). Treatment of Phase I will maintain existing habitat and treatment of Phase II will increase the amount of habitat in the Sweetwater complex.

Legal Authority: Projects addressing this risk are within the management responsibility of the Bridgeport Ranger District, Humboldt-Toiyabe National Forest.

Procedural Requirements: Projects addressing this risk are within the management responsibility of the Bridgeport Ranger District, Humboldt-Toiyabe National Forest.

Level of Partnership Commitment:

Funding Source: National Forest appropriated dollars requested for FY 2004 and in planning process for 2005; partnerships to be pursued for full implementation.

Implementation Process:

1. Project Planning: Forest Service (2004):
    a. Identify action locations.
    b. Enter into budget planning.
    c. Identify Proposed Action for treatment
    d. Schedule Heritage and Biological surveys
    e. Complete Environmental Analysis.
2. Project Implementation Forest Service/Partners (2005):
    a. Budget for project
    b. Budget for Partners
3. Project Monitoring: Forest Service/NDOW/ Partners (2005-2006):
    a. Forest Service monitor implementation for consistency with the proposed action. Monitor change in percent canopy cover of pinyon-juniper before treatment and one year after treatment. Complete additional treatment required to accomplish the project proposal.
    b. Nevada Department of Wildlife continue monitoring sage-grouse populations through lek counts for changes in numbers of males visiting leks.
    c. Report accomplishment to USFWS, Reno Office.

Project Area Locations:

1. Project Site One: Sweetwater Complex; One mile west of Wiley Ditch #2 lek (T8N, R25E, E ½ Sec 15, W ½ 14).
   Description:

a. Elevation 7,000-7,200 feet
b. Aspect: East
c. Dominant Vegetation: Mixed brush community with mountain big sagebrush, Wyoming Big sagebrush, desert peach, bitterbrush.
d. Pinyon Phase: Phase I – few too many young/submature trees present, but not affecting understory. Phase II.
e. Acres: 960
f. Soil Type: Soil Map Unit 851 and 861
g. Other Existing Uses:
   - Grazing: Desert Peak S&G and Sweetwater C&H
   - Pine Nut collecting in adjacent mature stands of pinyon
   - Deer summer/transitory range

2. Project Site Two: Between Wiley Ditch and Wiley Ditch #2 (T.8N, R25E, NWSW, Sec. 18, T8N, R24E, NESE, Sec. 12)

   Description:

   a. Elevation 6600 feet
   b. Aspect: East
   c. Dominant Vegetation: Mixed brush community with mountain big sagebrush, Wyoming Big sagebrush, desert peach, bitterbrush.
   d. Pinyon Phase: Phase I and II.
   e. Acres: 160
   f. Soil Type: Soil Map Unit 851
   g. Other Existing Uses:
      - Grazing: Desert Peak S&G and Sweetwater C&H
      - Deer summer/transitory range

3. Project Site Three: Sweetwater Complex; East of Wiley Ditch #1 (T8N, R25E, Sec 17, East ½ of the West ½).
   a. Elevation: 6,600
   b. Aspect: Southwest
   c. Vegetation: Pinyon Phase I and II: Understory is intermix of big sagebrush, bitterbrush and low sagebrush.
   d. Acres: 100
   e. Soil Type: Soil Map Unit 851
   f. Other Existing Uses:
      - Grazing: Nye Canyon C&H

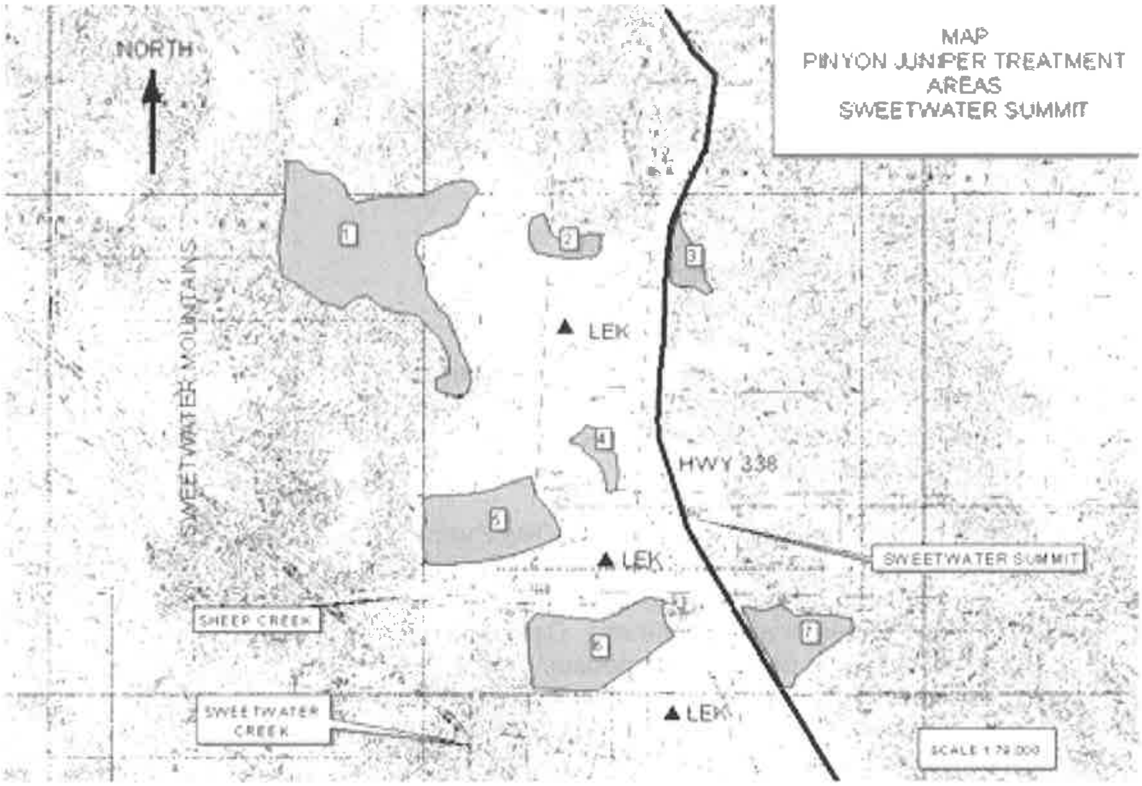
4. Project Site Four: Sweetwater Complex; South of Wiley Ditch #3 and north of Sweetwater #1 (T8N, R25E, Sec 30, NWSE)
   a. Elevation: 6900
   b. Aspect: Northeast
   c. Vegetation: Big sagebrush
   d. Pinyon Phase: Phase I –few too many young/submature trees present, but not affecting understory.
   e. Acres: 200
   f. Soil Type: Soil Map Unit 861
   g. Other Existing Uses:
      - Grazing: Sweetwater C&H

5. Project Site Five: 1 mile West to Northwest of Sweetwater #1 (T8N, R24E, Sec. 35, 36).
    a. Elevation 7200-8400 feet
    b. Aspect: Northeast
    c. Dominant Vegetation: Mixed brush community with mountain big sagebrush, Wyoming Big sagebrush, desert peach, bitterbrush.
    d. Pinyon Phase: Phase I, II.
    e. Acres: 1000
    f. Soil Type: Soil Map Unit 923, 851
    g. Other Existing Uses:
        - Grazing: Desert Peak S&G and Sweetwater C&H
        - Pine Nut collecting in adjacent mature stands of pinyon
        - Deer summer/transitory range

6. Project Site Six: 1/2 mile west of Sweetwater #2 (T7N, R25E, Sec 6 West ½)
    a. Elevation: 7,000 - 7,200
    b. Aspect: East
    c. Vegetation: Pinyon Phase I., II., III: Understory is mountain big sage and bitterbrush
    d. Acres: 640
    e. Soil Type: Soil Map unit # 851, 861
    f. Other Existing Uses:
        - Grazing: Sweetwater C&H

7. Project Site Seven: One and a half mile east of Sweetwater #2 (T7, R26E, Sec 4, SE ¼) Long Doctor Spring
    a. Elevation: 6,500
    b. Aspect: southwest
    c. Vegetation: Pinyon Phase I., II: Understory is low sagebrush with Wyoming and Mountain big sagebrush.
    d. Acres: 320
    e. Soil Type: Soil Map Unit 861
    f. Other Existing Uses:
        - Grazing: Bald Mountain S&G and East Walker Stock drive
        - Wildlife: Mule Deer winter and transitory range.
        - Mining: Isolated claims with low potential for activity

Figure 4-2. Location of proposed pinyon-juniper treatment areas in the Desert Creek PMU.



Conservation Action: Riparian Habitat Improvement

Risk: Loss of late summer brooding habitat from encroaching pinyon pines on riparian areas in the Desert Creek/Fales PMU.

Objective: Remove encroaching pinyon trees from riparian habitat that supported wet to dry meadow vegetation

Action: Remove pinyon overstory with most appropriate technique (cutting, burning, chaining, herbicide, etc.)

Rationale: Late summer brooding habitat is being replaced by encroaching pinyon-juniper in portions of the Desert Creek/Fales PMU. Late summer habitat consists of wet and dry meadows, springs, seeps and streams. These riparian areas are important sources of insects and forbs when the surrounding upland habitat dries up in the late summer. Numerous riparian areas at the mid-elevation of the Sweetwater and Pine Grove Mountains have been or are going to be lost due to increasing density of trees. Locations are on National Forest land private lands.

Legal Authority: Projects addressing this risk are within the management responsibility of the Bridgeport Ranger District, Humboldt-Toiyabe National Forest or private land owners

Procedural Requirements: National Environmental Policy Act requirements are identified in the project description below for National Forest Lands.

Level of Partnership Commitment:

Funding Source: National Forest appropriated dollars requested for FY 200__ and in planning process for 200___; partnerships to be pursued for full implementation. Cost share grants are available for private land from various sources.

Implementation Process:

1. Project Planning: Forest Service (200__):
   a. Identify action locations.
   b. Enter into budget planning.
   c. Identify Proposed Action for treatment
   d. Schedule Heritage and Biological surveys
   e. Complete Environmental Analysis.
2. Project Implementation Forest Service/Partners (200__):
   a. Budget for project
   b. Budget for Partners
3. Project Monitoring: Forest Service/NDOW/ Partners (200__-200__):
   a. Forest Service monitors implementation for consistency with the proposed action. Monitor change in percent canopy cover of pinyon before treatment and one year after treatment. Complete additional treatment required to accomplish the project proposal.
   b. Nevada Department of Wildlife continues monitoring sage-grouse populations through lek counts for changes in numbers of males visiting leks.
   c. Report accomplishment to USFWS, Reno Office.

4. Project Planning: NDF, Private Land Partners (200__):
   a. Identify action locations.
   b. Enter into budget planning.
   c. Identify Proposed Action for treatment
   d. Schedule Heritage and Biological surveys
   e. Complete Environmental Analysis.

5. Project Implementation NDF/Partners (200__):
   a. Budget for project
   b. Budget for Partners

6. Project Monitoring: NDF/NDOW/ Partners (200__-200__):
   a. Monitor implementation for consistency with the proposed action. Monitor change in percent canopy cover of pinyon before treatment and one year after treatment. Complete additional treatment required to accomplish the project proposal.
   b. Nevada Department of Wildlife continues monitoring sage-grouse populations through lek counts for changes in numbers of males visiting leks.
   c. Report accomplishment to USFWS, Reno Office.

Project Plans:

1. Project Site One: Dead Ox Spring (T9N, R25, Sec. 25)

Joint Volunteer Project with Bi-State Planning Team and USFS
Description:

a. Land Ownership: USFS
b. Elevation 7800 feet
c. Aspect: South
d. Dominant Vegetation: Pinyon Pine
e. Acres: 20?
f. Soil Type
g. Other Existing Uses:
   - Grazing:
   - Pine Nut collecting in adjacent mature stands of pinyon
   - Deer summer/transitory range

Figure 4.2 Location of Dead Ox Spring project area

Map
Dead Ox Spring
Project Area

2. Project Site Two: Long Doctor Spring (T7N ,R.26E, Sec. 4)
   a. Land Ownership: USFS
   b. Elevation 6600 feet
   c. Aspect: East
   d. Dominant Vegetation: Mixed brush community with mountain big sagebrush, Wyoming Big sagebrush, desert peach, bitterbrush.
   e. Pinyon Phase: Phase I and II.
   f. Acres: 20
   g. Soil Type: Soil Map Unit
   h. Other Existing Uses:
      - Grazing
      - Deer summer/transitory range

3. Project Site Three: Upper portion of Dalzell Canyon (T.8 N. R25E, Sec.8, 17, 18.)
   a. Land Ownership: Private/USFS
   b. Elevation: 6700
   c. Aspect: NE
   d. Vegetation: Pinyon Phase I and II: under story meadow, creek
   e. Acres: 100
   f. Soil Type: Soil Map Unit
   g. Other Existing Uses:
      - Grazing

4. Project Site Four: Portions of Fryingpan Creek (T7N, R25E, 32, 33, and 34)
   a. Land Ownership: Private/USFS
   b. Elevation: 6200- 6700
   c. Aspect: E

d. Vegetation: Pinyon Phase I and II: under story meadow, creek
e. Acres: 100
f. Soil Type: Soil Map Unit
g. Other Existing Uses:
  - Grazing

5. Project Site Five: Misc. other springs, seep, meadows as identified at a later date.
   a. Land Ownership: Private/USFS

4.4.2 Urbanization/Land Use

Private rangeland in Desert Creek, Fales/Burcham Flat, Sweetwater, and the east side of Antelope Valley are being converted to residential and vacation homes. Residential development may reduce habitat resulting in risks to habitat quantity and fragmentation. Human activities including ORV, private airstrips, horse riding, biking, walking, etc. may disturb individual birds during the breeding and nesting seasons. Domestic dogs and cats can prey on sage-grouse. This risk is manageable and predictable and can range from inexpensive to expensive to mitigate.
See Map ____ for private lands in PMU.

Additional Data Needs to Verify and Further Characterize the Risk:

- An inventory of land ownership and vegetation types is needed to evaluate the extent of potential losses of habitat from this activity.

- An inventory of habitat types on private lands and existing use by sage-grouse is needed to characterize habitat distribution in the PMU.

Conservation Action: Maintain Or Improve Habitat Quality And Quantity On Private Lands

Risk: Private lands in the Wheeler Flat and Burcham Flat areas in California and the Desert Creek, Sweetwater, and Antelope Valley areas in California and Nevada are under current or future threat of development.

Objective: Maintain or improve habitat quality and quantity on private lands in the Wheeler Flat and Burcham Flat area in California and the Desert Creek, Sweetwater and Antelope Valley areas in California and Nevada.

Action: Provide information, education and funding to maintain and improve existing sage-grouse habitat on private lands.

Rationale: Residential development may reduce habitat resulting in risks to habitat quantity and fragmentation.

Legal Authority: Projects addressing this risk are within the management responsibility of California Fish and Game and Nevada Department of Wildlife, Mono, Douglas and Lyon County government.

Procedural Requirements: Dependent on program.

Level of Partnership Commitment: High

Funding Source: Various private, State and Federal programs.

Implementation Process:

1. Identify existing land ownership
    a. Who - NDOW, CFG
    b. When – 2004

2. Develop a map of private lands areas with critical habitat concerns
    a. Who - NDOW,CFG
    b. When – 2004

3. Establish partnerships with private landowners and determine their interest in sage-grouse conservation. Provide habitat assessment on private land to identify management opportunities for sage-grouse..
    a. Who - Bi-State planning group, NDOW, CFG, NRCS
    b. When – 2004-05

4. Provide information/partnerships on funding programs for habitat management and improvement of private land. Conduct workshops for private landowners on management techniques that can be used to maintain or enhance sagebrush habitats.
    a. Who - Bi-State, NDOW, CFG, partners
    b. When - 2004

5. Develop and implement habitat management projects on private lands.
    a. Who – NDOW, CFG, NRCS
    b. When – 2005-06
    c. Identify project locations
    d. Identify proposed projects
    e. Identify funding sources
    f. Acquire funding
    g. Implement projects/actions

6. Support zoning that will maintain, enhance or preserve critical sage-grouse habitat
    a. Who - NDOW, CFG, partners
    b. When – When local planning is initiated

7. Identify, propose and initiate: conservation easement- short term and long term, land exchange or land acquisition for private lands that are under current or future threat of development.
    a. Who – NDOW, CFG, NRCS, private land owners
    b. When – 2005-06
    c. Identify project locations
    d. Identify proposed projects
    e. Identify funding sources
    f. Acquire funding
    g. Implement projects/actions

8. Project Monitoring. Monitor sage-grouse populations. Report accomplishment to USFWS, Reno Office.
    a. Who – NDOW, CFG, Partners
    b. When – 2006

4.4.3 Conversion of Rangeland to Agriculture

Land conversion from rangeland to agriculture risks sage-grouse habitat quality, quantity, and sage-grouse populations. Winter habitat on private sagebrush rangelands in specific sites including Sweetwater, Desert Creek, Dalzel Canyon, and state line at the Walker River is being converted to irrigated pasture and hay fields. Irrigated pasture has been known to provide late summer habitat for sage-grouse, but it may be at the loss of needed winter habitat. Agriculture uses may benefit sage-grouse if certain habitat characteristics are provided for. The risk to sage-grouse from habitat conversion is manageable and predictable, but expensive.

Additional Data Needs to Verify and Further Characterize the Risk:

- An inventory of land ownership and vegetation types is needed to evaluate the extent of potential losses of winter habitat from this activity.

- An inventory of habitat types on private lands and existing use by sage-grouse is needed to characterize habitat distribution in the PMU.

Conservation Action: Maintain Or Improve Habitat Quality And Quantity On Farm And Ranch Lands

Risk: Private lands in the Desert Creek, Sweetwater and Antelope Valley areas in California and Nevada are under current or future threat of conversion to agriculture.

Objective: Maintain existing habitat on private lands and provide opportunity to improve habitat on private lands.

Action: Provide information, education and funding to maintain and improve existing sage-grouse habitat on private lands.

Rationale: Private rangeland conversion to agriculture risks sage-grouse habitat quality, quantity and populations.

Legal Authority: Projects addressing this risk are within the management responsibility of California Fish and Game and Nevada Department of Wildlife, Mono, Douglas and Lyon County government.

Procedural Requirements: Dependent on program.

Level of Partnership Commitment: High

Funding Source: Various private, State and Federal programs.

Implementation Process:
1. Identify existing land ownership

   a. Who - NDOW, CFG
   b. When – 2004

2. Develop a map of private lands areas with critical habitat concerns
   a. Who - NDOW, CFG
   b. When – 2004

3. Establish partnerships with private landowners and determine their interest in sage-grouse conservation. Provide habitat assessment on private land to identify management opportunities for sage-grouse
   a. Who - Bi-State planning group, NDOW, CFG, NRCS
   b. When – 2004-05

4. Provide information/partnerships on funding programs for habitat management and improvement of private land
   a. Who - Bi-State, NDOW, CFG, partners
   b. When – 2004

5. Develop and implement habitat management projects on private lands.
   a. Who – NDOW, CFG, NRCS
   b. When – 2005-06
   c. Identify project locations
   d. Identify proposed projects
   e. Identify funding sources
   f. Acquire funding
   g. Implement projects/actions

6. Support zoning that will maintain, enhance or preserve critical sage-grouse habitat
   a. Who - NDOW, CFG, partners
   b. When – When local planning is initiated. Note: Smith Valley in process of developing a Master Plan for 2005.

7. For those private lands that are under current or future threat of conversion to agriculture, identify, propose and initiate conservation easement, short term and long term; land exchange or land acquisition
   a. Who – NDOW, CFG, NRCS, private land owners, partners
   b. When – 2005-06
   a. Identify project locations
   b. Identify proposed projects
   c. Identify funding sources
   d. Acquire funding
   e. Implement projects/actions

8. Project Monitoring. Monitor sage-grouse populations. Report accomplishment to USFWS, Reno Office.
   a. Who – NDOW, CFG, Partners
   b. When – 2006

4.4.4 Human Disturbance

Risks to sage-grouse populations in the Desert Creek - Fales PMU from human disturbance are affecting multiple birds on multiple sites year round, but especially during the breeding and nesting seasons. Some critical sage-grouse habitats in the Desert Creek - Fales PMU are accessible for public recreation year round or are adjacent to recently developed housing areas. Lek activity has been published by NDOW, and lek locations are easily accessed and well known. Mitigating these kinds of risks from human disturbance is manageable but expensive.

Additional Data Needs to Verify and Further Characterize the Risk:

- Identify seasonal use areas by sage-grouse in the Desert Creek – Fales PMU by radio telemetry to correlate with existing land use activity.

Initial Conservation Strategy:

- Limit public access to lek sites during the breeding and nesting season to avoid disturbance by humans.

- Establish a wildlife viewing point for the Desert Creek lek for the public at safe distances from the leks and develop educational programs and materials to inform people about the problems caused by human disturbance, i.e. driving to the lek during breeding season.

- Limit the disturbance in critical winter habitats.

<u>Conservation Action: Limited Public Access</u>

<u>Risk:</u> Disturbance of the birds during the breeding and nesting season may be reducing reproduction success.

<u>Objectives:</u>
1. Limit public access to lek sites during the breeding and nesting season to avoid disturbance by humans.
2. Establish wildlife viewing points for the public at safe distances from the leks and develop educational programs and materials to inform people about the problems caused by human disturbance.
3. Limit the disturbance in critical winter habitats.

<u>Actions:</u>
1. Close public access to the Desert Creek lek sites during breeding and nesting season.
2. Establish a wildlife viewing area for the Desert Creek Lek with educational information.
3. Identify winter use areas of sage-grouse to determine if there is a conflict with winter recreational uses.

<u>Rationale:</u> By reducing possible disturbance to the birds during breeding and nesting season, reproductive success may improve.

Legal Authority: Projects addressing this risk are within the management responsibility of the Bridgeport Ranger District, Humboldt-Toiyabe National Forest. Highway Kiosk USFS, NDOT and Lyon County. Monitoring sage-grouse and recreational activities would include NDOW, CFG and USFS.

Procedural Requirements: NEPA.

Level of Partnership Commitment:

Funding Source: National Forest appropriated dollars requested for FY 200__ and in planning process for 200__; partnerships to be pursued for full implementation.

Implementation Process:

1. Project Planning: Forest Service (200__):
    a. Identify action locations.
    b. Enter into budget planning.
    c. Complete Environmental Analysis.
2. Project Implementation Forest Service/Partners (200__):
    a. Budget for project
    b. Budget for Partners
3. Project Monitoring: Forest Service/NDOW/ Partners (2005-2006):
    a. Forest Service monitors implementation for consistency with the proposed action.
    b. NDOW and CFG continues monitoring sage-grouse populations through lek counts for changes in numbers of males visiting leks.
    c. Report accomplishment to USFWS, Reno Office.

Project Area Locations

1. Project Site One: Desert Creek Lek Closure – March 1 to May 30.
    a. Acres: 1280 acres
    b. Other Existing Uses:
        - Grazing: Cattle, winter use
        - Deer summer/transitory range

2. Project Site Two: Desert Creek Kiosk and Viewing Area
   Location: Along Hwy 338 across from Lek areas.

Figure 4-4. Proposed location of Desert Creek Lek Closure and Kiosk.

Map
Desert Creek
Closed Area
And
Kiosk

4.4.5 Overall Sagebrush Habitat Condition

The ecological condition of sagebrush habitats within the Desert Creek – Fales PMU is variable across the landscape resulting in potential and current risks to habitat quality for sage-grouse. Sagebrush is old and decadent in some areas with little desirable understory. Mountain sagebrush cover is dense in areas such as Burcham and Wheeler Flat. Sagebrush sites such as the area surrounding the Desert Creek nesting area and some early brooding areas lack forbs and associated insects for young broods. At the opposite extreme, old crested wheatgrass seedings on Sweetwater summit have a good diversity of species and the sagebrush is in high vigor. Other factors that affect the quality of sagebrush habitats include wildfire, drought, insects, and range improvement budgets for federal land management agencies.

Additional Data Needs to Verify and Further Characterize the Risk:

- Quantify and map vegetation types to document the age and structural character of sagebrush in key areas.
- Review National Forest Management Guidelines for approved land management techniques.
- Monitoring data on condition and trend of key sagebrush habitats.

Initial Conservation Strategy:

Maintain or improve the health and vigor of existing sagebrush habitat in the PMU.

Conservation Action: Maintain/Improve Health/Vigor Of Existing Sagebrush Habitat

Risk: Reduction of quality and quantity of sagebrush habitat from natural decline and decadence.

Objectives:
1. Emphasize monitoring, analysis, and management of sagebrush range sites for sage-grouse on public lands.
2. Integrate specific objectives for sage-grouse habitat into land management plans.
3. Implement vegetation treatments appropriate to rejuvenate decadent sagebrush sites in the Desert Creek – Fales PMU.
4. Increase fire suppression priorities in critical sagebrush habitats, particularly areas prone to cheatgrass invasion.

Action: Inventory and assess sagebrush habitat for possible treatment to reduce the cover and density of mature and decadent sagebrush and to provide for the establishment of grasses, forbs and young sagebrush plants. Treatment: Brush beat, burn, herbicide, etc.

Rationale: Portions of the PMU contain sagebrush vegetation that is providing low quality habitat for sage-grouse.

Legal Authority: Projects addressing this risk are within the management responsibility of the Bridgeport Ranger District, Humboldt-Toiyabe National Forest.

Procedural Requirements: Projects addressing this risk are within the management responsibility of the Bridgeport Ranger District, Humboldt-Toiyabe National Forest.

Level of Partnership Commitment:

Funding Source: National Forest appropriated dollars requested for FY 200__ and in planning process for 200__; partnerships to be pursued for full implementation.

Implementation Process:

1. Project Planning: Forest Service (200__):
    a. Identify action locations.
    b. Enter into budget planning.
    c. Identify Proposed Action for treatment
    d. Schedule Heritage and Biological surveys
    e. Complete Environmental Analysis.
2. Project Implementation Forest Service/Partners (200__):
    a. Budget for project
    b. Budget for Partners
3. Project Monitoring: Forest Service/NDOW/ CFG/Partners (200__-200__):
    a. NDOW/CFG/ continue monitoring sage-grouse populations through lek counts and brood counts.
    b. Report accomplishment to USFWS, Reno Office.

Project Area Locations:

1. California Locations:
    a. Wheeler Flat
    b. Burcham Flat area
    c. Upper Desert creek

2. Nevada Locations:
    a. Sweetwater Summit
    b. The Elbow
    c. Bald Mountain

4.4.6 Power Lines, Roads, and Other Infrastructure

Power lines, roads, airstrips, and fences are risks to sage-grouse in the Desert Creek-Fales PMU that affect habitat quantity and populations on a yearlong basis. Breeding habitats, brood habitats, and migratory habitat can be impacted. Recent declines in the Fales population may be related to construction of power lines and associated land use activities over the last ten years. Power lines and roads may be effective barriers to bird movements. Sage-grouse have been known to fly into newly constructed fences.

New developments that pose this type risk are being managed on federal lands in conjunction with the National Environmental Policy Act (NEPA) process, and on private lands in California in accordance with the California Environmental Quality Act (CEQA).

Additional Data Needs to Verify and Further Characterize the Risk:

- Compile maps and specifications of transportation routes and corridors or road improvements proposed for construction in the Desert Creek – Fales PMU.
- Analyze the cumulative effects of existing transportation routes and corridors.

Initial Conservation Strategy:

- Use flagging to mark new fences, or relocate fence construction away from critical habitat areas.
- Maintain existing corridors for power lines and transportation routes. Locate new utility corridors away from leks.
- Modify aerial structures to prevent avian predator perching or nesting.
- Close and reclaim roads that ORV users have created into critical sage-grouse habitat areas.
- Limit development of new roads and trails to minimize impacts to critical habitat areas.

Conservation Action: Utility/Transportation Route Analysis

Risk: Predation, Accident Mortality, Loss of Habitat

Objectives: Reduce further impact to sage-grouse

Action: Compile maps and specifications of transportation routes and corridors or road improvements proposed for construction in the Desert Creek – Fales PMU. Analyze the cumulative effects of existing transportation routes and corridors. Locate new utility corridors away from leks.

Rationale: Will provide information on current and future impacts to sage-grouse.

Legal Authority: CFG, NDOW, USFS, NDOT, CalTrans

Conservation Action: Modify Aerial Structures

Action: Modify aerial structures to prevent avian predator perching or nesting.

Rationale: Aerial structures are know to provide perches for raptors and other avian predators.

Legal Authority: Utility Company.

Procedural Requirements

Level of Partnership Commitment:

Funding Source: Partners, Utility Company

Implementation Process:

Project Area Locations: Highway 395 from West Walker to Fales area

Conservation Action: Limit Off-Highway Routes

Action: Close and reclaim roads that ORV users have created into critical sage-grouse habitat areas. Limit development of new roads and trails to minimize impacts to critical habitat areas

Rationale: Roads may fragment habitat, support noxious weeds, disturb sage-grouse.

Legal Authority: USFS

Procedural Requirements

Level of Partnership Commitment:

Funding Source: USFS, partners

Implementation Process:

Project Area Locations:

4.4.7 Livestock Grazing

The risk to sage-grouse from livestock grazing is the reduction or removal on an annual basis of plant production that could either provide nesting/hiding cover or forage for sage-grouse. Grazing of meadows used for brooding by sage-grouse is not detrimental to the habitat when adequate cover and forbs are provided to meet sage-grouse needs. The potential for grazing to impact riparian meadow habitats by decreasing cover and forage for sage-grouse is more prevalent during the mid-late brooding period. Long term risk could be the change in composition of vegetation in key habitat.

The Humboldt-Toiyabe National Forest administers grazing within the Desert Creek - Fales PMU on National Forest land. Grazing allotments, season of use, and past use are summarized in Table 4.2.

Table 4-2. Livestock grazing allotments and season of use in the Desert Creek Fales PMU.

Allotment Name	Sage Grouse Seasonal Habitat	Land Manager	Class of Livestock	Livestock Season of Use
Rickey Peak	unknown	USFS	Sheep	6/28-9/30
South Swauger	unknown	USFS	Sheep	7/1-9/10
Little Walker	breed, nest, early-late brood	USFS	Cattle	6/16-9/15
Poison Creek	nest, early-late brood	USFS	Sheep	6/19-9/25
Junction	unknown	USFS	Cattle	6/16-9/24
Mount Jackson	unknown	USFS	Cattle	6/16-9/30
Sierra Blanca	unknown	USFS	Cattle	6/16-9/15
North Swauger	unknown	USFS	Sheep	7/21-8/5
Burcham	breed, nest, early-late brood	USFS	Sheep	7/1-9/15
Cottonwood	breed, nest, winter	USFS	Sheep	7/1-9/15
Sweetwater	breed, nest, early-late brood, winter	USFS	Cattle	6/16-10/15
Frying Pan-Murphy Creek	late brood	USFS	Cattle	6/16-9/20
Desert Creek	late brood	USFS	Cattle	7/15-8/15
Desert Peak	late brood	USFS	Sheep	5/19-6/18
Risue	unknown	USFS	Sheep	5/19-6/18
Topaz	none	USFS	Cattle	11/15-5/25
Wild Oat	none	USFS	Sheep	4/1-5/15
Simpson	late brood	USFS	Cattle	Vacant
Saroni Canal	unknown	USFS	Sheep	4/1-5/18
Fourmile	breed, nest	USFS	Cattle	11/15-1/15
Dalzell	nest	USFS	Cattle	1/16-2/28
Conway	early-late brood, winter	USFS	Cattle	12/11-2/14
Bald Mountain	late brood, winter	USFS	Sheep	5/16-6/15
Nye Canyon	late brood, winter	USFS	Cattle	6/16-9/15
Sulfur (Spring)	winter	USFS	Sheep	4/16-5/24
Sulphur (Winter)	winter	USFS	Sheep	12/16-3/15
Missouri Flat	unknown	USFS	Cattle	11/1-1/31
Wellington Springs	winter	USFS	Sheep	4/16-5/15
Wheeler Flat	unknown	USFS	Cattle	11/1-2/28
Gray Hills	unknown	USFS	Sheep	1/1-12/31
Sugarloaf	unknown	USFS	Sheep	12/16-2/28
Pine Grove	winter	USFS	Sheep	5/25-6/27

Current management practices on National Forest allotments in the PMU are providing adequate nesting cover and brooding habitat. There has been no grazing in the Desert Creek lek area for the past several years. Cattle graze the Sweetwater lek area during late spring, after nesting, and utilization levels have been moderate. No grazing occurs in the Fales/Wheeler area during the nesting season.

Livestock grazing occurs throughout the Desert Creek – Fales PMU under the authority, permitting, and management of the National Forest Service Bridgeport Ranger District. Grazing allotments and seasons of use in the Desert Creek – Fales PMU are summarized in Table 4-2. All other livestock grazing is found on private land with in the PMU.

Additional Data Needs to Verify and Further Characterize the Risk:

- Continue to monitor utilization or stubble height at known nesting sites prior to the nesting season. This includes Desert Creek, Sweetwater, Fales and Wheeler Flat leks.
- Monitor utilization or stubble height on late brooding habitat. This includes Wheeler Flat, Sweetwater, Fales, Jackass Springs and numerous other sources in the Sweetwater Mountains.
- Evaluate the ecological condition of known nesting habitat to determine the potential for producing optimal nesting habitat as described in the WAFWA Guidelines. This includes Desert Creek, Sweetwater, Fales and Wheeler Flat lek areas.
- Inventory and conduct Proper Functioning Condition (PFC) evaluations on meadows and riparian habitats used or potentially used by sage-grouse. This will provide a baseline to determine the existing and potential habitat for these area and help direct efforts for management.
- Monitor birds' movements with radio telemetry to identify nesting, early brood, and late brood habitats to determine potential conflicts with season of grazing, use levels and class of livestock (cattle or sheep).

Initial Conservation Strategy:

- Maintain grazing management practices on National Forest allotments where current utilization levels and season of grazing are consistent with maintaining or enhancing nesting and brood habitats.
- Use an adaptive management approach during drought periods to modify grazing to provide cover requirement for nesting and forage for brooding habitat.
- Manage livestock grazing to maintain sage-grouse use on all currently used meadows.
- When possible, modify water sources to restore wet meadow and riparian habitats.
- Identify locations and install water developments and guzzlers to improve summer habitat conditions.

Conservation Action: Livestock Management

Risk: Reduction or removal of cover or forage on an annual basis. Long term reduction of cover, forage or change in species composition.

Objective:

1. Maintain grazing management practices on National Forest allotments where current utilization levels and season of grazing are consistent with maintaining or enhancing nesting and brood habitats.

2. Use an adaptive management approach during drought periods to modify grazing to provide cover requirements for nesting and forage for brooding habitat.

3. Manage livestock grazing to maintain sage-grouse use on all currently used meadows.

4. Manage existing and new water sources to restore wet meadow and riparian habitats and improve summer habitat conditions.

Actions:

1. Inventory, evaluate and monitor habitat per Additional Data Needs (above).
2. Identify developed water sources in sage-grouse habitat to determine if they are maintaining associated wet meadows and riparian habitats. Modify water developments if needed for sage-grouse habitat.
3. Develop water sources for livestock if they will maintain or improve sage-grouse habitat.
4. Identify appropriate locations and install water developments and guzzlers to improve summer habitat conditions for sage-grouse.
5. Continue to monitor habitat and birds' movements with radio telemetry to identify any ongoing conflicts. Modify grazing as necessary during drought periods.

Rationale: Management of livestock grazing needs to be done in such a way as to maintain or improve sage-grouse habitat.

Legal Authority: Projects addressing this risk are within the management responsibility of the Bridgeport Ranger District, Humboldt-Toiyabe National Forest.

Procedural Requirements: Projects addressing this risk are within the management responsibility of the Bridgeport Ranger District, Humboldt-Toiyabe National Forest.

Level of Partnership Commitment:

Funding Source: National Forest appropriated dollars requested for FY 200__ and in planning process for 200___; partnerships to be pursued for full implementation.

Implementation Process:

1. Project Planning: Forest Service (2004):
   a. Identify action locations
   b. Enter into budget planning
   c. Identify Proposed Action for treatment
   d. Schedule Heritage and Biological surveys
   e. Complete Environmental Analysis.
2. Project Implementation Forest Service/Partners (2005):
   a. Budget for project

b. Budget for Partners

3. Project Monitoring: Forest Service/NDOW/ CFG/Partners (2005-2006):
   a. Forest Service monitor utilization levels.
   b. NDOW/CFG continue monitoring sage-grouse populations through lek counts and brood counts.
   c. Report accomplishment to USFWS, Reno Office.

Project Area Locations: To be identified at a later date.

4.4.8 Predation

Predation on sage-grouse is a threat to the population that is affected by many conditions including availability of other prey species, habitat condition, and climate. The range and size of predator populations can be expanded by human activities such as road and fence construction, landfills, and housing development. Predator densities can also increase with the number and availability of prey species.

Predation has not been identified as a significant limiting factor for sage-grouse in the Desert Creek – Fales PMU.

Additional Data Needs to Verify and Further Characterize the Risk:

- Obtain and review predator control records from APHIS for the Desert Creek – Fales PMU area.
  a. Who: CFG, NDOW
  b. When: ongoing

- Mark and monitor sage-grouse to determine predation rates.
  a. Who: CFG, USGS, NDOW
  b. When: ongoing

Initial Conservation Strategy:

- Educate private landowners to reduce predation by domestic pets.
  a. Who: CFG, NDOW, Partners
  b. When: ASPS

- Provide optimal habitat of sage-grouse for all seasons to minimize predation.

4.4.9 Hunting

Hunting is the physical act of removing individual birds from the population. However, hunting seasons are only scheduled when specific population criteria are met. Currently there is no hunting within the Desert Creek - Fales PMU.

Initial Conservation Strategy:

- Continue routine population monitoring to assess trends in breeding populations and annual production.
  a. Who: CFG, NDOW, Partners
  b. When: ongoing

- Permit and schedule hunting seasons only when specific population criteria indicate that the population will not suffer from loss of individuals.
    a. Who: CFG, NDOW, Partners
    b. When: ongoing

5.0 BODIE PMU

5.1 PMU Description

5.1.1 Location and Boundary

The Bodie PMU encompasses 349,630 acres in northern Mono County, California. The majority of the PMU is located north of California State Route 167 and east of US Highway 395 in the Bodie Hills. Adjacent portions of the Mono Basin, Bridgeport Valley, and east slope of the Sierra Nevada comprise the remainder of the PMU. The north half of Mono Lake constitutes about 7% of the PMU area. The Bodie PMU is bounded on the north by the Desert Creek-Fales PMU, the east by the Mount Grant PMU, and the south by the South Mono PMU (Figure 5.1.1-1).

The PMU boundary follows the East Walker River from the California-Nevada state line, southwest through Bridgeport Valley, then along Sawmill Ridge to Robinson Peak. From Robinson Peak, the boundary trends southeast along the upper elevations of the east slope of the Sierra Nevada to Lee Vining Peak. From Lee Vining Peak, the boundary drops into the lower elevations of the Mono Basin and continues easterly to the California-Nevada state line. The boundary then follows the state line northwest to the East Walker River.

5.1.2 Land Ownership and Regulatory Jurisdictions

Land ownership in the Bodie PMU is predominantly public with nearly 74% of the PMU managed by the Bureau of Land Management (BLM) and the US Forest Service (USFS). The BLM, Bishop Field Office, is responsible for management of the largest portion of the PMU. The Humboldt-Toiyabe National Forest (HTNF), Bridgeport Ranger District, and the Inyo National Forest (INF), Mono Ranger District, manage National Forest lands in the PMU. Private lands comprise about 17% of the PMU, with some private lands in the northern Mono Basin owned and managed by the City of Los Angeles, Department of Water and Power (DWP). State of California lands comprise about 2% of the PMU and include Bodie State Historic Park, Green Creek Wildlife Area, East Walker Wildlife Area, Wilson Creek Wildlife Area, and a few scattered school sections. Native American reservation lands under jurisdiction of the Bridgeport Pauite Colony represent less than 1% of the PMU. Land ownership in the Bodie PMU is summarized in Table 5.1.2-1.

The existing land ownership pattern is primarily the result of early mineral development and ranching activities. Numerous, often small and isolated, private parcels are distributed throughout the PMU. A large block of private land occurs in Bridgeport Valley (Figure 5.1.2-1). Many of these private parcels are associated with perennial water and provide important sage-grouse habitat. Significant historic human population centers and associated development occurred in the vicinities of Bodie, Bridgeport, Masonic, Lundy and Dunderberg. Contemporary residential and commercial development is predominately clustered along the corridors of US Highway 395, California State Route 167, and California State Route 182. Bridgeport and Mono City are the primary population centers. Residential and recreational development is also common in the Virginia Lakes and Twin Lakes basins. Additional development of the numerous private parcels traditionally associated with ranching and mining is increasing, particularly along California State Route 167 in the northern Mono Basin.

Table 5.1. Summary of Land Ownership in the Bodie PMU.

LAND MANAGER OR OWNER	ACRES	PERCENT OF PMU
Total Acres	**349,630**	**100**
Bureau of Land Management	180,022	51
Private (Including DWP)	58,952	17
Humboldt-Toiyabe National Forest	44,836	13
Inyo National Forest	36,546	10
Mono Lake	23,153	7
State of California	6,081	2
Native American	40	<1

Land use, management and development on most lands in the Bodie PMU is guided by existing land use plans. The Bishop Resource Management Plan (BLM 1993) provides direction for management of BLM lands in the PMU. National Forest Lands in the PMU are managed under direction of the Humboldt-Toiyabe National Forest Land and Resource Management Plan (USFS 1986), and the Inyo National Forest Land and Resource Management Plan (USFS 1988). The Mono County General Plan (Mono County 1992) guides land use and development on private lands in the PMU.

The southern limits of the PMU include a portion of the Mono Basin National Forest Scenic Area. Other significant Federal land use designations include BLM managed Areas of Critical Environmental Concern (ACECs) for the Bodie Bowl, Conway Summit and Travertine Hot Springs. Large portions of BLM land in the Bodie Hills and northeast Mono Basin are also designated as Wilderness Study Areas (WSAs). In addition, small portions of the Humboldt-Toiyabe National Forest along the western boundary of the PMU are identified as proposed additions to the Hoover Wilderness.

5.1.3 Topography and Climate

Elevations in the Bodie PMU range from 5,940 ft (1,811 m) to 12,380 ft (3,773 m). The majority (80%) of the PMU lies between 6,500 ft (1,981 m) and 9,000 ft (2,743 m). Mean elevation is 7,540 ft (2,298 m). Lower elevations occur in the Mono Basin, Bridgeport Valley, and along the East Walker River. Upper elevations are associated with the highest peaks of the Bodie Hills and the east slope of the Sierra Nevada. In the Bodie Hills, elevations above 9,000 ft (2,743 m) are restricted to the environs of Bodie Mountain, Potato Peak and Masonic Mountain. The highest elevations in the PMU occur along the east slope of the Sierra Nevada near Robinson Peak, Monument Ridge, Kavanaugh Ridge, Dunderberg Peak, Mount Warren and Lee Vining Peak.

Topography is diverse with the full spectrum of slope and aspect classes well represented. Steep slopes (10-35% slope) are the dominant topographic class and comprise 39% of the PMU area. A combination of flats, very gentle slopes (0-3% slope), and gentle slopes (3-10% slope) characterize an additional 47% of the PMU. The remaining 14% of the PMU is considered very steep (>35% slope). Northerly, easterly, southerly and westerly aspects are nearly equally represented. The physiographic diversity in slope and elevation within the PMU provides for a variety of microclimatic temperature and moisture gradients.

Climate is typical of the Basin and Range Province, characterized by hot, dry summers and cold winters. Temperatures range from summer highs above 90° F to winter lows below -30° F. Bodie and Bridgeport commonly report some of the coldest recorded winter temperatures in the contiguous United States. Average annual precipitation measured at Bodie from 1964 through 2001 is 13.50". Bodie received a record high of 26.04" of precipitation in 1965 and a record low of 6.84" of precipitation in 2000 (Western Regional Climate Center 2003). Most precipitation occurs during the winter as snow. However, spring, summer and fall rains provide significant moisture in some years.

5.1.4 Sagebrush Associated Vegetation Communities and Distribution

A diversity of sagebrush species and associated vegetation communities typical of the southern Great Basin sagebrush ecosystem (Miller and Eddleman 2001) occur in the Bodie PMU. The predominant sagebrush species are mountain big sagebrush (*Artemisia tridentata spp. vaseyana*), Wyoming big sagebrush (*Artemisia tridentata spp. wyomingensis*) and low sagebrush (*Artemisia arbuscula spp. arbuscula*). Silver sagebrush (*Artemisia cana spp. viscidula*) and basin big sagebrush (*Artemisia tridentata spp. tridentata*) are also common, but occur on a considerably smaller spatial scale. Subalpine big sagebrush (*Artemisia spiciformis*) is limited to the Sierra Nevada portion of the PMU. Though not contiguous, sagebrush habitats are generally well distributed and found from the lowest to the highest elevations of the PMU.

Wyoming big sagebrush tends to be the dominant tall sagebrush variety in the lower elevation, arid portions of the PMU. Significant stands of Wyoming big sagebrush are found in the northeastern Mono Basin and on some lower elevation slopes adjacent to Bridgeport Valley. On many Wyoming big sagebrush sites, antelope bitterbrush (*Purshia tridentata var. tridentata*), basin big sagebrush and other xeric shrubs are common to co-dominant in the plant community. Singleleaf pinyon (*Pinus monophylla*), and to a lesser extent juniper (*Juniperus spp.*), are common along the upper elevation limits of many of the Wyoming big sagebrush communities. Common grass species associated with Wyoming big sagebrush in the Bodie PMU include Nevada needlegrass (*Achnatherum nevadensis*), western needlegrass (*Achnatherum occidentalis*), squirreltail (*Elymus elymoides*) and bluegrass (*Poa secunda* spp. *secunda*).

Mountain big sagebrush is the dominant tall sagebrush variety in the cooler, mid to upper elevations of the PMU. Mountain big sagebrush is typical of deeper, well-drained soils, both within and above the pinyon-juniper belt. Bitterbrush is frequently a dominant or co-dominant component in most of the mid-elevation mountain big sagebrush communities. Singleleaf pinyon is also common in many mid-elevation mountain big sagebrush sites. At higher elevations, and on moister slopes and aspects, mountain snowberry (*Symphoricarpos oreophilus*), wax currant (*Ribes cereum*) and other montane shrubs are common associates of mountain big sagebrush. Common grass species associated with mountain big sagebrush in the Bodie PMU include Thurber's needlegrass (*Achnatherum thurberianum*), Indian rice grass (*Achnatherum hymenoides*), western needlegrass, basin wild rye (*Leymus cinereus*) and needle and thread grass (*Hespirostipa comata* ssp. *comata*).

Low sagebrush is well distributed on shallower, impermeable soils, associated with flats, ridges, and steeper slopes at the mid to upper elevations of the PMU. Frequently, low sagebrush forms a mosaic with mountain big sagebrush or mixed mountain big sagebrush-bitterbrush communities. Singleleaf pinyon, and to a lesser degree juniper, have invaded some mid-elevation low sagebrush communities in the PMU. Common grass species associated with low sagebrush in the Bodie PMU include Webber's needlegrass (*Achnatherum webberi*), June grass (*Koeleria macrantha*) and several bluegrass species (*Poa secunda ssp. secunda*, *Poa wheeleri* and *Poa nervosa).*

Silver sagebrush is common within and along the margins of moist meadow communities at all elevations of the Bodie PMU. Notable silver sagebrush stands occur at Big Flat, upper Cottonwood Canyon, and the headwaters of Rough Creek. Basin big sagebrush is found primarily at the lower to mid-elevations of the PMU and associated with deeper, well-drained sandy or loamy soil inclusions. The majority of basin big sage habitats within the PMU are found in valley bottoms and along drainage corridors. Common grass species associated with basin big sage habitats in the Bodie PMU include basin wild rye, Indian rice grass and needle and thread grass. Subalpine big sagebrush is limited to upper elevations on the Sierra Nevada side of the PMU where it occurs on moist opens slopes and along the fringes of mountain meadows and streamside riparian habitats.

Singleleaf pinyon is common, with significant stands occurring along the lower to mid-elevation slopes of the both the Bodie Hills and the Sierra Nevada. In the Bodie Hills, large stands of pinyon are found on the northern flank adjacent to the East Walker River, on the southern flank from the Nevada border to Conway Ranch, on the eastern flank along the Nevada border, and on the western flank from Clearwater Creek to Bridgeport. Though seldom dominant, juniper is common in many of the pinyon stands in the Bodie Hills. On the Sierra Nevada side of the PMU, significant stands of pinyon occur adjacent to Bridgeport Valley from the Hunewill Hills south to Dog Creek and south of Lundy Canyon adjacent to US Highway 395 west of Mono Lake. Juniper is rare on the Sierra Nevada side of the PMU. Pinyon, and to a lesser extent juniper, encroachment is common in sagebrush communities in these areas of the Bodie PMU.

Native and irrigated meadows and streamside riparian habitats are common associates of sagebrush communities in the Bodie PMU. Though of limited overall extent, numerous small springs and associated meadows are scattered throughout the PMU. The largest meadow complexes are found in the vicinities of Bridgeport Valley, Summers Meadows, Green Creek, Sinnamon Meadows, Kirkwood Meadows, Conway Summit, Conway Ranch, Bodie Creek, Mormon Meadows, Cottonwood Creek, and the headwaters of Rough Creek. Streamside riparian habitats are associated with the headwaters of the East Walker River and the Mono Basin and are found in both the Bodie Hills and the Sierra Nevada portions of the PMU.

Other associated vegetation types include mixed evergreen forests, aspen, mountain mahogany and mixed shrub communities.

5.2 Sage-grouse Habitat Description and Condition Assessment

Most sagebrush associated upland range sites in the Bodie PMU are considered to be in mid to late-seral ecological condition. These mid to late-seral communities are generally classified as either key (R0) or understory limited (R2) sagebrush habitats. As a result, R0 and R2 are the dominant sagebrush habitat condition classes represented in the PMU. Pinyon-juniper encroached (R3) sagebrush habitats are also common, but occur on a smaller spatial scale. Sagebrush limited (R1) and potential sagebrush habitats without sagebrush (R4) are relatively rare in the Bodie PMU.

Understory limited (R2) sagebrush habitats in the Bodie PMU are characterized by a wide variety of sagebrush canopy cover and herbaceous understory conditions. Mountain big sagebrush associated R2 types with high (> 40%) shrub canopy cover and a limited native grass-forb understory are relatively common. In these sites, excessive shrub cover may be a factor contributing to limited understory conditions. In other R2 types, shrub cover is lower (15-40%) and not likely to be a factor limiting the understory. Though seldom dominant, cheat grass (*Bromus tectorum*) is a significant component in the understory of some R2 sites. Many R2 sites in the Bodie PMU have tremendous potential for sage-grouse habitat improvement. However, finer resolution mapping of R2 sites will be required to ensure the application of appropriate management techniques.

Pinyon-juniper encroached (R3) sagebrush habitats are common at the lower to mid-elevations of the Bodie PMU. Significant areas of pinyon, and to a much lesser extent juniper, encroachment can be found on all flanks of the Bodie Hills. On the Sierra Nevada side of the PMU, pinyon encroachment is occurring adjacent to Bridgeport Valley from the Hunewill Hills south to Dog Creek and south of Lundy Canyon adjacent to US Highway 395 west of Mono Lake. Juniper is rare on the Sierra Nevada side of the PMU. Many of these R3 sites provide excellent opportunities for sage-grouse habitat improvement, particularly those adjacent to leks and meadows. R3 sites that occur between known seasonal use areas or adjacent breeding populations are also good candidates for sage-grouse habitat improvement projects.

Sagebrush limited (R1) habitats in the Bodie PMU are restricted to relatively recent (< 40 years) burns, mechanical disturbances, or other site altering activities. Contemporary disturbances have been limited and affected a very small percentage of the PMU. No landscape scale fires or other disturbances have occurred over the last 40 years. During the 1960s, several herbicide sprays were conducted to reduce shrub cover in mid to upper elevation mountain big sagebrush and low sagebrush habitats in the PMU. However, sagebrush cover was quick to recover and most of these spray sites are now classified as key (R0) sagebrush habitats. Generally, R1 sites in the Bodie PMU are naturally transitioning early to mid-seral sagebrush communities in which sagebrush cover will improve over time.

Roads, housing developments, mineral material pits, and other activities that completely remove vegetation from an area characterize potential sagebrush habitats without sagebrush (R4) in the Bodie PMU. Large contiguous blocks of R4 habitat are essentially absent. To date, no type conversion of sagebrush dominated habitat to non-native annual grassland has occurred in the PMU. However, cheat grass is common and some risk of type conversion does exist, especially in the lower elevation Wyoming big sagebrush habitats adjacent to Bridgeport Valley. Some lower to mid-elevation mountain big sagebrush sites are also at risk of conversion to non-native annual grassland. This risk is greatest on dryer, south and west facing slopes and sites where pinyon encroachment has increased the potential for a large, hot fire. R4 habitat restoration opportunities are generally limited to small, isolated sites in the Bodie PMU.

5.2.1 Breeding Habitat

The Bodie PMU includes one of the largest breeding complexes in the Bi-State Planning Area. To date, 29 different leks have been mapped within the boundary of the PMU. Of these, 8 appear to be dependable long-term strutting locations based on review of lek coding, geographic location, and male attendance. Of the remaining 21 mapped locations, 6 appear to be satellite leks, 6 may represent either satellites or changes in lek focal activity, and 6 are one-time observations of strutting males. The significance of 4 cannot be determined as documentation other than a mapped location is lacking.

Leks in the Bodie PMU are arrayed roughly in a mid-elevation ring surrounding Bodie Mountain and Potato Peak (Figure 5.2.1-1). The easternmost lek (11/12), on Dry Lakes Plateau near the Nevada border, and the westernmost lek (10), at Lower Summers Meadow west of US Highway 395, are separated by a distance of 11.6 miles (18.6 km). The northernmost lek (7/8) at Big Flat and the southernmost lek (5/6) at Bridgeport Canyon are 16.3 miles (26.2 km) apart. Leks range in elevation from 6,820 ft (2,079 m) at Lower Summers Meadow (10) to 8,450 ft (2,576 m) at the Racetrack (4) near Bodie State Historic Park. Mean elevation of all mapped strutting locations is 7,874 ft (2,400 m). Leks are on wet and dry meadows, dry lakes and low sagebrush sites. In general, sagebrush habitats are uniformly distributed around leks in the Bodie PMU. However, sagebrush tends to be irregularly distributed at the lower elevations, especially in the vicinities of lek 9 near US Highway 395 and lek 10 at Lower Summers Meadow. Pinyon, and to a lesser extent juniper, are the primary factors fragmenting sagebrush habitats in these areas.

Telemetry tracking of approximately 10 sage-grouse per year has been underway in the Bodie PMU since 1999, a cooperative effort of the California Department of Fish and Game (CDFG), the Bureau of Land Management (BLM), and the United States Geological Survey (USGS). A total of 10 nests have been located, 8 of which have hatched successfully. Nest shrub information was recorded and vegetation measurements were collected along transects centered on the nest, using a protocol developed by Idaho BLM (Sather-Blair et al. 2000) based on the guidelines (Connelly et al. 2000).

BLM found that in 1999-2002, nest sites compared favorably with shrub height, grass height, and grass cover recommendations published in the guidelines. Nest site shrub communities differed from those described in the guidelines in that shrub canopy cover tended to be greater and bitterbrush provided a major cover component. In addition, bitterbrush was often selected as a nest shrub, with no apparent detriment to nest success. Basin wild rye contributed notably to tall, dense grass cover (BLM 2003). Twenty-two forbs known to be preferred sage-grouse forage are found in the Bodie PMU. Those found during nest site evaluations included birdsfoot trefoil (*Lotus* sp., rare), milkvetch (*Astragalus* sp., sparse), hawksbeard (*Crepis* sp., sparse), phlox (*Phlox* sp., rare to common), groundsmoke (*Gayophytum* sp., scattered to common) and yarrow (*Achillea millifolium*, common to abundant) (BLM Bishop FO files).

5.2.2 Summer/Late Brood Habitat

Within the Bodie Hills, east of US Highway 395, telemetered males and hens without broods have begun moving to higher elevations in early June, followed by hens with broods during late June and early July. Both telemetry and casual observations show that throughout the remainder of the summer, significant numbers of sage-grouse concentrate around Bodie Mountain and Potato Peak, and are commonly found from about 9,000 ft (2,743 m) in elevation up to the top of Bodie Mountain near 10,170 ft (3,099 m). These high elevation summer observations also cluster around springs, streams and meadows that comprise the headwaters of Rough Creek and originate on the northern and eastern flanks of the peaks. Key areas include the upper reaches of the Paramount Mine drainage, Meadow Canyon, Rough Creek, Atastra Creek, and the small reservoir that lies between the two peaks. This results in many grouse concentrating in a small percentage of all sagebrush habitats in the Bodie PMU.

Low sagebrush and mountain big sagebrush are common at these higher elevations, with patches of bitterbrush, currant and snowberry occurring on more mesic sites. These higher elevations generally remain cooler and moister, and support forbs to a later date, than the lower elevations of the PMU. Telemetry study has thus far spanned drier than average years and continued study may reveal whether such concentrated sage-grouse use of the highest elevations during the summer is also the norm during wetter years. Further vegetation assessments may also reveal the extent to which sagebrush community characteristics at high-elevation sites altered by chemical treatments 4 decades ago may be a factor in summer habitat selection.

An apparently lesser number of sage-grouse are also found during the summer in sagebrush-associated habitats adjacent to lower elevation spring-fed or irrigated wet meadows in the western portion of the Bodie PMU. Sage-grouse in this area also summer on the high ridges dividing streams that flow out of the eastern flank of the Sierra Nevada, ranging up to the tree line at about 9,000 ft (2,743 m) and occasionally onto the higher peaks that are bare of trees. Mixed shrub communities comprised of mountain big sagebrush, bitterbrush, snowberry, currant and other montane shrubs are prominent. Pure stands of mountain big sagebrush and low sagebrush are limited west of US Highway 395. Larger meadow complexes are also a prominent feature of the western portion of the PMU. Important meadow complexes include Bridgeport Valley, Summers Meadows, Green Creek, Sinnamon Meadows, Kirkwood Meadows, Conway Summit, Conway Ranch and Mormon Meadows.

5.2.3 Winter Habitat

In 2000 through 2003, nearly all telemetered sage-grouse left summer habitats by mid-September and returned to the 7,000 ft (2,314 m) to 8,000 ft (2,438 m) level. During September-November, they tended to concentrate in the expanses of sagebrush near two of the lek areas, Big Flat (7/8) and north and east of Mount Biedeman (2). These areas have extensive, almost monotypic stands of sagebrush with what appears to be good canopy cover. In December-February sage-grouse continued to use these fall habitats, occasionally visiting higher elevations when weather conditions allowed. Use of Big Flat is also documented for a telemetered female sage-grouse from the Desert Creek - Fales PMU during the winter of 1998-1999. By March, telemetered sage-grouse had begun spreading out into all the lek areas in the PMU. Casual observations of wintering sage-grouse are recorded for the Mono Basin near Mono City and east of Mono Lake. A significant low elevation stand of Wyoming big sagebrush occurs east of Mono Lake and may provide important winter habitat in some years.

Winter telemetry observations have thus far taken place only during dry winters with less than average snowfall. During non-drought years, suitable wintering areas may be few and/or distant, as pinyon, and to a lesser extent juniper, cover much of the sagebrush habitat below 7,000 ft (2,134 m) in the PMU. Continued telemetry study through several winters of heavy snowfall will be needed to find out where sage-grouse go when snow completely covers much of the sagebrush in the Bodie PMU. Aircraft tracking support during the winter months is crucial to gaining this information.

5.3 Sage-grouse Populations

5.3.1 Population Characteristics and Distribution

Sage-grouse in the Bodie PMU exhibit at least 2 of 3 seasonal movement patterns described in the guidelines (Connelly et al. 2000): 1) Non-migratory, with well-integrated seasonal habitats; and 2) One-stage migratory, with distinct summer areas and integrated winter and breeding areas. To date, no evidence of two-stage migratory movement has been documented. However, as described above, severe winters with deep snow conditions may necessitate a two-stage migratory pattern.

Connelly et al. (2000) also identify active leks separated by ≤ 12.4 miles (20 km) as belonging to a single breeding population. Applying this definition to active leks within the Bi-State Planning Area indicates that sage-grouse in the Bodie and Mount Grant PMUs comprise one breeding population. Currently, the northernmost active lek (Big Flat) in the Bodie PMU is only 7.9 miles (12.7 km) from the southernmost active lek (China Camp #2) in the Mount Grant PMU. Comparison of active vs. inactive leks shows no significant reduction in the overall extent of breeding range within the Bodie PMU. However, the loss of strutting activity at 3 of the southernmost leks (Aurora, Mud Springs and China Camp #1) in the Mount Grant PMU indicates some reduction in breeding range for the combined Bodie-Mount Grant population (Figure 5.3.1-1).

To the north, active leks near Sweetwater Summit in the Desert Creek Fales PMU are separated by just over 14.3 miles (23 km) from the northernmost active leks in the Bodie and Mount Grant PMUs. To the south, the northernmost active lek (Parker Meadows) in the South Mono PMU is about 17.4 miles (28 km) south of the southernmost active lek (Bridgeport Canyon) in the Bodie PMU. A female sage-grouse radioed by the Nevada Department of Wildlife (NDOW) during the spring of 1998 near Sweetwater Summit in the Desert Creek/Fales PMU moved into the Bodie PMU near Big Flat later that fall, a distance of about 14.3 miles (23 km). The movement of this hen documents some interaction between these two breeding populations. To date, no similar movement between the Bodie and South Mono PMUs has been documented.

5.3.2 Population Estimates and Trends

Annually, the California Department of Fish and Game (CDFG), Bureau of Land Management (BLM) and other agencies cooperate to assess the status of sage-grouse breeding populations in Mono County, California. Annual efforts include surveying all known leks for activity, searching for new leks, and obtaining peak counts of male attendance at each known lek. Initial population monitoring efforts in the Bodie Hills began in 1953 with the counting of just three leks (1, 2 and 3). A fourth lek (4) was discovered in 1957, followed by the addition of satellites 2a and 2b in 1970, leks 5/6, 7/8, 9 and 10 in 1976, lek 11/12 in 1977, and satellite

2c in 1980. To date, a total of 8 dependable, long-term leks and several associated satellite grounds have been identified in the Bodie PMU (see Section 5.2.1 Breeding Habitat).

Beginning in 1987, the method for conducting lek counts was standardized in an attempt to obtain the annual single day peak male attendance for all known active leks in the Bodie PMU. The method used to establish the annual single day peak count typically involves 1 experienced person counting each active lek on at least 3 separate days during the period when female and male presence is at a maximum (Connelly et al. 2003). The annual single day peak count is reported for the day with the highest cumulative number of males counted on all active leks visited within the PMU. Leks are monitored for activity beginning in March to judge the likely period of peak lek occupation. Annual monitoring efforts prior to 1987 did not always involve multiple lek counts because of constraints associated with personnel, weather and access.

Connelly et al. (2000) summarize the limitations of lek counts and recommend that population assessments based on lek counts be viewed with caution. Despite those limitations, they also recognize that lek counts provide the best index to breeding population levels and trend. Population estimates and trends based on annual lek surveys for the Bodie PMU are provided below.

Population Estimates

Two population expansion estimators, Emmons and Braun (1984) and Walsh (2002), were used to estimate the upper and lower limits of the most recent spring sage-grouse population in the Bodie PMU. The low estimate (Emmons and Braun 1984) assumes that there are 2.00 hens per male and that the number of undetected males (adult and juvenile males not observed on leks) is 25% that of visible males. The high estimate (Walsh 2002) assumes that only 50% of all males attend leks and that there are 2.73 hens per male. The assumption that 10% of all leks in the PMU are still undetected was applied to both estimators. Based upon the average of annual single day peak lek counts conducted in the Bodie Hills breeding complex from 2001-2003, the most recent spring population estimate for the California segment of the combined Bodie-Mount Grant breeding population is between 560 and 830 sage-grouse.

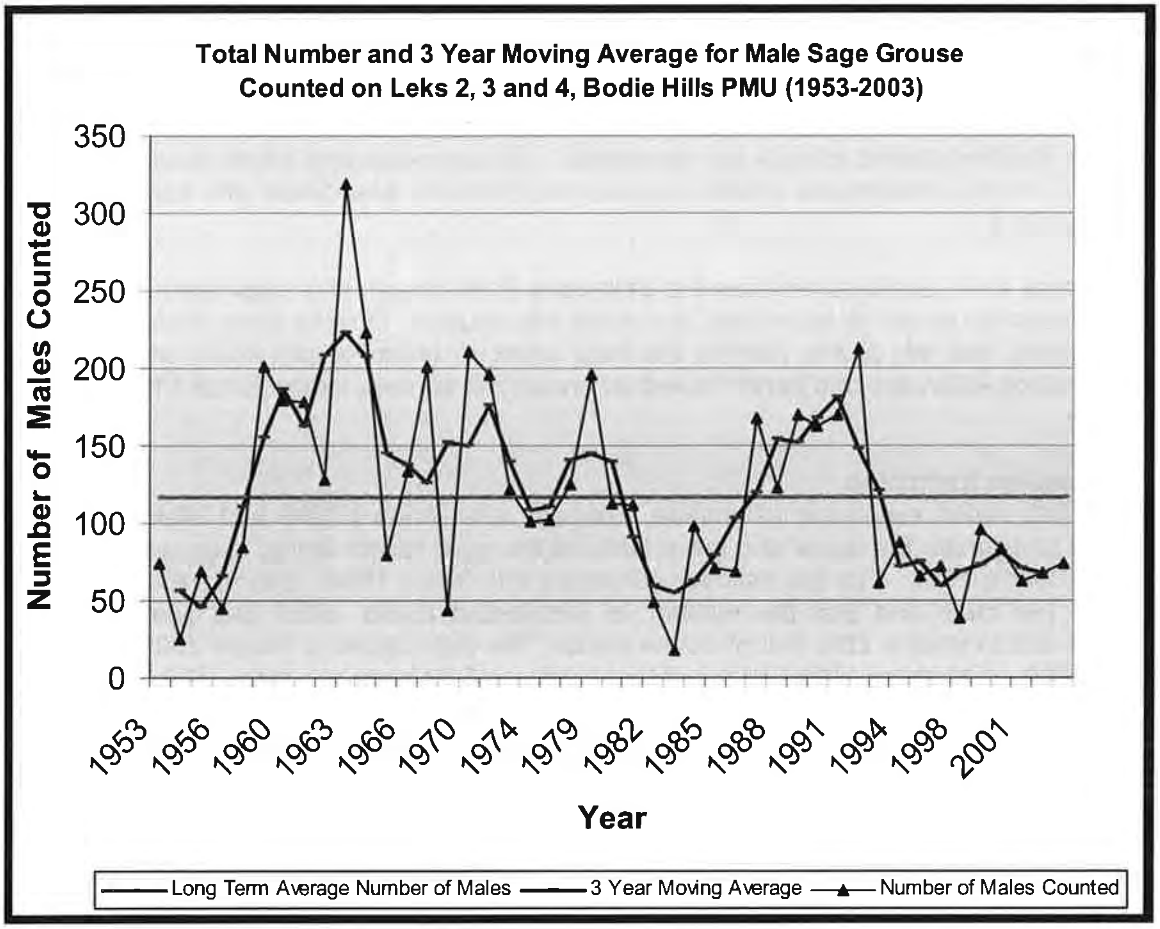
Sage-grouse hunting in the Bodie PMU is currently managed under a limited quota permit system. The current system was established in 1987, following a 4-year season closure, when CDFG established the North Mono and South Mono hunt areas. Annual permit quotas are determined separately for each hunt area based on the estimated fall population as derived from lek counts and estimated production. The need to develop breeding population estimates for each hunt area requires that lek surveys reflect the peak single day male count (Connelly et al. 2003). The peak single day count typically provides a more conservative population estimate than peak counts for each individual lek.

Population Trends

Long-term Trend (1953-2003). Three leks (2, 3 and 4) were used to assess the long-term breeding population trend in the Bodie PMU. These three leks were used for evaluating long-term trend because 1) they have been consistently counted by sage-grouse managers since 1953, and 2) they function as core leks that on average represent 73% of all males counted annually in the Bodie PMU. The highest total number of strutting males observed on leks 2, 3 and 4, including associated satellite leks, for years in which adequate data exist was 319 in 1963 (Figure 5.3.2-1). The lowest number of males counted on these three leks combined for those years in which adequate data exist was between 45 and 50 in 1956, 1969, 1982 and

1998. Since 1953, the average number of males, hereafter referred to as the long-term average, counted on leks 2, 3 and 4 was 117 (Figure 5-1).

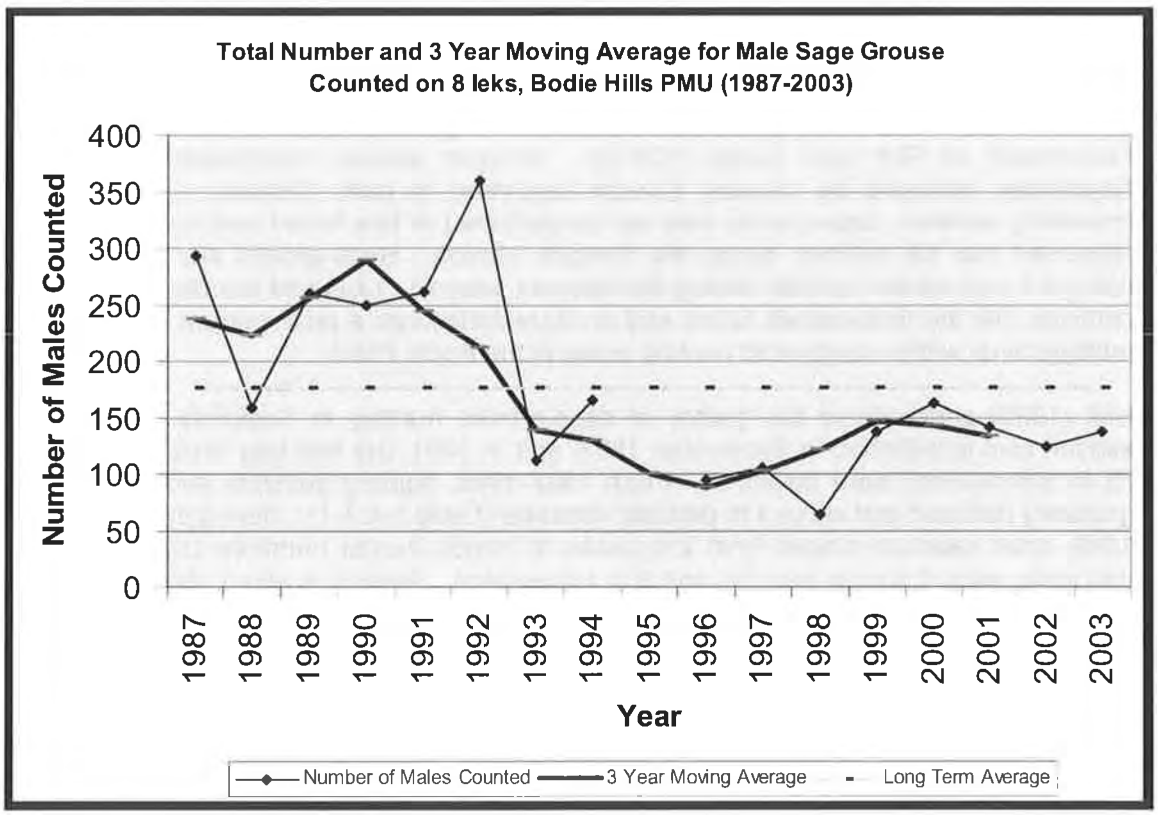
Figure 5-1. Total Number and 3-year Moving Average for Male Sage Grouse Counted on Leks 2,3, and 4 in the Bodie PMU (1953-2003).



The long-term trend in breeding population for the Bodie PMU from 1953 to the present was evaluated for leks 2, 3 and 4 using a three-year moving average, where each year is an average of that year and the year before and after. This trend is marked by several distinct changes in population. From 1959-1980, three-year moving averages for the number of males counted were near, or well above, the long-term average (Figure 5.3.2-1). This era was highlighted by the period from 1959-1965 when the breeding population was at its highest level, indicated by three-year moving averages that ranged from 124% to 191% of the long-term average. This trend was reversed from 1981-1986 when three-year moving averages ranged from 47% to 88% of the long-term average. From 1988-1992, the trend in breeding population increased, with three-year moving averages ranging from 126% to 155% of the long-term average. This upward trend was again reversed from 1993-2002, when three-year moving averages ranged from 50% to 69% of the long-term average. The trend has been relatively stable over the last three years (2000-2003) at between 58% and 63% of the long-term average (Figure 5.3.2-1).

Recent Trend (1987-2003). Because more leks have been consistently counted in recent years, the trend in peak male attendance from 1987-2003 was also evaluated for 8 core leks using three-year moving averages (Figure 5-2). These 8 core leks include leks 2, 3 and 4 which were used to assess the long-term trend, plus leks 5/6, 7/8, 9, 10 and 11/12. This analysis excludes the 1995 count because it was based on a one-time helicopter survey that yielded results not comparable to ground surveys. From 1987-2003, the highest total number of strutting males observed on all 8 leks combined, including associated satellite leks, was 360 in 1992 (Figure 5-2). The lowest number counted was 64 in 1998. The long-term average number of breeding males for the period was 178.

Figure 5-2 Total Number and 3-year Moving Average for Male Sage Grouse Counted Eight Leks in the Bodie PMU (1987-2003).



For these 8 core leks, the trend in breeding population for the period from 1987-2003 was marked by two distinct changes in population similar to that defined by leks 2, 3 and 4. From 1989-1992, the trend in strutting males remained high, ranging from 141% to 205% of the long-term average. This trend was reversed from 1993-2003 when the average number of males dropped to between 36% and 94% of the long-term average. Over the last three years (2000-2003), the average number of breeding males for these 8 leks has been relatively stable at between 70% and 93% of the long-term average (Figure 5-2).

5.4 Bodie PMU Risk Assessment and Conservation Actions

Existing and foreseeable risks evaluated for the Bodie PMU include licensed hunting, predation, fences, utility lines, permitted livestock grazing, feral horses, land use change and development, mineral exploration and extraction, recreation, fire, pinyon-juniper encroachment, water distribution, quality of sagebrush habitats and quality of meadows and riparian habitats. Risk assessments for each these risks are presented in the following format: 1) An overview of the nature of the risk that includes the risk type, the habitat component or season affected, and the habitat and population scale; 2) A brief discussion of the specific habitat and population risks; and 3) A synopsis of existing management efforts and future management options and priorities.

5.4.1 Licensed Hunting

Licensed hunting was evaluated as a population risk in the Bodie PMU. Licensed hunting is a seasonal risk, with specific season dates and bag limits established by the California Department of Fish and Game (CDFG). Shotgun season traditionally occurs in mid-September, followed by falconry season beginning in early October. Depending upon prevailing weather, sage-grouse may be concentrated in late brood and summer habitats or dispersed into fall habitats during the shotgun season. Sage-grouse are most likely to be using fall and winter habitats during the falconry season. Licensed hunting is anticipated to continue into the foreseeable future and is characterized as a past, current and future risk to multiple birds within designated hunting areas in the Bodie PMU.

Hall (1995) summarized the history of sage-grouse hunting in California. The first open season was established in September 1853, and in 1901, the first bag limits (25 per day and 25 in possession) were instituted. From 1907-1986, hunting seasons and bag limits were gradually reduced and subject to periodic closures (Table 5.4.1-1). During the period of 1910-1949, open seasons ranged from 2-6 weeks in length, hunter numbers were unlimited, and bag limits were 4 grouse per day and 8 in possession. Beginning about 1950, open seasons were reduced to 2-3 days in length. Hunter numbers were still unlimited, but bag limits were reduced to 1-2 birds per day and per season. From 1950-1972, season dates coincided with Labor Day weekend and a time when sage-grouse were heavily concentrated on water. By 1973, the season was changed to mid-September in an attempt to further reduce harvest by allowing time for birds to disperse into fall habitats. The era of unlimited sage-grouse hunting permits in California ended in 1983.

Sage-grouse hunting in the Bodie PMU is currently managed under a limited quota permit system. The CDFG instituted the current system in 1987, following a 4-year season closure, when they established the North Mono and South Mono hunt areas. Annual permit quotas are determined for each hunt area based on the estimated fall population as derived from lek counts and estimated production. CDFG issues these permits annually through a statewide drawing. Sage-grouse hunting in the PMU occurs primarily in the North Mono hunt area. A very small portion of the PMU, south of California State Route 167 and east of US Highway 395, is within the South Mono hunt area. Few, if any, South Mono hunt area permit holders hunt within the Bodie PMU.

Table 5-2. Closure Patterns of Sage-grouse Hunting Seasons in California, 1907-1986.

YEAR	PATTERN OF HUNTING SEASON CLOSURE
1907-1910	Closed
1911-1930	Open
1931-1949	Closed
1950-1952	Open
1953-1958	Closed
1959-1960	Open
1961-1962	Closed
1963-1965	Open
1966-1969	Closed
1970-1982	Open
1983-1986	Closed

The North Mono hunt zone encompasses the Bodie Hills and is described as "that portion of Mono county beginning at the intersection of Highway 182 and the California-Nevada state line; south and east along the California-Nevada state line to Highway 167; west along Highway 167 to Highway 395; north along Highway 395 to Highway 182 at Bridgeport; north along Highway 182 to the point of beginning" (CDFG 2003). A description of the South Mono hunt zone boundary is provided in the South Mono PMU section.

From 1987-1997, quota numbers for the North Mono hunt area ranged from 150 to 450 permits. Season openers were held as early as September 13 and as late as October 14 (Table 5.4.1-2). By 1998, concerns over a declining population trend in the Bodie Hills prompted the CDFG to significantly reduce the number of available permits. Since 1998, the North Mono hunt area quota has not exceeded 25 permits. Only 10 permits were issued in 2003. Season length is currently limited to 2 days with a bag limit of 1 sage-grouse per season. Annual permit quotas are combined for shotgun, archery and falconry.

Direct mortality of sage-grouse from hunting is a potentially significant population risk. In contrast to many upland game species, sage-grouse are relatively long-lived with low annual turnover (Zablan 1993, Connelly et al. 1994) and low reproductive capability (Gregg 1991, Connelly et al. 1993). Hunting may be additive to other causes of mortality (Johnson and Braun 1999, Connelly et al. 2000a) and season dates, bag limits and permit quotas must be set with caution to avoid potential over-harvest. Breeding population size, trend and geographic extent should also be considered when establishing hunting regulations (Connelly et al. 2000) to further improve harvest management. A limited permit quota system is clearly the best management option for addressing these concerns and maintaining desired harvest levels.

The termination of licensed hunting is also a potentially significant population risk. Connelly et al. (2000) recognize the importance of hunter provided wings for monitoring production and recruitment. When adequate sample sizes are available, wings provide the best measure of nest success and juvenile: adult ratios. Hunters are also recognized as valuable allies in the effort to conserve sage-grouse. Revenue derived from license fees, upland game bird stamps and federal excise taxes on the purchase of firearms and ammunition pay for the bulk of State sage-grouse population monitoring and management activities. In addition, sportsmen groups commonly provide the funding, labor and political support needed to implement conservation actions.

Table 5.3 Sage-grouse Permits for the North Mono Hunt Area, Mono County, California, 1987-2003.

YEAR	PERMITS	BAG LIMIT DAY/SEASON	SEASON DATES
1987	300	1/1	Oct 10-11
1988	300	1/1	Oct 8-9
1989	300	1/1	Oct 14-15
1990	300	1/1	Oct 13-14
1991	450	1/1	Oct 5-6
1992	450	1/1	Oct 3-4
1993	300	1/1	Oct 2-3 (falcon Oct 9-Dec 7)
1994	300	1/1	Oct 1-2 (falcon Oct 8-Dec 6)
1995	150	1/1	
1996	150	1/1	
1997		1/1	
1998	20	1/1	
1999	20	1/1	
2000	25	1/1	
2001	25	1/1	
2002	25	1/1	Sept 14-15 (falcon Oct 1-Dec 2)
2003	10	1/1	Sept 13-14 (falcon Nov 1-Dec 31)

Licensed hunting is characterized as a manageable risk, with current permit numbers very conservative and well below the maximum harvest rates ($\leq$10% of the estimated fall population) recommended in the guidelines (Connelly et al. 2000). Compared to other causes of direct mortality, current harvest rates are believed to be insignificant. The number of permits issued for 2003 equates to approximately 1.2% of the estimated spring population and 0.4% of the estimated fall population. CDFG's current limited-quota permit system is effective because it eliminates the potential for over harvest due to weather and other influences. Additionally, the current system employs a mail-in hunter reporting system that provides wing data necessary for evaluating harvest and production trends.

Licensed hunting is arguably the most closely regulated risk identified for the Bodie PMU; however, the Bodie PMU planning group still expressed a clear desire to improve upon existing management. Specific items identified for consideration include: 1) Identifying thresholds for season closures based on breeding population size; 2) Incorporating population trend into permit allocations; 3) Tailoring hunt area boundaries to the geographic extent of distinct breeding populations; and 4) Coordinating and standardizing harvest management strategies with the Nevada Department of Wildlife (NDOW).

Conservation Action: Licensed Hunting Management

Objectives: Ensure that licensed hunting does not adversely affect sage-grouse populations in the Bodie PMU. Maintain the current conservative approach to managing sage-grouse harvest levels in the Bodie PMU.

Actions:
1) Develop and implement a comprehensive harvest management strategy for licensed sage-grouse hunting in the Bodie PMU.
2) Maintain a conservative approach to managing harvest levels through the current limited-quota permit system.
3) Identify population thresholds for season closures.
4) Incorporate population trend data into permit allocation decisions.
5) Modify hunt area boundaries to more accurately reflect breeding populations or to protect small or at risk sub-populations.
6) Adjust season dates as necessary to moderate disproportional harvest of females and broods on water sources.
7) Improve hunter feedback requirements to facilitate data collection opportunities.
8) Coordinate and standardize harvest management strategies with the Nevada Department of Wildlife (NDOW) to ensure that similar limited-quota harvest methods are adopted and employed for any licensed hunting within the Bi-State Planning Area.
9) Re-evaluate this comprehensive harvest management strategy annually and update as needed using an adaptive management approach.

Rationale: CDFG currently lacks a comprehensive harvest management strategy for sage-grouse in the Bodie PMU, coordinated with NDOW. A comprehensive strategy should include criteria for making harvest management decisions based on breeding population extent, population trend, annual hunter success and weather influences; and should specify hunter reporting requirements and how this data will be used to evaluate harvest and production trends.

Legal Authority: All actions addressing this risk are under the management authority of the California Department of Fish and Game (CDFG).

Procedural Requirements: The California Department of Fish and Game (CDFD) will develop a formal harvest management plan for sage-grouse in the Bodie PMU.

Level of Partnership Commitment: The California Department of Fish and Game (CDFG) is committed to improving all aspects of harvest management within the Bodie PMU. The Bodie PMU planning group expressed a clear desire to improve upon existing hunting management where possible.

Funding Sources: The California Department of Fish and Game (CDFG) will fund and develop a Sage-grouse Harvest Management Plan for the Bodie PMU.

Implementation Process:
1. Review existing harvest management actions, population trend data and other information relevant to sage-grouse harvest management in the Bodie PMU.
2. Develop a Sage-grouse Harvest Management Plan for the Bodie PMU.
3. Implement the harvest management plan.
4. Annually review and, if necessary, update the harvest management plan based on the most current population trend, hunter harvest data and other information relevant to sage-grouse harvest management in the Bodie PMU.

5.4.2 Predation

Predation was evaluated as a population risk in the Bodie PMU. A host of avian and terrestrial predators capable of killing adult and juvenile sage-grouse occurs in the PMU. Potential nest predators are also common. Predation is considered a yearlong risk throughout the PMU, with the risk greatest in seasonal concentration areas. Predation is characterized as a past, current and future risk to multiple birds throughout the Bodie PMU.

Potential predators of adult and juvenile sage-grouse include coyotes, mountain lions, bobcats, golden eagles and other raptors. Potential nest predators include California gulls, ravens, snakes, coyotes, badgers, bears and small mammals. Predator population levels in the Bodie PMU are not well documented, but populations have likely rebounded from extensive predator control efforts of the late 1800s and early to mid-1900s. However, there are no clear indicators of artificially high predator numbers in the PMU. Trash dumps have the potential to artificially increase raven, gull, coyote and bear populations, but at this time community trash is collected and stored at covered transfer stations. Trash containers at Bodie State Historic Park are kept covered as well. With the possible exceptions of bears in the Bodie Hills, and ravens in Bridgeport Valley, no predator species currently appear to be increasing. Because residential development and recreational use are light in much of the PMU, predation and disturbance by free roaming and feral pets are not considered problems at this time.

Adult and juvenile sage-grouse in the Bodie PMU may be most vulnerable to predators when concentrated in seasonal use areas of limited extent; for example, leks during the spring, water sources during dry summers, or snow free sagebrush habitats (currently unknown) during winters of heavy snowfall. Mortalities among 41 telemetered sage-grouse within the PMU have in 4 instances revealed clear evidence of predation. Two were adult males killed at one lek site during the strutting season, within a few days of each other, evidently by a golden eagle. The other 2 were females during the nesting season; one had been incubating but was killed by an unknown predator while off her nest, the other was not nesting and was killed by an avian predator. Additional instances of predation probably went undetected due to lack of forensic evidence. Further information is needed to adequately assess the level of predation on sage-grouse in the Bodie PMU.

Vulnerability to nest predators begins at egg laying and continues through hatching. Nesting in the Bodie PMU generally occurs from late April through mid to late June (BLM 2003, USGS in press). Telemetry study through 4 breeding seasons has monitored 10 nesting hens with only 1 instance of nest predation. Groups of foraging California gulls from Mono Lake have been observed flying low over Bridgeport Canyon during the nesting season and one predated nest has been noticed there. Though the sample size is extremely small (n=10), nest predation does not appear to be an issue in the Bodie PMU at this time.

Predation is not known to be a significant limiting factor in the Bodie PMU and few studies have identified predation as a primary factor limiting sage-grouse populations elsewhere (Connelly et al. 2000). Currently available data for the PMU suggests high nest success and annual adult hen survival. Steep declines in the sage-grouse population for any reason, such as disease, large-scale habitat loss or severe weather could render the population critically vulnerable to predation impacts. Under such a scenario, predator control could become a viable management tool. Connelly et al. (2000) recommend that predator control be implemented only in cases where nest success of < 25%, or annual survival of adult hens of < 45% can be documented. Studies specifically addressing predator interactions are not a high priority, but may be appropriate if the population undergoes a steep decline. Telemetry study and predator observations gathered during the course of other work in the PMU will continue to add to our knowledge.

Predation is to some extent manageable in the Bodie PMU by means of managing other factors that affect sage-grouse vulnerability to predators. Manageable human-induced factors include: 1) Free roaming or feral pets or other non-native predators; 2) Illegal dumping, which is minimal at present but has the potential to increase as transfer station fees are raised; 3) Hunting, if at levels that are clearly additive to other causes of direct mortality; 4) Fences and utility lines that create artificial predator perches or result in additive sources of direct mortality; and 5) Grazing, especially if nest success is compromised by inadequate herbaceous understory cover.

Conservation Action: Predator/Predation Monitoring And Management

Risk: Potential for predation by wild predators and/or free-roaming or feral pets to be a population-limiting factor in the Bodie PMU. (Utility poles as avian predator perches are addressed separately).

Objectives: Gather data on predators and predation in the Bodie PMU. Initiate predator control as a management tool only if deemed necessary, feasible, and likely to be effective in stabilizing or increasing sage-grouse numbers (i.e., a predator management strategy that effectively increases nest success, juvenile survival or adult survival).

Actions: Standardize and coordinate compilation of predator observations and sage-grouse predation. If predation is implicated as a population-limiting factor, initiate formal studies to assess the need for, feasibility of, and projected effectiveness of predator control measures. Initiate predator control measures as per the outcome of formal studies.

Rationale: The Bodie PMU planning group could not identify predation as a population-limiting factor based on currently available data. Observations on predator abundance and sage-grouse predation should continue to be gathered, with formal studies and predator control measures implemented if other factors reduce the population to a level at which it is not resilient to predation.

Legal Authority: Any predator control response would be legally conducted according to Federal, State and local laws by the U.S. Department of Agriculture (USDA), Animal Plant and Health Inspection Service (APHIS), Wildlife Services (WS) program. "WS is a cooperatively funded, service oriented program that provides technical assistance to requesting public and private entities" (USDA 2002). WS activities would be conducted under the direction of the California Department of Fish and Game (CDFG) and in coordination with Mono County, the Bureau of Land Management (BLM), the U.S. Fish and Wildlife Service (FWS), the U.S. Forest Service (USFS), and any affected private parties in accordance with the appropriate Cooperative Agreement or Memorandum of Understanding (MOU). Work could be conducted on both private and public lands in cooperation with Federal, State and local agencies, and private organizations and individuals. Control of free-roaming pets by enforcing existing leash laws is within the authority of Mono County.

Procedural Requirements: Formal studies would be observational only and would require no more than a Memorandum of Understanding (MOU) or Cooperative Agreement among involved parties and a Categorical Exclusion (CE) on public lands. Predator control would require a Cooperative Agreement or MOU with Wildlife Services (WS) in order to verify the need for the requested work, and to identify the roles of WS and its cooperators (USDA 2002). Typically, according to Animal Plant and Health Inspection Service (APHIS) procedures as they relate to the National Environmental Policy Act (NEPA), individual wildlife damage management actions and any related technical assistance and monitoring efforts can be afforded a CE (USDA 2002).

Level of Partnership Commitment: All participants in the Bodie PMU planning group endorse this stepped course of action.

Funding Sources: In the event that formal studies are needed, the California Department of Fish and Game (CDFG), Bureau of Land Management (BLM) and U.S. Forest Service (USFS) would seek internal funding and pursue partnerships for matching funds in the event that Wildlife Services (WS) is needed to implement a predator control.

Implementation Process:

1. Continue current predator observations:
    a. Continue telemetry study, maximizing frequency of observations to improve the chances of locating fresh kills, identifying predators, and distinguishing predation from scavenging.
    b. Continue to gather casual predator observations from other personnel in the field including researchers, agency personnel, and livestock operators.
    c. Provide a standardized format for recording predator observations and designate a person to collect, keep, and summarize the data.
    d. Designate an interdisciplinary group such as the Bi-State Technical Advisory Committee (TAC) to review and summarize the data annually.

2. If data indicate that predation may be a limiting factor, consider initiating formal predator studies, especially if the population is rendered vulnerable by sharp declines due to other causes.
    a. TAC or similar group must concur that study is warranted.
    b. Seek funding and complete any procedural requirements.
    c. Contract study. Study plan should include observation of predator numbers and predator-prey interactions at all life stages from egg to adult, assessment of habitat features that influence vulnerability to predators, and estimation of predator impacts on the sage-grouse population. The study should also address the cost, feasibility, likely effectiveness, and possible negative impacts of various predator control measures and of habitat measures to decrease prey vulnerability.

3. Initiate a pilot predator control project only if studies indicate it is necessary for protection of the sage-grouse population in Bodie PMU. The pilot project should be designed to assess the benefits and overall effectiveness of predator control, as well as economically viability and feasibility. Monitor subsequent predator and sage-grouse populations. Discontinue predator control if it is ineffective or results in negative impacts to sage-grouse or other species of concern (including predator populations if they approach unviable numbers).

4. Seek enforcement of existing Mono County regulations to control free-roaming pets in areas of concern if problems with predation or undue disturbance become apparent.

5. Educate authorities responsible for trash management regarding the importance of continuing to keep all trash contained and keeping dump fees reasonable to deter illegal dumping, in order to minimize proliferation of ravens, gulls, bears, coyotes, and other predators.

5.4.3 Fences

Fences were evaluated as a habitat and a population risk in the Bodie PMU. Fences are common in, and adjacent to, a variety of sage-grouse habitats on both public and private lands within the PMU. In addition, the construction of new fences in the PMU is likely in the foreseeable future. Principal habitats of concern include lek, night roost, nesting, early brood, late brood and summer habitats. Fences are a yearlong risk, with seasonal peaks occurring in the spring and summer, as birds concentrate near strutting grounds and late brood habitats. Fences are characterized as a past, current and future risk that affects multiple sites and multiple birds in the Bodie PMU.

Habitat risks include changes in habitat quality and habitat fragmentation. In the Bodie PMU, fences are commonly used to manage livestock or delineate property boundaries. When poorly designed and sited, such fences can be detrimental to sage-grouse habitat quality. Though fence construction may not result in direct habitat loss, fences can cause sage-grouse to avoid traditional use areas. Such habitat avoidance was observed following construction of the Bodie State Historic Park fence through the Racetrack lek and the private property boundary fence built adjacent to the Lower Summers Meadow lek. However, properly designed and sited fences are recognized as an important management tool that may be used to improve sage-grouse habitat quality.

Direct mortality of sage-grouse due to fence strikes is a potentially significant population risk. This risk is most often associated with the low-level flight of birds into leks under poor light conditions. Similar impacts are expected as sage-grouse access other small habitats of concentrated use, for example night roosts, springs and meadows. A single mortality was documented in the fence adjacent to Lower Summers Meadow during the summer of 2003. The exact date of the mortality could not be determined, but is estimated to have occurred in the late spring or summer, as the bird was leaving the meadow for nearby sagebrush-bitterbrush habitat (Nelson, BLM Bishop FO files). Similar strikes are documented in the South Mono PMU (Russi, BLM Bishop FO files), as well as other areas within sage-grouse range (Connelly et al. 2000). Fences may also provide perches for avian predators and contribute to increased predation rates. Increased predation rates are also expected to be the greatest in seasons and habitats of concentrated use.

Fencing is clearly a manageable risk; however, present management is inadequate to address sage-grouse needs. Currently, all fence construction is done at the discretion of the individual landowner or agency constructing the fence. Design and placement options capable of reducing impacts to sage-grouse are seldom incorporated into fence construction projects in the Bodie PMU. The Bishop Resource Management Plan (BLM 1993) prohibits the construction of fences on strutting grounds and requires the use of let down fences in areas where sage-grouse are susceptible to wire strikes as they enter or leave a lek. No other guidance for fence construction in or adjacent to sage-grouse habitats in the PMU exists. In addition, many existing fences within the PMU may not be adequately designed or sited to meet sage-grouse needs. The Bodie PMU planning group expressed concern about existing fences in the following areas: Bodie State Park, 7-Troughs, Lower Summers Meadow, and small exclosure sites like 4-way Meadow and Murphy Meadow. Concern was also expressed about existing land use designations and management policies (for example, Interim Management Policy for Wilderness Study Areas) that limit fence design and placement options and often take precedence over sage-grouse habitat needs.

Conservation Action: PMU Group Review Pending

5.4.4 Utility Lines

Utility lines were evaluated as a habitat and a population risk in the Bodie PMU. Utility lines are present in several known sage-grouse use areas and several key habitat types within the PMU. The construction of new utility lines is probable in the foreseeable future, most likely to provide service to private property developments. Utility lines are a yearlong risk, with sage-grouse most vulnerable during the breeding season. Potential impacts to leks, nesting areas and early brood habitats are of particular concern. Utility lines are characterized as a past, current and future risk that affects multiple sites and multiple birds in the Bodie PMU.

Habitat risks are similar to those described for fences (see Section 5.4.3 Fences) and include reduced habitat quality and habitat fragmentation. Poles for above ground utility lines provide perches for avian predators (Ellis 1984, Ellis et al. 1989) and may cause sage-grouse to avoid the immediate area where they are placed. Roads developed for the installation and maintenance of utility lines often result in the long-term direct loss of extended linear segments of habitat. The extent to which predators use utility poles as perches within the Bodie PMU is unknown, but sage-grouse may instinctively avoid such tall objects regardless of raptor activity. Overhead utility lines have had a clear negative influence on lek attendance in northern California and strutting activity has ceased on all leks within 1 mile (1.7 km) of overhead utility lines in that region (F. Hall, CDFG, personal communication). In the 1980s, a utility line was constructed near lek 9 alongside US Highway 395, despite recommendations that the lek area be avoided. Construction of this utility line may have been a factor in the subsequent reduction in the number of strutting males observed on this lek.

Utility lines may also cause direct mortality if flying sage-grouse strike the wires (Call and Maser 1985). To date, no utility wire strikes have been documented in the Bodie PMU. As stated above, utility poles may also provide perches for avian predators and contribute to increased predation rates. In northern California, the percentage of radioed grouse lost to avian predation increased as distance between lek of capture and overhead utility lines decreased. Post capture life spans also decreased as distance between lek of capture and distance to overhead utility lines decreased (F. Hall, CDFG, personal communication). Utility pole height, location and design likely influence the extent to which utility poles contribute to sage-grouse predation. Increased predation rates are expected to be the greatest in breeding habitats. Potential impacts to strutting, nesting and brooding sage-grouse are of particular concern.

Parts of the Bodie PMU identified as having utility lines that may be negatively affecting sage-grouse include the Bridgeport Valley; the Mono Basin, including Mill Creek, Conway Ranch and the utility line adjacent to "Pole Line Road" (California State Route 167); the US Highway 395 corridor from the Mono Inn north to the Bodie Road (California State Route 270); the east slope of the Sierra Nevada from Lundy Powerhouse north to Bridgeport Valley; and the Bodie Hills from the Bodie Substation east through 7-Troughs and along Bodie Creek to the Nevada border. There are also traces of an historic line that once provided electricity to the town of Bodie. There are no major, multi-line, high voltage utility corridors in the PMU, nor any designated corridors to accommodate such use identified in current land use plans.

Utility lines are considered a somewhat manageable risk; however, past management has been inadequate to address sage-grouse needs. Future management should focus on quantifying and reducing any negative effects of existing utility lines, as well as eliminating or substantially reducing the negative affects of new utility lines. In key habitat areas, land managers should explore opportunities to have anti-perch devices installed on existing utility poles during normal maintenance activities. Land managers should also investigate possibilities for removing old, inactive utility lines. Where feasible, new utility lines should be placed underground, located to avoid key habitats or designed to significantly reduce negative effects on sage-grouse.

Conservation Action: PMU Group Review Pending

5.4.5 Permitted Livestock Grazing

Permitted livestock grazing was evaluated as both a habitat and a population risk in the Bodie PMU. Most of the land, both public and private, in the PMU is rangeland that is grazed during some part of the year. In general, domestic livestock and sage-grouse use the same vegetation communities and the majority of suitable range in the PMU is sage-grouse habitat. Habitats of concern include lek, night roost, nesting, early brood, late brood, summer and fall habitats. However, breeding and summer habitats are most likely to be affected by domestic livestock grazing. Grazing by domestic livestock has occurred in the Bodie PMU since the late 1800s and is expected to continue into the foreseeable future. Permitted livestock grazing is characterized as a past, current and future risk to multiple sites and multiple birds in the Bodie PMU.

Approximately 75% of the Bodie PMU is within the boundaries of federal grazing allotments administered by the Bureau of Land Management (BLM), Bishop Field Office, the Humboldt-Toiyabe National Forest (HTNF), Bridgeport Ranger District, or the Inyo National Forest (INF), Mono Ranger District (Table 5-3). Though comprised of mostly public lands, these allotments also include significant private in-holdings. These private in-holdings, or base property, are frequently associated with perennial water and provide important sage-grouse habitat. Private lands are generally managed under the same grazing regime as public lands within the allotments. In the Bodie Hills portion of the PMU, several key private landowners are active participants and cooperators in the development and implementation of Coordinated Resource Management Plans (CRMPs) that address grazing management issues. Domestic livestock also graze most private land outside of federal grazing allotments in the PMU. A significant block of private rangeland and irrigated pasture occurs in Bridgeport Valley. Permitted livestock grazing is limited on State and City of Los Angeles, Department of Water and Power (DWP) lands in the Bodie PMU.

Table 5-3 Federal Livestock Grazing Allotments in the Bodie PMU.

ALLOTMENT NAME	SAGE-GROUSE SEASONAL USE	ACRES IN PMU	LAND MANAGER	CLASS OF LIVESTOCK	LIVESTOCK SEASON OF USE
Aurora Canyon		20,088	BLM	Cattle	6/15-9/30
Bodie Mountain		56,263	BLM	Cattle	6/1-10/15
Dog Creek		7,675	BLM	Sheep	6/1-10/31
Green Creek		4,384	BLM	Sheep	6/1-10/31
Little Mormon		9,974	BLM	Sheep	6/1-10/31
Mono Sand Flat*		51,085	BLM	Cattle	12/1-5/21
Mono Settlement		572	BLM	Sheep	6/1-10/31
Mormon Ranch		3,322	BLM	Sheep	7/22-10/15
Mount Biedeman		4,953	BLM	Sheep	6/1-10/31
Potato Peak		14,670	BLM	Cattle	6/1-10/31
Rancheria Gulch		26,238	BLM	Sheep	6/1-10/31
Travertine Hills		10,595	BLM	Sheep	5/17-10/31
Mono Sand Flat*		9,083	INF	Cattle	
Buckeye*		62	HTNF	Cattle	6/28-9/30
Cameron Canyon		4,245	HTNF	Sheep	6/28-9/30 (10/1-10/15)~
Dunderberg		7,001	HTNF	Sheep	6/28-9/30 (10/1-10/15)~
Eagle Creek*		91	HTNF	Cattle	7/16-9/15
Green Creek		1,308	HTNF	Sheep	Inactive
Hunewill Hills		1,186	HTNF	Cattle	5/25-6/23
Larkin Lake*		43	HTNF	Cattle	11/1-11/30
Masonic*		18,661	HTNF	Cattle	7/1-10/15
Rickey Peak*		553	HTNF	Sheep	6/28-9/30 (10/1-10/15)~
Robinson Creek*		758	HTNF	Cattle	6/1-10/15
Rough Creek*		1,741	HTNF	Cattle	6/1-10/15
Summers Meadows		2,467	HTNF	Sheep	6/16-10/31
Tamarack*		2,340	HTNF	Sheep	6/28-9/30 (10/1-10/15)~
Virginia Creek*		922	HTNF	Cattle	Inactive
Wild Horse*		642	HTNF	Cattle	12/1-5/31

*Only portions of these allotments are within the Bodie PMU.

~These allotments are managed under a four-year deferred rotation schedule. O

Cattle are the dominant class of domestic livestock in the Bodie PMU. Cattle graze approximately 67% of the acreage within federal grazing allotments in the PMU. Cattle also graze the majority of private rangelands outside of federal grazing allotments. Sheep graze the remaining 33% of the acreage within federal grazing allotments in the PMU. Sheep grazing is limited on private rangelands outside of federal grazing allotments. Less than 1% of the acreage within federal grazing allotments in the PMU is inactive. Cattle allotments dominate the northern and eastern portions of the PMU. Sheep allotments are concentrated in the southwestern portion of the PMU (Figure 5-5).

Permitted livestock grazing is primarily a habitat quality risk in the Bodie PMU. While there is little direct scientific evidence that links livestock grazing to sage-grouse population levels, indirect evidence suggests that grazing practices that significantly reduce the height and cover of the herbaceous understory in breeding habitat may negatively affect sage-grouse populations (Connelly et al. 2000). Though the sample size is extremely small (n=10), currently available data suggests that nest success is not an issue in the Bodie PMU at this time. Grazing may also reduce herbaceous understory vigor and contribute to accelerated shrub community succession (Miller and Eddleman 2001, Wambolt et al. 2002). This may be particularly important in mountain big sagebrush communities that are prone to high (>40%) shrub canopy cover. Abundant forbs are an important source of nutrition for pre-laying hens and hens with broods (Connelly et al. 2000) and some argue that excessive shrub canopy can limit forb production (Wambolt et al. 2002). Additional habitat assessments are needed to determine the extent to which permitted livestock grazing is influencing the quality of breeding habitats in the Bodie PMU.

Meadows, riparian stringers and irrigated pastures are key components of sage-grouse late brood and summer habitats (Connelly et al. 2000, Wambolt et al. 2002) that can be degraded by incompatible domestic livestock grazing practices. These habitats tend to be limited in both extent and distribution in the Bodie PMU, particularly east of US Highway 395. In addition, both livestock and sage-grouse use tends to be concentrated around these habitats during the summer. Due to their limited extent and susceptibility to livestock grazing induced ecological changes, the availability of quality meadow and riparian habitats may be a significant limiting factor for sage-grouse in the PMU. Several studies have reported that properly managed and timed grazing can improve sage-grouse habitat quality by increasing forb availability during the spring, late brood and summer period (Neel 1980, Klebenow 1985, Miller and Eddleman 2001, Wambolt et al. 2002). Numerous opportunities to improve the quality of meadow, riparian and irrigated pasture management are available in the Bodie PMU; however, many of these sites are privately owned and continued cooperation of private landowners will be required to make appropriate changes.

Livestock management facilities such as spring developments, fences, holding pens and salting and supplemental feeding locations can also negatively affect sage-grouse habitat quality. Habitat impacts associated with permitted livestock grazing may be exacerbated by conditions that influence vegetation conditions such as fire and drought.

The elimination of grazing is also a potentially significant habitat risk. As noted above, properly managed grazing of meadows is documented as having a positive influence on sage-grouse habitat. In addition, range managers are recognized as valuable allies in the effort to conserve sage-grouse and the importance of private rangelands to sage-grouse in the Bodie PMU cannot be overstated and should not be overlooked. Land managers should strive to develop flexible grazing management strategies that address sage-grouse habitat needs as well as the economic viability of livestock operators. Management strategies that contribute to poor private land management or the eventual subdivision and development of private rangelands could have significant long-term negative impacts on overall sage-grouse habitat quality and quantity in the Bodie PMU.

Lek disturbance and nest trampling by domestic livestock during the breeding season are potential population risks. Authorized seasons of use on most federal grazing allotments within the Bodie PMU due not begin until after June 1 (Table 5.4.5-1). This eliminates the potential for lek disturbance in the majority of the PMU. Some potential for lek disturbance exists from early season grazing in or adjacent to Bridgeport Valley; however, with the exception of lek 10 at Lower Summers Meadow, no leks are currently documented for this portion of the PMU. Most authorized seasons of use also occur after the peak of the nesting season and this significantly reduces the potential for nest disturbance or trampling. However, June hatching dates have been documented in the Bodie PMU and some potential for nest disturbance and trampling does exist for late season nesters. Sage-grouse are indeterminate nesters known to abandon nests when disturbed (Cite); but the potential for nest disturbance or trampling is also limited by permitted seasons of use, as well as livestock behavior. Except when trailing, cattle do not travel in large groups or walk directly through sagebrush habitats in a manner that would likely crush or disturb a nest site. In contrast, sheep may be more likely to disturb or trample nests due to behavior and movement patterns associated with herding. In either case, trailing is considered to have the greatest potential for direct physical impact to nesting sage-grouse. Trailing was identified as an issue in the western portion of the PMU in the vicinities of Lower Summers Meadow, Green Creek and Clearwater Creek.

Permitted grazing is considered a manageable risk with current management representing a significant improvement over historic use. Currently, all federal grazing allotments in the Bodie PMU are managed under Allotment Plans (AMPs) or Coordinated Resource Management Plans (CRMPs) developed to meet multiple resource objectives. Several key private landowners are active participants and cooperators in the development and implementation of CRMPs in the Bodie Hills portion of the PMU. Sage-grouse were frequently identified as a wildlife species of concern during the development of these plans. Still, many opportunities exist to tailor livestock management practices to better address sage-grouse needs. AMPs and CRMPs provide the mechanism for adjusting livestock management practices to take advantage of these opportunities.

The best available data specific to sage-grouse habitat requirements and rangeland management practices must be considered during the future development or revision of grazing management plans in the Bodie PMU. Special emphasis should be given to: 1) Maintenance or improvement of sagebrush communities in known breeding areas; 2) Improvement of meadow, riparian and irrigated meadow habitats; 3) Eliminating or substantially reducing trailing disturbance in breeding habitats in the western portion of the PMU; 4) Proper design, location and development of livestock management facilities; 5) Reducing impacts associated with drought conditions; and 6) Developing management strategies and incentives that encourage the long-term maintenance and improvement of private rangelands in the PMU.

<u>Conservation Action: PMU Group Review Pending</u>

5.4.6 Feral Horses

Feral horses were evaluated as a habitat and a population risk in the Bodie PMU. Horses occur in the southeastern portion of the PMU where they occupy known key sage-grouse use areas and key habitat types. Current use is concentrated near the 7-Troughs lek and potential winter and connectivity habitat in the northeastern Mono Basin. Impacts to lek, night roost, nesting, early brood, summer and winter habitats are of most concern. Horses are a yearlong risk, with the present risk greatest during the spring. Feral horses are characterized as a past, current and future risk to multiple sites and multiple birds in the Bodie PMU.

Feral horses have been present in the Bodie PMU for many years. Until recently, known horse use in the PMU was limited to the northeastern Mono Basin in the vicinities of Larkin Lake, Cedar Hill and Mono Sand Flat. Large groups of horses (>30) could be observed in these low elevation areas of the PMU during the winter. Horses were first observed in the mid-elevations of the PMU about 4 years ago, during spring sage-grouse strutting ground surveys. Since that time, up to 6 horses have been consistently observed near the 7-Troughs lek during the spring and summer. Other recent observations and sign of horse use in the PMU have occurred in the vicinities of Mexican Springs, Brawley Peaks, Milk Ranch Canyon and Geiger Grade near Truck Tank. A total of 18 horses were counted in the Bodie Hills portion of the PMU during a July 2003 capture effort. The best available information suggests that feral horse numbers and range are increasing in the Bodie PMU.

Habitat risks for feral horses in the Bodie PMU are similar to those described for permitted livestock grazing (see Section 5.4.5 Permitted Livestock Grazing) with potential impacts to breeding, summer and winter habitats of most concern. The principal difference is that stocking rates, seasons of use and forage utilization levels are not actively managed. Therefore, any significant increase in horse numbers or range within the PMU is anticipated to have commensurate effects on sage-grouse habitat quality. The current extent of breeding and summer habitat degradation attributable to horses in the PMU is unknown, but believed to be insignificant due to low horse numbers. The extent of winter habitat degradation is even less understood, but also believed to be insignificant because winter habitat quality is mainly dependent upon sagebrush cover, which is minimally affected by horse use. Habitat impacts associated with feral horses are exacerbated by conditions that influence vegetation conditions such as fire and drought.

Lek and night roost disturbance is a potentially significant population risk near the 7-Troughs lek. The current trend of extremely low male sage-grouse lek attendance coincident with spring feral horse use in the 7-Troughs area is cause for concern; however, horses are not assumed to be the sole contributing factor. Other risks are also likely influencing sage-grouse habitats and populations in the 7-Troughs area including fences, utility lines, permitted livestock grazing, recreation and the quality of meadow and riparian habitat.

Feral horses are a manageable risk, although the process of capture and adoption is difficult and expensive. There is no designated Herd Management Area (HMA) within the Bodie PMU and horses in the PMU are drift from the adjacent Powell Mountain Wild Horse Territory (WHT). The Humboldt-Toiyabe National Forest (HTNF), Bridgeport Ranger District, manages the Powell Mountain WHT with the Appropriate Management Level (AML) goal of 26 horses. The Bureau of Land Management (BLM) and National Forest management goal is zero horses outside of the established territory boundaries. Federal horse removal programs are active in attempts to meet these goals. In July 2003, BLM Wild Horse and Burro specialists from Ridgecrest captured and removed 26 horses from the Powell Mountain WHT. An additional 7 horses were captured and removed from the Bodie Hills outside of the designated territory. An estimated 30 horses remain in the Powell Mountain WHT and an estimated 11 horses remain in the Bodie Hills outside of the territory. During the course of the capture, 10 of the remaining Bodie Hills horses were at least temporarily driven into the Powell Mountain WHT. Future management should focus on removing all feral horses outside of established territory boundaries and maintaining AML goals within the Powel Mountain WHT.

Conservation Action: Feral Horse Removal

Objectives: No feral horses in the Bodie PMU. Maintain horses at the Appropriate Management Level (AML) in the adjacent Powell Mountain Wild Horse Territory (WHT) in the Mount Grant PMU.

Actions: Remove all feral horses from the Bodie PMU and control horse numbers in the adjacent Powell Mountain Wild Horse Territory (WHT).

Rationale: Feral horses have been increasing in the PMU and expanding their range in key sage-grouse habitats, and all are drift from the Powell Mountain WHT. Horse numbers have been above the established Appropriate Management Level (AML) in the Powell Mountain WHT for many years. The Bureau of Land Management (BLM) has a legal obligation to remove horses outside of established HMAs. The U.S. Forest Service (USFS) has a legal obligation to manage horse numbers within the Powell Mountain WHT at AML.

Legal Authority: Horse removal is under the management authority of the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM).

Procedural Requirements: The U.S. Forest Service (USFS) and the Bureau of Land Management (BLM) must complete a capture plan and supporting environmental documentation prior to any capture and removal effort.

Level of Partnership Commitment: No objection to horse removal has been raised during the Bodie PMU planning process. BLM is committed to its policy calling for no horses on public lands outside of established HMAs and the U.S. Forest Service (USFS) is committed to maintaining horses in the Powell Mountain Wild Horse Territory (WHT) at Appropriate Management Level (AML). Private landowners in the Bodie PMU concur that horse removal is beneficial.

Funding Sources: Horse removal is cooperatively funded by the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM). Additional out-year funding will be required to implement future captures.

Implementation Process:

1. Develop capture plans and supporting environmental documents to capture and remove horses from the Powell Mountain Wild Horse Territory (WHT).
2. Gather all feral horses in the Bodie PMU.
3. Remove horses from the Powell Mountain WHT as needed to maintain the herd at the established Appropriate Management Level (AML).
4. Continue to monitor the horse population and remain watchful for any further encroachment into the Bodie PMU.

5.4.7 Land Use Change and Development

Land use change and development was evaluated as a habitat risk in the Bodie PMU. Private lands are scattered throughput the PMU and include all sage-grouse habitat types. Several key sage-grouse use areas and important habitat types are known to occur on private lands in the PMU. Residential, commercial and recreational development of private lands in the PMU is increasing, and additional development is likely in the foreseeable future. Development of some public lands in the PMU is also likely. Land use change and development is a yearlong risk, with potential impacts to breeding, summer, winter and connectivity habitats of most concern. Land use change and development is characterized as a past, current and future risk to multiple sites and multiple birds in the Bodie PMU.

Private lands comprise about 17% of the Bodie PMU. The existing land ownership pattern developed largely to support ranching and mining, with numerous, often small and isolated, private parcels distributed throughout the PMU. The largest block of private land occurs in Bridgeport Valley. Many of the private parcels in the PMU are associated with perennial water and provide important sage-grouse habitat. Contemporary residential and commercial development is predominately clustered along the corridors of US Highway 395, California State Route 167, and California State Route 182. Bridgeport and Mono City are the primary population centers. Residential and recreational development is also common in the Virginia Lakes and Twin Lakes basins. Development of the numerous private parcels traditionally associated with ranching and mining is increasing, particularly along California State Route 167 in the northern Mono Basin. The current land ownership pattern is likely to contribute to 'leap frog' development that may have significant negative impacts on sage-grouse in the Bodie PMU.

Habitat loss and fragmentation due to land use change and development is a significant risk in the Bodie PMU. The majority of private lands in the PMU are still characterized as rangeland and the commercial, residential or recreational development of these private rangelands is of particular concern. Such land use change and development will result in the direct loss and fragmentation of sage-grouse habitat. In addition, the construction of roads, fences, utility lines and other infrastructure required to support such development will magnify the extent of habitat loss and fragmentation. Additional indirect impacts resulting from increased human presence and disturbance associated with development will further degrade sage-grouse habitat quality. Potential development in, and adjacent to, strutting, nesting, brooding, summer, winter and connectivity habitats may be especially damaging. Significant impacts to sage-grouse will likely result from the development of meadows and currently intact sagebrush habitats in the PMU. The existing land ownership pattern increases the potential for land use change and development induced habitat loss and fragmentation impacts in the Bodie PMU.

Habitat loss and fragmentation associated with land use change and development is not restricted to private lands in the Bodie PMU. Rights-of-ways for roads, utility lines, sewage treatment plants and other public purposes on public lands are frequently requested, and granted, to support development activities on adjacent private lands. Bodie State Historic Park has expressed an interest in acquiring public land for the construction of a Visitor's Center in the Bodie Hills portion of the PMU. Again, the potential for such land use change and development impacts are exacerbated by the existing land ownership pattern.

Land use change and development is considered a manageable risk with land use and development on most lands in the Bodie PMU guided by existing land use plans. Existing plans include the Mono County General Plan (Mono County 1992), the Bishop Resource Management Plan (BLM 1993), the Humboldt-Toiyabe National Forest Land and Resource Management Plan (USFS 1986), and the Inyo National Forest Land and Resource Management Plan (USFS 1988). Mono County has the primary responsibility for regulating land use and development activities on private lands in the PMU. To date, the extent of habitat loss and fragmentation attributable to land use change and development in the PMU has been limited. Private landowners and citizens of Mono County have a clear opportunity to guide future land use and development to substantially reduce impacts to sage-grouse. However, the juxtaposition of private lands and key sage-grouse habitats will make this a complex and contentious issue. The cooperation of adjacent public land managers, particularly the Bureau of Land Management (BLM), the Humboldt-Toiyabe National Forest (HTNF) and Bodie State Historic Park will be required to successfully address the problem.

The Bodie PMU planning group identified the following priorities for addressing land use change and development challenges in the Bodie PMU: 1) Update existing land use plans to incorporate appropriate guidelines and mitigation strategies specific to land use change and development in sage-grouse habitats; 2) Encourage the use of conservation easements and other incentives that promote the long-term maintenance and conservation of private rangelands; 3) Improve and streamline the land exchange process to facilitate land tenure adjustments that protect key sage-grouse habitats and maintain Mono County's private property base; 4) Develop educational information to improve private landowners understanding of sage-grouse habitat needs; and 5) Avoid public land management strategies and policies that contribute to poor private land management or the eventual subdivision and development of private rangelands.

Conservation Action: PMU Group Review Pending

5.4.8 Mineral Exploration and Extraction

Mineral exploration and extraction was evaluated as a habitat and a population risk in the Bodie PMU. Mineral exploration and extraction has played a significant role in the history of human settlement and subsequent ecological change in the PMU. The best available information indicates that significant mineral deposits remain in the PMU and mineral exploration is likely to continue into the foreseeable future. The potential for future mineral extraction is dependent upon the extent of future discoveries, as well as economic, technological and political factors that influence prospective development. Mineral exploration and extraction is characterized as a yearlong risk, with potential impacts to all sage-grouse habitat types in the PMU. Direct loss of key seasonal habitats or population disturbance during key seasonal use periods are of most concern. Mineral exploration and extraction is characterized as a past, present and future risk to multiple sites and multiple birds in the Bodie PMU.

The Bodie PMU is best known for historic hard rock mining and the extraction of gold and silver during the mining boom of the late 1800s and early 1900s. Significant blocks of public land in the PMU are under valid existing mining claims. With the exception of Dog Town, the Bodie Bowl ACEC and the Travertine Hot Springs ACEC, all public lands in the PMU are open to mineral location. Sand and gravel are also common mineral commodities in the PMU. Active and historic mineral material pits are located along Green Creek Road near the Lower

Summer Meadows lek and in the Mono Basin near Mono City and Conway Ranch. The southern portion of the PMU is within the Mono-Long Valley Known Geothermal Resource Area (KGRA). Several valid geothermal leases are present within the KGRA; however, geothermal exploration has been limited, and no geothermal development has occurred, in the Bodie PMU.

Habitat risks associated with mineral exploration and extraction include changes in habitat quality and direct habitat loss. The direct loss of habitat due to surface disturbing activities has the potential for significant long-term impacts to overall habitat quality in the Bodie PMU. Mines of the gold and silver boom era of the late 1800s and early 1900s were mainly underground and probably had minor direct impacts on the overall extent and quality of sage-grouse habitat in the PMU. Wood was in huge demand for mine timbers, smelting operations, building and heating. The consumption of trees changed the landscape to an unknown degree, such that it is uncertain whether the current extent of woodlands represents expansion or recovery relative to the mining boom era. Mining activity continued at a low level in the PMU until as recently as the 1960s, leaving a few scars in sage-grouse habitat. Some opportunity exists for the reclamation and restoration of these historically mined areas.
Present-day mining practices have the potential to disturb large areas and create associated impacts such as noise, stream sedimentation, water or soil contamination and road proliferation. Even minor disturbances may have a disproportionate impact on sage-grouse if they occur in seasonal concentration areas during the season of sage-grouse use. Recent mining activities have focused on gold and silver exploration and sand and gravel extraction. Notable proposals within the past decade include a request to conduct exploratory drilling at the old Paramount Mine near an important sage-grouse summer concentration area and a request for access to State mineral reserves near the lek area on Dry Lakes Plateau. There is also a potential for "recreational" miners to create new roads during the course of prospecting and staking claims.

Direct mortality of sage-grouse for sustenance was a major population risk and indirect effect of historic mining in the Bode PMU. The gold and silver boom of the late 1800s brought about a rapid increase in human population in mining camps such as Bodie, Masonic, Lundy, Dunderberg, Mono Diggings and Dogtown. While the population of Bodie grew from a handful of miners in 1879 to a peak of 6,000-10,000 in 1881, agricultural production lagged behind and sage-grouse were a ready food source. The extent to which sage-grouse were exploited and the potential genetic ramifications of such exploitation may never be known. The contemporary population risk is generally associated with the occasional opportunistic poaching of sage-grouse by recreational prospectors or the disturbance of sage-grouse in key seasonal habitats during mineral exploration or extraction activities.

Mineral exploration and extraction is believed to be a manageable, although potentially expensive, risk in the Bodie PMU. The current risk is generally restricted to small-scale gold and silver exploration and sand and gravel extraction activities that are considered to have minimal impacts on sage-grouse. New technology and political and economic factors that influence development potential could bring the risks associated with large-scale mineral exploration and extraction to the forefront in the future. Future management should focus on the application and enforcement of existing county, state and federal laws, regulations and policies specific to mineral development and extraction. Special emphasis should be given to: 1) Developing effective guidelines and mitigation measures designed to protect key sage-grouse seasonal use areas; 2) Developing and implementing practical reclamation techniques to restore disturbed sites; and 3) Identifying and prioritizing potential restoration sites.

Conservation Action: PMU Group Review Pending

5.4.9 Recreation

Recreation was evaluated as a habitat and a population risk in the Bodie PMU. A wide-variety of recreational activities occur in the PMU, many within or adjacent to known key sage-grouse use areas and key habitat types. Recreation is a yearlong risk, with sage-grouse particularly vulnerable to disturbance during the breeding season and other periods of concentrated use. Potential impacts to leks, nesting areas, early and late brood habitats and summer and winter concentration areas are of particular concern. Recreational use varies by season, with most activity occurring in the late spring, summer and early fall. Some recreational uses also produce predictable seasonal peaks in the level of activity. Recreation is characterized as a past, current and future risk to multiples birds and multiple sites in the Bodie PMU.

Recreation in the Bodie PMU draws visitors from a broad region including many from urban areas in southern California, the Bay Area and northern Nevada. Popular recreation activities in the PMU include camping, hiking, site-seeing, mountain biking, horseback riding, cross-country skiing, snowshoeing, off-highway vehicle use (OHV), snowmobiling, bird watching, bird dog training, fishing and hunting. Fishing, camping and hiking are the dominant recreation activities on the Sierra Nevada side of the PMU. Visitation to Bodie State Historic Park accounts for the majority of recreational use in the Bodie Hills portion of the PMU. Most recreation use occurs in the late spring, summer and early fall. Fishing and hunting season openers, holiday weekends and other special events result in short, but prominent, upsurges in visitation in the PMU. Nearly all recreation involves OHV use to some degree, as visitors use unpaved roads to reach recreation destinations. OHV use for its own sake also occurs, including a few large organized events. Winter recreation is largely dependent upon snowfall and snowmobiling, cross-country skiing and snowshoeing occur in scattered areas of the PMU when conditions allow.

The primary population risk associated with most recreational use is disturbance and displacement. Disturbance may cause sage-grouse to flush making them more vulnerable to predation. Excessive disturbance may also cause sage-grouse to avoid traditional use areas. The effects of disturbance are exacerbated when use occurs in important seasonal concentration areas, especially leks. Excessive lek disturbance by campers and bird watchers, as may occur in other PMUs, is currently not a problem in the Bodie PMU. However, it is imperative that this risk be monitored and all parties remain alert to the potential for lek disturbance. Dogs accompanying recreationists may increase the level of disturbance by flushing and may chase and kill young birds. Bird dog training is not known to occur at high levels in the PMU at this time but should also be monitored for undue disturbance to sage-grouse. In general, light, non-motorized recreation currently presents a low population risk to sage-grouse in the Bodie PMU. Sage-grouse hunting is a potentially significant population risk that is addressed specifically in a separate section (see Section 5.4.1 Licensed Hunting).

Population impacts of motorized recreation include disturbance, displacement and direct mortality from vehicle collisions. Habitat effects include accelerated erosion and the creation of new routes which may increase access to previously undisturbed areas. Impacts to wet meadows, riparian areas and currently intact sagebrush habitats are of particular concern. Developed recreation sites constructed to provide visitor services can also result in the direct loss and fragmentation of sage-grouse habitat. The results are the same as those described for land use change and development (see Section 5.4.7 Land Use Change and Development). Developments in or adjacent to key habitats are of particular concern. Increased human presence and disturbance associated with developed recreation sites will further degrade sage-grouse habitat quality. Wildfire caused by carelessness is potentially the most catastrophic habitat risk associated with recreation in the PMU. Fire is addressed in a separate section (see Section 5.4.10 Fire).

Recreation is considered a manageable risk in the Bodie PMU. Developed recreation sites and concentrated recreation use are generally limited to the Twin Lakes basin, the Virginia Lakes basin and the vicinity of Bodie State Historic Park. Current land use plans and policies allow land managers the latitude to mitigate future impacts of recreational use on sage-grouse in the PMU. The current policy on all public lands throughout the PMU is to allow OHV use only on existing, designated routes. Land management agencies also have the authority to close unauthorized new routes and rehabilitate old routes that significantly affect sage-grouse habitat quality. Land managers also issue permits for organized and commercial events, regulating their location and timing. Snowmobile use is currently light and has not yet been addressed in terms of designating use and non-use areas.

Recreation use is predicted to increase in the Bodie PMU and land managers must be aware of changing use patterns that may negatively affect sage-grouse. Management activities must keep pace and include proactive outreach and education programs, as well as increased regulation and law enforcement effort if necessary. The Bodie PMU planning group expressed particular concern about the desire of Bodie State Historic Park to construct a Visitor's Center in the Bodie Hills, the dissemination of potentially sensitive lek location information, the potential for a catastrophic human cased fire, and the prospect of increased motorized recreational use.

Conservation Action: PMU Group Review Pending

5.4.10 Wildfire

Wildfire was evaluated as a habitat and a population risk in the Bodie PMU. The effects of both wildfire and wildfire suppression activities on sage-grouse populations and habitats in the PMU were considered. Essentially all sagebrush associated habitats in the PMU are subject to some fire related risk. Wildfire and wildfire suppression activities are a risk to several known key sage-grouse use areas and key sage-grouse habitat types in the PMU. Wildfire is a yearlong risk, with the risk of natural ignition and large fires generally restricted to the summer fire season (May–October). The risk of human caused fires is also greatest during the summer fire season. Wildfire is characterized as a past, current and future risk to multiple sites and multiple birds in the Bodie PMU.

Wildfire and wildfire suppression activities are primarily a habitat risk in the Bodie PMU. Habitat risks include direct loss of key habitats, habitat fragmentation and long-term changes in habitat quality. Population risks are largely associated with the displacement of sage-grouse from key habitats or the disturbance of sage-grouse during critical seasons of use. Increased recreational use and expansion of the wildland-urban interface increase the potential for human caused fires and may ultimately limit fire suppression and management options in the Bodie PMU.

Contemporary wildfire activity in the PMU has been limited and no significant impacts to key sage-grouse habitats have been documented. In general, most recent burns in sagebrush associated habitats in the PMU are functioning as naturally transitioning early to mid-seral sagebrush communities in which sagebrush cover will improve over time. No landscape scale fires have occurred over the last 40 years and even the largest contemporary burns in the PMU can be characterized as small. Nonetheless, the potential for a large uncontrolled wildfire to significantly impact key sage-grouse seasonal use areas is clearly recognized. The risks to nesting, early brood, fall and winter habitats are of particular concern. As with other sage-grouse habitats throughout the west, sagebrush associated habitats in the Bodie PMU with favorable characteristics for sage-grouse are most likely to burn.

Overzealous wildfire suppression activities may also lead to direct habitat loss or long-term ecological changes in habitat quality. Direct impacts associated with fire suppression techniques such as dozer lines, burnouts and similar suppression techniques may actually impede habitat recovery following a fire. For example, a dozer line in low sage habitat may take several decades to recover. In addition, years of aggressive wildfire suppression have likely contributed to the abundance of late seral shrub communities and pinyon-juniper expansion in the Bodie PMU. This abundance of late seral shrub communities and significant stands of pinyon-juniper heighten the potential for large fires. Excessive fire suppression may ultimately have a negative impact on overall sagebrush habitat quality by reducing overall habitat diversity and productivity. The risks to leks, night roost, early-brood, late brood, summer and connectivity habitats are of most concern. The long-term risks to future nesting, fall and winter habitats are also a concern.

The presence of cheatgrass in some sagebrush associated plant communities in the Bodie PMU also adds the risk of altered fire cycles and increased cheatgrass abundance. To date, no landscape scale fires or type conversion of sagebrush dominated habitats to non-native annual grasslands has occurred in the PMU. However, cheat grass is common and some risk of type conversion does exist, especially in the lower elevation Wyoming big sagebrush habitats adjacent to Bridgeport Valley. Some lower to mid-elevation mountain big sagebrush sites are also at risk of conversion to non-native annual grassland. This risk is greatest on dryer, south and west facing slopes and sites where pinyon encroachment has increased the potential for a large, hot fire.

Fire is characterized as a manageable risk, although fire management options are often expensive and unpredictable. In general, both cost and manageability are directly related to protection priorities and prevailing fire behavior. All agencies with fire management responsibilities in the Bodie PMU have existing policies and plans that direct their fire management activities. Threats to human life and property are clearly recognized as the highest priority for protection and contemporary management has largely focused on suppression. In addition, other resource values often take precedence over sage-grouse conservation needs and little fire management direction exists to ensure the long-term maintenance and improvement of key sage-grouse habitat in the Bodie PMU.

The Bodie PMU planning group identified the following priorities for addressing fire management related risks and challenges in the Bodie PMU: 1) Identification and protection of key seasonal habitats from direct loss or degradation due to catastrophic fires or inappropriate fire suppression techniques; 2) Identification of fire suppression priorities and the implementation of fire suppression techniques compatible with sage-grouse population and sagebrush associated plant community needs; 3) Identification of fire rehabilitation priorities and the development of criteria for fire rehabilitation efforts in sagebrush associated plant communities; and 4) Use of prescribed fire, fire surrogate treatments or other appropriate actions to reduce the potential for large, catastrophic fires or to improve the ecological heath of sagebrush associated plant communities. The group also recognized the need to: 1) Improve and increase fire prevention efforts to reduce the occurrence of human caused fires; 2) Recognize the ecological differences among sagebrush species in the PMU and the expected responses to fire, fire suppression techniques and restoration efforts; 3) Evaluate historic burns to improve our knowledge of local sagebrush associated plant community responses to fire and the potential effects on sage-grouse populations and habitats; and 4) Identify local sagebrush associated communities at risk of cheat grass conversion.

Conservation Action: Fire Protection And Management

Risks: Direct loss or degradation of key sage-grouse habitats from catastrophic wildfire in the Bodie PMU. Population disturbance or habitat degradation from the application of wildfire suppression techniques or fuels management actions that may be incompatible with sage-grouse needs in the Bodie PMU. Potential long-term ecological changes to sagebrush associated plant communities in the Bodie PMU from overzealous fire suppression.

Objectives: Protect key sage-grouse habitats in the Bodie PMU from direct loss or significant degradation resulting from catastrophic wildfire. Ensure that future wildfire suppression and fuels management actions promote the maintenance or improvement of sage-grouse habitat in the Bodie PMU.

Actions: Develop and implement interagency fire management guidelines for the protection and management of sage-grouse habitats in the Bodie PMU. Include elements that address: 1) Identification and protection of key seasonal habitats; 2) Priorities for fire suppression and compatible fire suppression techniques; 3) Priorities for fire rehabilitation and criteria for rehabilitation efforts; 4) Prescribed fire and fire surrogate treatments for fuels management and habitat improvement; 5) Fire prevention to reduce human caused starts; and 6) Identification of sagebrush associated plant communities at risk of cheatgrass conversion. These guidelines must recognize the ecological differences among sagebrush species present in the Bodie PMU, and the expected responses to fire, fire suppression techniques and fire rehabilitation efforts. Incorporate these guidelines into fire management plans, land use plans and fire related activity plans for the Bureau of Land Management, Bishop Field Office, Inyo National Forest, Toiyabe National Forest, Bridgeport Ranger District and Bodie State Historic Park.

Rationale: Development and implementation of the proposed interagency fire management guidelines will address the risks and help ensure the long-term protection, maintenance and improvement of sage-grouse habitats and populations in the Bodie PMU.

Legal Authority: Development of fire management guidelines and fire management plans for public lands and national forest lands is under management authority of the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS). The California Department of Forestry and Fire Protection (CDF) is the principal authority for fire management on private and State owned wildlands in California.

Procedural Requirements: The Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) must complete appropriate environmental review prior to implementation of any fire management plan or fire related activity plan. Any subsequent land use plan updates would also require appropriate environmental review.

Level of Partnership Commitment: Several existing partnerships and cooperative agreements will facilitate completion of this action. The Bureau of Land Management (BLM), Bishop Field Office and the Inyo National Forest currently operate under a unified fire command. The Humboldt-Toiyabe National Forest and California Department of Forestry (CDF) are also current partners committed to cooperative fire management in the region. Some additional coordination will be required to ensure that Bodie State Historic Park (BSHP) is an active participant in this process.

Funding Sources: The Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) frequently receive priority funding to complete fire management planning efforts. Targeted funding may be required to ensure completion of this priority action.

Implementation Process:

1. Establish an interagency, interdisciplinary team to develop interagency fire management guidelines for the protection and management of sage-grouse habitats in the Bodie PMU.
2. Send proposed guidelines out for agency, peer and public review.
3. Review comments and finalize guidelines.
4. Complete appropriate environmental review and update applicable plans to include guidelines.
5. Periodically review the guidelines for effectiveness at protecting sage-grouse habitats and update as needed.

5.4.11 Pinyon-Juniper Encroachment

Pinyon-juniper encroachment was evaluated as a habitat and a population risk in the Bodie PMU. Significant stands of singleleaf pinyon, and to a lesser extent juniper, are found adjacent to several known key sage-grouse use areas and key habitat types in both the Bodie Hills and the Sierra Nevada portions of the PMU. Pinyon-juniper encroachment is a yearlong risk, with encroachment into currently occupied breeding, summer, fall and winter habitats of most concern. Increased tree density and expansion into adjacent non-woodland habitat types and potential connectivity habitats is also a concern. The potential contribution of pinyon-juniper densities to large catastrophic fires and the potential for long-term plant community type conversion accentuate this risk. Pinyon-juniper encroachment is characterized as a current and future multiple site, multiple bird risk.

Pinyon-juniper encroachment is primarily a habitat risk in the Bodie PMU. Habitat risks include changes in habitat quality and habitat loss or fragmentation. Pinyon-juniper encroached (R3) sagebrush habitats are common at the lower to mid-elevations of the PMU. Significant areas of pinyon, and to a much lesser extent juniper, encroachment can be found on all flanks of the Bodie Hills. Notable stands of pinyon are found on the northern flank adjacent to the East Walker River, on the southern flank from the Nevada border to Conway Ranch, on the eastern flank along the Nevada border, and on the western flank from Clearwater Creek to Bridgeport. Though seldom dominant, juniper is common in many of these pinyon stands. On the Sierra Nevada side of the PMU, pinyon encroachment is occurring adjacent to Bridgeport Valley from the Hunewill Hills south to Dog Creek, and adjacent to US Highway 395 south of Lundy Canyon west of Mono Lake. Juniper is rare on the Sierra Nevada side of the PMU. In some cases, the role of pinyon-juniper encroachment in reducing sage-grouse habitat quality and the likely response to treatment is clear. In other cases, improved mapping and evaluation of pinyon-juniper habitats and sage-grouse needs will be needed before appropriate management strategies can be developed and implemented.

Pinyon-juniper encroachment may also be a limited population risk. Pinyon and juniper trees can function as perches for avian predators and could contribute to increased predation rates. Increased predation rates are expected to be the greatest in seasons and habitats of concentrated use. Potential impacts to strutting, nesting, brooding and wintering sage-grouse are of most concern.

Pinyon-juniper encroachment is clearly a manageable risk; however, recent management has been inadequate to address sage-grouse needs. Many pinyon-juniper encroached sites in the Bodie PMU provide excellent opportunities for sage-grouse habitat improvement, particularly those adjacent to leks and meadows. Pinyon-juniper encroached sites that occur between known seasonal use areas or adjacent breeding populations are also good candidates for sage-grouse habitat improvement projects. The Bodie PMU Planning Group identified the vicinities of lek 9 near US Highway 395 and lek 10 at Lower Summers Meadow as a priority for treatment to reduce pinyon-juniper encroachment in and adjacent to occupied breeding habitat. The group also identified sagebrush habitats adjacent to Summers Meadows, Mormon Meadows, Conway Ranch (Rancheria Gulch) and Big Alkali as potential treatment areas. The group recognized a clear need to improve mapping and evaluation of pinyon-juniper habitats in relation to sage-grouse needs. Of particular interest are potential connectivity habitats with the Mono Basin, the Mount Grant PMU and the Desert Creek-Fales PMU. The role of fire and fire surrogates in addressing long-term plant community changes and reducing the potential for large catastrophic fires should also be investigated. Concern was also expressed about existing land use policies (for example, Interim Management Policy for Wilderness Study Areas) that may limit pinyon-juniper treatment options and often take precedence over sage-grouse habitat needs.

Conservation Action: Pinyon Removal And Management

Risks: Direct habitat loss, habitat fragmentation and habitat degradation from pinyon and/or juniper encroachment into key sage-grouse habitats and adjacent non-woodland habitats in the Bodie PMU. Increased potential for catastrophic fire and long-term sagebrush associated plant community type conversions in the Bodie PMU.

Objectives: Improve sage-grouse habitat quality by treating pinyon and/or juniper encroachment into key sage-grouse habitats in the Bodie PMU. Manage pinyon and juniper in the Bodie PMU to ensure long-term connectivity between sage-grouse seasonal use areas and adjacent breeding populations. Reduce the potential for catastrophic fire and sagebrush associated plant community type conversion from excessive pinyon and/or juniper densities and continuous fuel conditions in the Bodie PMU.

Actions:

1) Remove pinyon and/or juniper in and adjacent to currently occupied breeding habitat in the Bodie PMU using the most appropriate technique (cutting, burning, chaining, herbicide application, etc) to achieve project objectives.
2) Design and implement pinyon-juniper removal projects that include a scientific research component designed to improve our knowledge and ability to effectively manage pinyon-juniper in the Bodie PMU.

3) Map and compare current pinyon-juniper extent with historic pinyon-juniper extent to assess temporal changes in pinyon-juniper distribution in the Bodie PMU.
4) Evaluate the current extent of pinyon-juniper in relation to sage-grouse habitat needs, fire ecology and sagebrush associated plant community health in the Bodie PMU.
5) Identify additional priority treatment sites and implement additional pinyon and/or juniper removal treatments to improve sage-grouse habitat and sagebrush associated plant community health in the Bodie PMU.

Rationale: Removing pinyon-juniper in and near current breeding areas is expected to bring about immediate improvement of a key habitat. The remaining actions will increase understanding of the dynamics of pinyon-juniper encroachment and effects of removal efforts, and allow long-term adaptive management to improve sage-grouse habitat conditions and connectivity.

Legal Authority: The Bureau of Land Management (BLM) has management authority for the implementation of pinyon-juniper treatments or research projects on public lands in the Bodie PMU. The U.S. Forest Service (USFS) has management authority for the implementation of pinyon-juniper treatments or research projects on national forest lands in the PMU. Pinyon-juniper treatments or research projects on private lands in the Bodie PMU are at the discretion of individual private landowners.

Procedural Requirements: The Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) must complete appropriate environmental review prior to the implementation of any pinyon-juniper treatment or research project on public lands or national forest lands in the Bodie PMU. Any treatment on public lands under Wilderness Study Area (WSA) designation must comply with the BLM's Interim Management Policy (IMP) for WSAs. Private landowners can request the assistance of the Natural Resource Conservation Service (NRCS), the California Department of Forestry and Fire Protection (CDF), or the University of California (UC) Cooperative Extension to develop and implement project plans.

Level of Partnership Commitment: The Bureau of Land Management (BLM), Bishop Field Office and Humboldt-Toiyabe National Forest, Bridgeport Ranger District were active participants and partners in the development of this action plan. The Bodie PMU planning group expressed a keen interest in pinyon-juniper management in the PMU.

Funding Sources: The Bureau of Land Management (BLM), Bishop Field Office and Humboldt-Toiyabe National Forest, Bridgeport Range District are responsible for identifying and securing funding for project implementation. Significant levels of funding will likely be required to successfully implement proposed projects. Where possible, all cooperators should work to identify and secure contributed funds and volunteer labor to support implementation. A variety of contributed funds are likely available to support project implementation on public and private lands in the PMU.

Implementation Process:

1. Project Planning:
    a. Finalize project location, define project objectives and identify proposed treatment.
    b. Complete required surveys and appropriate environmental review.
    c. Conduct pre-project monitoring.

2. Project Implementation:
    a. Secure funding and complete appropriate coordination.
    b. Implement the proposed treatment.
    c. Conduct any immediate post-implementation monitoring.

3. Project Monitoring and Adaptive Management:
    a. Monitor plant community composition and sage-grouse population response.
    b. Review monitoring data and assess success at meeting project objectives.
    c. Update project as needed and complete additional treatment required to accomplish project objectives.
    d. Keep partners and participants informed throughout.

Priority Project Area Locations:

1) Lek 9 Breeding Complex (BLM, Bishop Field Office).
2) Lek 10 Breeding Complex - Hunewill Hills/Summers Meadows Complex (BLM, Bishop Field Office, Humboldt-Toiyabe National Forest, Bridgeport Ranger District and Private).
3) Mormon Meadows (BLM, Bishop Field Office and Private).
4) Rancheria Gulch (BLM, Bishop Field Office).
5) Big Alkali (BLM, Bishop Field Office and Private).

5.4.12 Water Distribution

Water distribution was evaluated as a habitat risk in the Bodie PMU. Water availability affects both habitat quality and quantity, as sage-grouse require open water when succulent vegetation is scarce. The availability of open water may to some extent define and limit sage-grouse summer habitat in the PMU. This risk is seasonal, peaking during the dry summer months and during extended drought periods. Water distribution is characterized as a past, present and future risk that affects multiple sites and multiple birds in the Bodie PMU.

Sage-grouse summer habitat quality and extent is likely influenced by the nature of water distribution in the Bodie PMU. Telemetry study has shown that sage-grouse in the PMU tend to concentrate near available water, particularly at higher elevations, during the warmest months. Springs and streams are abundant but patchily distributed, and some of these are ephemeral during drought years. Dependable summer water sources are primarily associated with the headwaters of the East Walker River and concentrated on the east slope of the Sierra Nevada and the northeast slopes of the Bodie Hills. Few perennial water sources are found in the northern Mono Basin and on the western flank of the Bodie Hills. The eastern Mono Basin is particularly dry. A few artificial reservoirs and livestock watering troughs supplement natural water sources. The effect of water distribution on sage-grouse summer habitat quality and quantity in the Bodie PMU can be exacerbated by extended drought conditions.

Livestock water developments are frequently proposed to improve livestock distribution and may provide some benefits to sage-grouse during the summer; however, livestock overuse may degrade the quality of sage-grouse habitats both directly adjacent to water sources and in a wider surrounding area. Livestock also tend to concentrate near water and use the same areas as sage-grouse during the summer. The potential effects of changed livestock distribution and use on sage-grouse habitat quality must be fully evaluated prior to the development of new livestock watering facilities. Shifts in livestock use patterns that significantly reduce the height and cover of the herbaceous understory in nesting areas should be avoided. Livestock watering troughs that have not been fitted with wildlife escape ramps also pose a drowning hazard. Pipelines and water developments that significantly alter spring sources and associated meadow vegetation can also negatively affect sage-grouse habitat quality (Connelly et al. 2000). Fences to exclude livestock from water sources may improve habitat conditions, but may also pose hazards to sage-grouse accessing them (see Section 5.4.3 Fences).

Sage-grouse habitat quality and quantity as influenced by water distribution is to some extent manageable in the Bodie PMU. Ongoing telemetry study and examination of habitat selection by sage-grouse in the PMU may identify areas that have suitable summer habitat characteristics except for a lack of water. Management emphasis should focus on: 1) Protecting and restoring existing water sources; and 2) Developing new water sources in or adjacent to known summer use areas. Land managers should take advantage of opportunities to improve water distribution for both livestock and sage-grouse; however; land managers must also ensure that such developments do not negatively affect key sage-grouse habitats or contribute to direct mortality of sage-grouse or other wildlife. Guidelines designed to ensure habitat protection and wildlife safety could easily be developed to address these issues. Some existing land use designations and policies (for example, Interim Management Policy for Wilderness Study Areas) may limit opportunities to improve water distribution for sage-grouse in the Bodie PMU. The Bureau of Land Management (BLM) and affected interests should strive to resolve these limitations and ensure that sage-grouse receive equal consideration when implementing such policies.

Conservation Action: Improved Access To Water

Risks: Poor water distribution may limit sage-grouse summer habitat availability in portions of the Bodie PMU. Extended drought may exacerbate the effects of poor water distribution on sage-grouse summer habitat availability in the Bodie PMU. Some natural springs and existing man-made water sources in the Bodie PMU do not provide sage-grouse safe access to water.

Objectives: Increase available sage-grouse summer habitat and mitigate extended drought conditions by improving water distribution in the Bodie PMU where appropriate. Protect natural spring sources and modify existing water developments to improve sage-grouse access to water in the Bodie PMU.

Actions:
- Evaluate sage-grouse habitat use in relation to water distribution in the Bodie PMU.
- Identify potential sites to improve sage-grouse access to water.
- If no overriding negative effects are identified, develop artificial water sources to improve water distribution.
- Identify and implement measures to protect natural spring sources.
- Modify fencing and/or install escape ramps to provide sage-grouse safe access to existing water developments.

Rationale: Identifying sites where lack of water is the main factor limiting summer habitat quality, and improving the availability of water in those places, is expected to increase usable summer habitat especially during drought conditions. Protecting existing natural water sources will maintain habitat quality. Improving safety of water sources will reduce mortality.

Legal Authority: The Bureau of Land Management (BLM) has management authority for the implementation of habitat improvement projects on public lands in the Bodie PMU. The U.S. Forest Service (USFS) has management authority for the implementation of habitat improvement projects on national forest lands in the PMU. Project implementation on private lands in the Bodie PMU is at the discretion of individual private landowners.

Procedural Requirements: The Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) must complete a project plan and appropriate environmental review prior to the implementation of any habitat improvement project on public lands or national forest lands in the Bodie PMU. Project implementation on public lands under Wilderness Study Area (WSA) designation must comply with the BLM's Interim Management Policy (IMP) for WSAs.

Level of Partnership Commitment: The Bureau of Land Management (BLM), Bishop Field Office and the Eastern Sierra Chapter of Quail Unlimited (QU) are active partners committed to the restoration, improvement and development of water sources for upland game birds in the Eastern Sierra. The local QU chapter has expressed a keen interest in habitat improvement projects to benefit sage-grouse in the Bodie PMU and has a proven track record of providing funding and labor to support such efforts. Private landowners and grazing permittees participating in the Bodie PMU planning group have also expressed an interest in partnering to improve water distribution to benefit both livestock and sage-grouse.

Funding Sources: Funding for the implementation of water development projects is readily available from Quail Unlimited (QU) and a variety of other conservation organizations. The Bureau of Land Management (BLM), Bishop Field Office, the Eastern Sierra Chapter of QU, and the Eastern Sierra Chapter of the California Deer Association (CDA) have been extremely successful at securing such funding over the past several years. The BLM and QU have also successfully secured funds through the National Fish and Wildlife Foundation (NFWF) "Answer the Call" program.

Implementation Process:

1. Evaluate sage-grouse habitat use in relation to current water distribution and identify potential project sites to improve sage-grouse access to water.
    a. Use telemetry and habitat data to identify areas of potential sage-grouse summer habitat that lack free water.
    b. Assess the potential for small water developments in these areas to improve sage-grouse summer distribution.
    c. Evaluate the expected positive and negative effects of water development on the distribution of other animals including domestic livestock and feral horses.
    d. Develop guidelines for water developments to ensure that sage-grouse are benefited.
    e. Seek cooperative opportunities to improve livestock and sage-grouse distribution by means of water development.
2. Construct guzzlers or other water developments as indicated by Step 1.
    a. Design for safe sage-grouse access.

   b. Design to require minimal maintenance and maximum longevity. If labor-intensive, consider compensation for extra effort on the part of private landowners.
   c. Complete project plans and appropriate environmental review including cultural surveys and Interim Management Policy (IMP) for Wilderness Study Area (WSA) notifications if necessary.
   d. Implement with the assistance of volunteer labor contributed by Quail Unlimited (QU) or other conservation organizations.
3. Protect natural spring sources and modify existing man-made water developments to improve sage-grouse summer habitat and sage-grouse access to water.
   a. Ensure that fences used to protect springs and streams allow safe access to water, by means such as let-down fences, using as few wires as practical, and/or runoff outside the fence.
   b. Retrofit all existing livestock water troughs with wildlife escape ramps.
   c. Include adequate water for sage-grouse in livestock water developments, via overflow or grouse waterers.
   d. Ensure that livestock water developments do not dry up meadows.

5.4.13 Quality of Sagebrush Habitats

PMU Group Evaluation Pending

5.4.14 Quality of Meadows and Riparian Habitats

PMU Group Evaluation Complete, Draft in progress

6.0 WHITE MOUNTAINS PMU

6.1 PMU DESCRIPTION

6.1.1 Physical Location and Boundary

The White Mountain PMU encompasses 1,753,875 acres in the area of the White Mountains in western Nevada and eastern California. The White Mountain PMU contains three distinct portions including the White Mountain portion, the Truman Meadows/Candelaria Hills portion, and the Silver Peak/Magruder portion. The PMU is located in Esmeralda and Mineral counties in Nevada and Inyo and Mono counties in California. Map 1 delineates the White Mountain PMU boundaries.

White Mountains—Those portions of Esmeralda and Mineral Counties in Nevada, and Mono and Inyo Counties in California bounded on the north by U.S. Highway 6 from the California/Nevada state line north and east to the junction of Nevada State Route 264, on the east by Nevada State Route 264 south to the Nevada/California State Line, California State Route 266, thence south along California State Route 266 to the junction of California State Route 168 at Oasis, on the south by California State Route 168 to the junction of U.S. Highway 395 at Big Pine, and on the west by U.S. Highway 395 north to the junction of U.S. Highway 6 at Bishop, thence north along U.S. Highway 6 to the California/Nevada State Line.

Truman Meadows / Candelaria Hills—Those portions of Mineral and Esmeralda Counties, Nevada, bounded on the south by U.S. Highway 6 from the California/Nevada state line north and east to the junction of the Columbus Road, on the east by the Columbus Road north to the junction of U.S. Highway 95, on the north by U.S. Highway 95 north and west to the junction of the Silver Dyke Canyon Road, thence west on that road and continuing past the end of that road to the top of the Excelsior Range, thence west along the top of the Excelsior Range to the Mount Grant PMU eastern boundary near Summit Spring, on the west by the eastern boundary of the Mount Grant PMU south to the Nevada/California state line, thence south and east along the state line to the junction with U.S. Highway 6.

Silver Peak / Magruder—Those portions of Esmeralda County in Nevada and Mono County in California bounded on the north by U.S. Highway 6 from the junction of Nevada State Route 264 east to the junction of Nevada State Route 265, on the east by Nevada State Route 265 south to the junction of the Railroad Pass Road at Silver Peak, thence south along the Railroad Pass Road to the junction of Nevada State Route 266, thence west on that State Route to the junction of the Tule Canyon Road, thence south from that junction along the Tule Canyon Road to the Nevada/California State Line, on the south by the Nevada/California State Line north and west to California State Route 168, on the west by California State Route 266 from Oasis north to the Nevada/California State Line, Nevada State Route 264, thence north on Nevada State Route 264 to the U.S. Highway 6 junction.

6.1.2 Land Ownership and Regulatory Jurisdictions

Public land comprises approximately 97 percent of the land within the White Mountain PMU. The Bureau of Land Management (BLM) manages 83 percent of the PMU (Tonopah Field Station in Nevada and Bishop Field Office in California). The Inyo National Forest, White Mountain District manages 14 percent of the PMU. Various private citizens or companies and the State of Nevada own the remaining three percent of the lands.

Herd Management Areas (HMA) —Within the White Mountain PMU, the BLM manages six wild horse HMAs. The Tonopah Field Station manages Fish Lake Valley, Silver Peak, and Palmetto HMAs. Carson City Field Office manages Montgomery Pass HMA, in cooperation with the U.S. Forest Service, Garfield Flats HMA and the Marietta Burro Range. Only 9500 acres of the Garfield Flats HMA lies within the White Mountain PMU. The BLM and USFS manage for wild horses in part of the White Mountains. These horses are difficult to manage because in some areas they move freely between USFS and BLM managed lands. However, the agencies are taking measures to assess the status and condition of the horses in the region. Map 2 shows the locations of the HMAs in the White Mountain PMU. The horses are not necessarily restricted to these areas by geographic or human made features. They can move throughout the area in the White Mountains.

Table 6-1 shows the current estimated populations of these HMAs and their appropriate management levels (AML). AML is the maximum number of horses or burros the HMA can sustain to maintain a healthy ecosystem. Estimates are very conservative as they are based on average birth rates only. Currently, the estimated numbers of horses are neither so high nor dense to be considered alarming.

Table 6-1. Herd Management Area Information for White Mountain PMU

HERD MANAGEMENT AREA	APPROPRIATE MANAGEMENT LEVEL	CURRENT POPULATION ESTIMATE
Fish Lake Valley	65	60 (2003)
Garfield Flat	125	141 (2002)
Silver Peak	312	west side only 133 (2003)
Palmetto	76	3 (2002)
Montgomery Pass	184	140 (2001)
Marietta Burro Range	104	93 (2002)

Domestic Livestock—The BLM manages eight grazing allotments in the Esmeralda County portion of the White Mountain PMU, three allotments in Mineral County portion, and ____ allotments out of the Bishop Field Office. Currently, two permittees use five Esmeralda County allotments for approximately 8200 cattle animal unit months (AUM). They graze the allotments seasonally. Three permittees use the Mineral County allotments in the winter.

The Inyo National Forest manages six grazing allotments in Esmeralda, Mono, and Inyo counties from Truman Meadows in the north to Crooked Creek in the south. Cottonwood Creek and Tres Plumas are former large allotments on the east side of the White Mountains in Mono County that have been removed from active grazing since 1990 for watershed restoration for the Piute cutthroat trout. Meadow hydrology, vegetative condition, and associated sagebrush stands have improved in herbaceous species density and composition since allotment rest. Grouse have not been seen in Cottonwood in past field trips possibly because of the small, fragmented patches of sagebrush interspersed with pinyon stands and aspen groves. Approximately half of the suitable sage-grouse range is located within active grazing allotments almost entirely on the east side of the White Mountains and Truman Meadow.

Since the 1920s, Deep Springs College has had a grazing permit on the Inyo National Forest for the Crooked Creek grazing allotment. The students have collected anecdotal evidence to support the conclusion that sage-grouse have been in the area since that time. Today, the college utilizes about 690 AUMs during the months of July, August and the first half of September. In 1992, the college established the "Deep Springs Resource Management Team," a diverse group of people with management interests and concerns on the land owned and leased by the college. The members include representatives from the Inyo National Forest, the Ridgecrest BLM, the California Dept. of Fish and Game, and the Native Plant Society. For the past decade, the team has worked to plan and manage the Deep Springs grazing operation with a goal of providing a stable ranch operation for the college within the context of environmental stewardship and habitat preservation.

Areas of Critical Environmental Concern (ACEC) —ACECs are specific to BLM lands. An ACEC designation constitutes a management commitment by the BLM. BLM regulations (43 CFR part 1610) define an ACEC as an area "within the public lands where special management attention is required (when such areas are developed or used or where no development is required) to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect life and safety from natural hazards."

To be eligible for ACEC designation, an area must meet relevance and importance criteria and require special management to protect or appropriately manage the important values. If current management provided for in the land use plan is not sufficient to protect or appropriately manage the important values, special management is needed.

The designation does not, by itself, automatically prohibit or restrict other uses or activities in an area, with the exception of the requirement of a Plan of Operations for any proposed mining activity within a designated ACEC.

Various groups and organizations have nominated 22 sites for ACEC status in Esmeralda County. For further information on these nominations please visit the following website: www.nv.blm.gov/bmountain/acec/acec_nomination_list_tfs.htm.

Wilderness Study Areas (WSA) —Two WSAs exist in the Esmeralda County portion of the PMU. Congress will make the final designation of a wilderness area on each WSA. The Silver Peak Range WSA has 33,900 acres and the Pigeon Spring WSA, west of Lida, has 3,575 acres; however, none are recommended for wilderness designation.

6.1.3 Topography And Climate

Elevations in the White Mountain PMU range from approximately 4,000 feet in the valleys to 14,246 feet on White Mountain Peak. The average elevation is 6,519 feet (1987 m). Fifty-eight percent of the area is less than 6,500 feet high, thirty-three percent of the area is between 6,500 and 9,000 feet high, and nine percent of the area is greater than 9,000 feet. The valleys run gradually into the foothills of the mountains. The mountains are very rugged and steep in places and some high meadows exist in the upper elevations. One quarter of the area is very steep scarps and cliffs (greater than 35% slope) and another quarter is gentle slopes (3-10% slope). Steep slopes (10-35% slope) account for 36% of the PMU. Only 14 percent of the PMU has flats and gentle slopes (0-3% slope). The aspects of the area are divided somewhat evenly between northerly (24%), southerly (22%), easterly (28%) and westerly (22%), with 4% no aspect or flat.

The climate has many characteristics of high, cold desert including highly variable precipitation patterns, extreme variation in daily temperature, and well-developed seasons. In the summers, The valley bottoms can attain daytime temperatures over 100 degrees F in the summers and below freezing in the winters. Precipitation varies in type and quantity. Mountainous areas receive average annual levels of snowfall around 158 inches, whereas the valley bottoms may receive none. Precipitation levels range on average from 4 inches per year in some of the drier locations to over 19 inches in the higher elevations of the White Mountains.

6.1.4 Vegetative Communities And Distribution

The Inyo National Forest surveyed habitats in Esmeralda County in 2002 to determine suitability for sage-grouse. Because of the fragmented stand nature and because no grouse were observed, the low value of these habitats became apparent even though they met criteria for suitability. Out of 16,000 acres surveyed, including Trail Canyon, Kennedy Flats and Sage Hen Flats, 2,815 acres or 17% were typed as sagebrush associations dominated by mountain big sagebrush and low sagebrush. The remaining 13,275 acres (83%) of the area were dominated by pinyon pine, followed by mountain mahogany, limber pine and high alpine barren. Most of the sagebrush stands rate as R0, key habitats since they have excellent understories of forbs and grasses and few non-native plants. Sagebrush canopy cover tends to be high but within useable guidelines.

The best continuous sagebrush habitats in the PMU are found in the southern and south central White Mountains in Mono County in the upper Crooked Creek watershed, and Chiatovich Flats where grouse are routinely seen. The sagebrush stands here are generally much larger in size and more continuous.

Salt Desert Shrub (Precipitation zones 3-5", 5-8")- Salt desert shrub occurs mainly in valleys and low hills throughout the area. These ecological sites are dominated by shadscale (*Atriplex confertifolia*), Bailey greasewood (*Sarcobatus vermiculatus baileyii*) and spiny menodora (*Menodora spinescens*). Associated species are wolfberry (*Lycium* spp.), cheeseweed (*Hymenoclea salsola*), Nevada ephedra (*Ephedra nevedensis*), bud sagebrush (*Artemisia spinescens*), winterfat (*Eurotia lanata*), Nevada dalea (*Psrothamus polydenius*), fourwing saltbush (*Atriplex canescens*), Indian ricegrass (*Achnatherum hymenoides*) and Joshua tree (*Yucca brevifolia*). Grass makes up 5 to 10% of the total production on most salt desert shrub ecological sites.

Sagebrush (Precipitation zone 8-12") - Sagebrush is found on hills and mountains in the Silver Peak Range, the Palmetto Mountains and the White Mountain range. These ecological sites are dominated either by black sagebrush (*Artemisia nova*), Wyoming big sagebrush (*Artemisia tridentata wyomingensis*), or mountain big sagebrush (*Artemisia tridentata vaseyana).* Associated species are green ephedra (*Ephedra viridis*), rabbitbrush (*Chrysothamnus* spp.), antelope bitterbrush (*Purshia tridentata),* cliffrose (*Cowania mexicana*), Indian ricegrass and bottlebrush squirreltail (*Sitanion hystrix*).
The higher elevation stream bottoms, slopes, and flats in the White Mountains such as Sage Hen Flat, Kennedy Flat, Pellisier Flat, Tres Plumas, and Chiatovich Flat are mosaics of mountain big sagebrush, big sagebrush *(A. tridentata tridentata),* and low sagebrush *(Artemesia arbuscula)* in association with rabbitbrush *(Chrysothamnus vicidiflorus)*, ephedra, antelope bitterbrush (*Purshia tridentata),* and snowberry *(Symphoricarpos longiflorus),* depending on soil type, and aspect. Common forbs and grasses include lupine *(Lupinus sp.)*

buckwheat, *(Eriogonum sp.),* Junegrass *(Koeleria macrantha)*, mountain brome *(Bromus carinatus),* western needlegrass *(Acnatherum occidentale,* and bottlebrush squirreltail (*Sitanion hystrix*).

Pinyon and Juniper Woodlands (Precipitation zone 10-16")- Pinyon and juniper woodlands are dominated by pinyon pine (*Pinus monophylla*) and Utah juniper (*Juniperus osteosperma*) with an understory of black sagebrush or Wyoming big sagebrush. In the White Mountains this zone occurs between 6,500 and 9,500 feet elevation.

Subalpine and Alpine Zone (Precipitation zone more than 20" at the highest elevations) - The White Mountains' subalpine zone (9,500 to 11,500 feet) is characterized by a mosaic of low, open bristlecone and limber pine forests interspersed with mountain big sagebrush, and low sagebrush types. Artemesia communities typically dominate on sandstone and granitic soil types in this zone. The alpine zone (11,500 feet to 14,246 feet) is characterized by low growing prostrate grasses, forbs, and shrubs with low sagebrush types occurring up to 12,000 feet. Low sagebrush types are widely distributed on dry, sandy soils.

Washes (Precipitation zone 3-12") - Washes are scattered throughout all other vegetation types in the area and are dominated by cheeseweed, fourwing saltbush, rubber rabbitbrush (*Chrysothamnus nauseosus*) and sagebrush (sagebrush grows in higher elevations only).

Blackbrush (Precipitation zones 5-8", 8-10") - Blackbrush (*Coleogyne ramosissima*) occurs in the higher elevations just above the hot desert vegetation and below the sagebrush in some southern portions of the area. In the lower and dryer portion of its range it is associated with shadscale, spiny menodora, creosote bush, white bursage and other shrubs in the Salt Desert and Hot Desert vegetation types. In the higher and cooler portions of its range, it is associated with Wyoming big sagebrush. Grass makes up less than 10% of the total production on most blackbrush ecological sites.

Saline Meadows and Alkaline Soils (Precipitation zone 3-8") - This vegetation type occurs on valley floors with a high water table, often at the soil surface. Black greasewood (*Sarcobatus vermiculatus*), alkali sacaton (*Sporobolus airoides*) and inland saltgrass (*Distichlis spicata stricta*) dominate the valley bottoms in alkaline and saline soils.

Hot Desert Vegetation (Precipitation zone 3-5", 5-8") - Hot desert vegetation is found on the lower elevations in the southern portion of the area. These areas are dominated by creosote bush (*Larrea tridentate*), white bursage (*Ambrosia dumosa*), shadscale, and spiny menodora. Associated species are wolfberry, Nevada ephedra, cheeseweed, spiny hopsage (*Grayia spinosa*), fourwing saltbush, cattle saltbush (*Atriplex polycarpa*), Fremont dalea (*Psorothamnus fremontii*), range ratney (*Krameria parvifolia*) and Joshua tree.

6.2 Sage-grouse Habitat Description And Condition Assessment

6.2.1 Breeding Habitat

Although the specific locations of leks have not been well documented in the White Mountains, observations of both male (not strutting) and female sage-grouse in the lower Trail Canyon area of the White Mountains during recent aerial lek searches suggest the possible existence of a lek in this area (See Current Distribution). NDOW's data base shows 5 known leks in the White Mountains PMU, currently classified as active.

Nesting and early brood habitat - Aerial lek searches and a recent telemetry project conducted in Esmeralda County by the Nevada Division of Wildlife have resulted in the identification of nesting and early brood habitat located along the east bench of the White Mountains. A series of low hills surrounding the lower end of Trail Canyon in the northern portion of the White Mountain area appears to be used for nesting and early brood rearing habitat in years when precipitation patterns result in favorable conditions (See Current Distribution). During the spring of 2001, two hens nested in the area just south of Trail Canyon. The area is typical of the Blackbrush habitat type described in the vegetative community descriptions, section 2.4.

Sage-grouse broods have also been observed in the Middle Canyon Chiatovich Creek, and Mustang Mountain areas of northern White Mountains. These areas are typical of the sagebrush vegetative community type as described in the Vegetative Community Section 2.4.

The Crooked Creek population in Mono County utilizes high elevation sagebrush slopes and terraces from 9,000 feet to over 11,000 feet throughout the breeding, nesting and brood-rearing periods. They may use this habitat year-round depending on the winter snowfall and severity. The habitat is a mosaic of mountain big sage and low sage plant associations. No information exists on exactly how high sage-grouse are found in the Whites, except that low sage plant associations occur into the alpine zone up to 12,000 feet. This habitat configuration continues north along the high flats and slopes of the range where sage-grouse are known, such as Chiatovich Flat, Kennedy Flat, and Sage Hen Flats. Below these high slopes and terraces the Whites have steep sloped drainages where sagebrush types become more fragmented, discontinuous, and more intermixed with mountain mahogany, limber pine and pinyon pine habitats. As a result these habitats may be marginal for sage-grouse. Below this zone is another foothill zone of suitable habitat between 5,500 and 7,000 feet.

Two nests were found in the Crooked Creek watershed, Mono County on the east slope of Bucks Peak in 2002. Both nests were at 10,320 feet approximately 0.2 mile apart. The nests were located in mountain big sagebrush stands near an ecotone with a low sagebrush terrace where the two species intermixed. Sagebrush canopy cover was approximately 25% (measured with line intercept) with 15 inch average height. Herbaceous cover dominated by Junegrass (*Koeleria macrantha*) was poor at less than 10% with low height and vigor from drought conditions.

6.2.2 Summer / Late Brood Habitat

Deep Springs College and the Inyo National Forest have documented observations over the years for the Crooked Creek population in Inyo and Mono Counties. Their observations show sage-grouse continue to utilize the same habitats throughout the summer as their nesting habitat. Crooked Creek itself and the associated riparian streamside and spring habitats probably are the areas the hens with broods prefer, while other birds are scattered throughout the high elevation sagebrush types possibly up into the low sagebrush stands up to 12,000 feet.

6.2.3 Winter Habitat

The recent observation of sage-grouse sign in the Volcanic Hills of Esmeralda County indicates the area may receive winter use in some years. The sage-grouse of the White Mountains and Truman Meadows areas of Esmeralda, Mono, and Inyo Counties may utilize high elevation sagebrush stands between 9,000 and 11,000 feet, as well as low elevation foothill and valley sagebrush habitats between 5,500 and 7,000 feet for winter range.

The Inyo National Forest, while surveying the upper slopes of Silver Canyon in Mono County on March 3, 2003, flushed 17 male sage-grouse from a mountain big sagebrush stand at 9,880 feet on the western slopes of the Whites. A second survey pushed up a female 1/2 mile north at 9,800 feet on March 22, 2003. In February 2003 two Inyo National Forest personnel surveyed Queen Valley in Esmeralda and Mono Counties for sage-grouse, or their sign. They saw no birds, scat or other sage-grouse sign in the sagebrush stands during the five-day survey._ Their search included the valley bottom sagebrush habitats as well as the foothill slopes. The valley lies between 5,400 and 6,800 feet with a crude estimate of over 20,000 acres of available sagebrush, and sagebrush associated shrub habitats. It remains largely snow-free throughout the winter except in the more severe winters, and even then sagebrush stands remain highly available. Additional surveys are planned for next winter.

Similar stands of available sagebrush habitats are found along the lower slopes the eastern side of the White Mountains from Deep Springs Valley north to Montgomery Pass between 5,500 and 7,000 feet. The Inyo National Forest is currently surveying for the presence of sage-grouse or sign of previous use.

6.2.4 Habitat Condition

The Nevada Sage-grouse Conservation Strategy defined five different habitat condition categories which are Given in Appendix B. In the White Mountain PMU, Esmeralda County, Nevada has approximately 4,700 acres characterized as R-3, approximately 56,000 acres as R-2, and approximately 13,000 acres as R-0. Mineral County, Mono and Inyo Counties___________

6.3 Sage-grouse Populations

6.3.1 Historical Distribution

Esmeralda County—Very little historic sage-grouse data exist for Esmeralda County. Information that does exist consists of harvest data, limited brood survey data, and various verbal reports received over the years from locals and sportsmen. This information indicates that sage-grouse densities have always been relatively low in Esmeralda County, and that the majority of sage-grouse occur along the east side of the White Mountains in the western portion of the county. The fact that sage-grouse were not abundant in Esmeralda County made the area a low priority for survey efforts in the past, which in turn has resulted in a lack of general knowledge about this population.

Anecdotal evidence, in the form of verbal sighting reports from sportsmen, locals, and others, suggests that sage-grouse historically occurred in low densities in the Magruder Mountain/Upper Tule Canyon area of southern Esmeralda County, Nevada. The latest, unverified report of a sage-grouse sighting in this area occurred in 1998. Anecdotal evidence also suggests that sage-grouse historically occurred in the Silver Peak Range although no sightings have been reported in many years.

Information gathered from 10 percent hunter harvest questionnaire data between 1960 and 1998 shows that the average annual sage-grouse harvest in Esmeralda County was 5.5 birds by an average of 5 hunters during 36 open seasons. Sage-grouse hunting in Esmeralda County was discontinued beginning in 1999.

A limited amount of brood survey data were gathered in 1972, 1975,1976, 1988, 1989, 1991, 1992, and 2001 for Esmeralda County (See Table 6-2). Brood survey efforts appear to have been limited exclusively to the eastern bench of the White Mountains. An average of 15.8 sage-grouse were observed during these surveys. The total number of birds observed during individual surveys likely reflects differences in survey effort and not relative abundance of sage-grouse in the area. The average brood size observed during these survey efforts was 3.3. Average brood size ranges from a high of 5 in 1976 to a low of 2 in 1989. The number of chicks per hen observed during brood survey efforts ranges from a high of 5 chicks per hen in 1976 to a low of 0.6 chicks per hen in 2001. The combined average for all surveys equals 2.7 chicks per hen. The small sample sizes obtained during surveys in Esmeralda County increases the likelihood of data being biased.

Table 6-2. Esmeralda County sage-grouse brood survey counts 1972-2001.

BIRDS OBSERVED	1972	1975	1976	1988	1989	1991	1992	2001
Cocks	11	0	0	0	3	0	0	0
Hens	4	1	1	5	13	2	5	8
Young	7	3	5	16	16	9	10	5
Total (includes unclassified)	22	4	6	23	36	11	15	13
Young/Hen	1.8	3.0	5.0	3.2	1.2	4.5	2.0	0.6
Average Brood Size	3.5	3.0	5.0	3.2	2.0	4.5	2.5	2.5

Mineral County—Anecdotal evidence, in the form of verbal sighting reports from sportsmen, locals, and others, suggests that sage-grouse historically occurred in the Truman Meadows and McBride Flats areas of southern Mineral County, Nevada. Historical observations also suggest the occurrence of low densities of sage-grouse in the Miller Mountain and Candelaria hills areas of Mineral County, Nevada.

Mono and Inyo Counties—In 1966 the Inyo National Forest evaluated the status of sage-grouse in the White Mountains in the "Sage-grouse Habitat Management Plan." The Plan noted four grouse population artificial subdivisions in the Whites with subjective statements of abundance as follows: Sage Hen Flat in Esmeralda County (light population density), Pellisier and Chiatovich Flats in Mono and Esmeralda Counties (medium density), Perry Aiken Flat in Mono County (light density), and Tres Plumas and Crooked Creek (medium density). Historical reports from 1865 to 1900 stated that grouse were extremely abundant throughout eastern California and the distribution at that time extended south from Inyo County to Independence, probably along the Sierra Nevada foothills. The plan provided no other information about grouse in the White Mountains.

6.3.2 Current Distribution

Esmeralda County—Currently, sage-grouse are known to occur primarily in and along the White Mountains in western Esmeralda County. Recent discovery of sage-grouse droppings in the Volcanic Hills indicates this area receives seasonal use in some years.

In April of 2001 and 2002, NDOW conducted aerial surveys for sage-grouse. They observed in the 2001 survey five (5) sage-grouse classified as follows: one (1) male (not strutting), one (1) female, and three (3) unclassified. Although all observations were of single birds, all were made in the same general area surrounding the lower end of Trail Canyon. Therefore, the grouse may strut in the area, particularly when heavy snow accumulations or severe weather make higher elevation areas of the White Mountains unsuitable for breeding activity.

During the 2002 survey NDOW observed a single hen in the Chiatovich Flats area. The area surrounding Trail Canyon was flown based on the results of the 2001 survey, but no other sage-grouse were observed. During 2002, lack of snow accumulations at higher elevation areas in the White Mountains may have influenced where sage-grouse carried out breeding activity.

Recent sightings of sage-grouse in Esmeralda County have all occurred in, and along the east bench of, the White Mountains (See Map 3). Due to a lack of sufficient data, it is presently impossible to make a reasonable estimate of the sage-grouse population in Esmeralda County.

During a sage-grouse trapping effort conducted in the spring of 2001, a female sage-grouse was captured in the Trail Canyon area of Esmeralda County. Feathers were removed from the hen and sent to the University of Denver for genetic testing. Further information on genetic study is given in section 2.3.

In the spring of 2001, NDOW trapped sage-grouse in the Chiatovich Creek area in Esmeralda County to put radio collars on sage-grouse. They caught only one (1) adult hen just south of Trail Canyon along the east bench of the White Mountains on May 22nd. The hen was on a nest incubating a clutch of eight (8) eggs. On May 29th the hen was still on the nest. On June 8th she was in the company of five (5) other adult hens approximately 0.5 miles southeast of the nest site. Further investigation showed a coyote had destroyed her nest and eaten the eggs. Several unsuccessful attempts were made to locate the hen throughout the remainder of June. In July an aerial telemetry follow-up successfully located the hen in the Chiatovich Flats area of the White Mountains at approximately 10,000 feet in elevation. The hen had traveled into California approximately eleven (11) airline miles southeast of the last known location. The hen remained in the Chiatovich Flats area through August. Many unsuccessful attempts were made to locate the hen until May 2002, at which time the search was abandoned.

Mineral County—Presently, no data exist on which to base current sage-grouse distribution in southern Mineral County, Nevada. Although suitable habitat exists, no recent sage-grouse sightings have been reported in the area. No genetic studies have been carried out in Mineral County.

Mono and Inyo County—Limited survey data are available for grouse in Mono County largely from a CDFG helicopter flight, Deep Springs College wrangler observations, Crooked Creek Research Station observations, and USFS personnel observations. During a survey flight in the early 1990s, CDFG identified three historic leks in the Crooked Creek watershed near Bucks Peak and Red Peak. A survey in 2002 by USFS personnel attempted to locate the leks post strutting. USFS found abundant sage-grouse scat at the Bucks Peak site and Sage Hen site, which suggests leks are still present. In addition two nests and a number of night roost locations were identified in that same area. Observations over the last decade indicate grouse are easily flushed in the Crooked Creek watershed and in the Chiatovich Flat area.

The consensus of agency biologists working in the White Mountains is that a "good" population of birds exists in these areas. A recent observation of over 20 grouse occurred on December 15, 2002 on the south side of Black Mountain in Inyo County at 7,200 feet 1.75 miles west northwest of Tollhouse Springs. Some birds may be flying substantial distances from their summer range to access suitable winter habitat.

Movement-Migration Within And Between PMU's—Insufficient data exist on which to base migration patterns and times within the White Mountain PMU. Anecdotal evidence gathered from sportsmen and locals suggests that sage-grouse occurring along the eastern White Mountains spend the summer in high elevation meadows within that mountain range, primarily in the California portion. Recent data gathered from a radio-collared hen support this theory (see Current Distribution).

6.3.3 Breeding Season

Peterson (1980) suggests that eggs are laid three to 14 days after copulation, and are incubated by the female for 25 to 28 days. Based upon these time frames and limited field data, we believe the sage-grouse breeding/nesting season within the White Mountain PMU occurs from mid/late March to late May. The data include an observation of a nesting hen incubating a clutch of eggs as late as May 29, 2001, and the observation of a hen with a brood as early as May 27,1999, both in the Chiatovich Creek/Trail Canyon area of Esmeralda County, Nevada.

Two nests were found in the Crooked Creek watershed, Mono County on the east slope of Bucks Peak in 2002. Both nests were at 10,320 feet approximately 0.2 mile apart. A hen was incubating on one nest on May 23rd and in a follow-up visit on June 6th both nests had only eggshells.

6.3.4 Food Habits

Presently, no evidence exists to suggest that food habits of sage-grouse occurring within White Mountain PMU differ from typical sage-grouse food habits. In 1950-51 the CDFG conducted a study of Mono County sage-grouse food habits. It examined the stomach contents of 135 sage-grouse killed during the hunting season in September. Leafage, fruits, and flowers and seeds from 31 different plants were identified. Sagebrush was in 91% of the samples and made up 64% of the volume. Clover, rush, snowberry, dandelions, cottonthorn, rabbitbrush and grass accounted for 31% of the volume.

6.4 White Mountains PMU Risk Assessment and Conservation Actions

Threats to sage-grouse populations and habitats are presented below. Threats have been rated as Low (1), Moderate (2), or High (3). Each threat has a conservation strategy to mitigate the threats.

Population Risks

6.4.1 Predation (1)

Although both avian and terrestrial predators exist in the planning area, their impacts on sage-grouse populations within the White Mountain PMU are unknown. Nesting habitat quality may directly influence nest predation rates, and the effects of predation on population dynamics cannot be understood until habitat quality is at "optimum" (__________[Cite]). Sage-grouse nests have been located in Esmeralda County in habitat types that will never meet "optimum" nesting habitat requirements due to natural limitations. In these areas, the only effective method to reduce predation rates may be direct control of predators. Further studies would be necessary before any predator control efforts were undertaken.

6.4.2 Disease/Pesticides (2)

Disease—While we know very little about disease in sage-grouse, any epidemic that might occur can substantially reduce or extirpate local populations.

Pesticides and Herbicides—Pesticides and herbicides are not generally used in this area as the human population and agriculture are limited. But accidental exposure to pesticides and herbicides can kill grouse, especially if they are sprayed directly with toxic agents.

6.4.3 Hunting/Poaching (1)

Poaching of sage-grouse is considered a low risk to populations within the White Mountain PMU, though it probably occurs.

6.4.4 Cycles/Populations (3)

Natural Cycles - Due to the naturally low population of sage-grouse occurring within the Esmeralda County portion of the White Mountain PMU, it is possible that a natural emigration of sage-grouse could reduce that population.

Lack of Knowledge - Due to the historically low numbers of sage-grouse occurring in Esmeralda County, this area has been a low priority for data gathering efforts in the past. Very little is known about the sage-grouse population ecology of this population.

Conservation Action: Identify Occupied Seasonal Sage-grouse Ranges Through Radio Telemetry And Other Field Investigations

Risk: Insufficient information concerning location, extent, and condition of occupied seasonal sage-grouse ranges makes proper management of sage-grouse and sage-grouse habitat difficult.

Objective: Identify and evaluate occupied seasonal sage-grouse ranges within the White Mountain PMU through use of telemetry and field investigations.

Actions:

1. Attempt to place radio collars on a minimum of 10 adult sage-grouse within PMU by 2005.
2. Inform cooperating agencies of collar frequencies and locations to aid in collection of additional data.
3. Develop and use a standard form for recording of telemetry data.
4. Conduct telemetry follow-up a minimum of biweekly.
5. Investigate mortality signals as soon as possible to properly identify causes of mortality.
6. Describe habitat type for all telemetry locations.
7. Evaluate habitat condition in all identified locations.
8. While conducting any field activities observed sage-grouse sign will be recorded and reported to the appropriate state wildlife agency.
9. Map occupied sage-grouse ranges.

10. Create working partnerships with non-governmental organizations, such as Deep Springs College, to assist with data collection. Land management agencies can provide guidance on data needs and formats.

Rationale: Accurately defining all currently occupied seasonal sage-grouse ranges will aid in making proper land and sage-grouse management decisions. Information gathered will also make it possible to more accurately assess population status.

Legal Authority: Population management is under the authority of state wildlife agencies. NDOW will be the project lead in the Nevada portion of the PMU. CDFG will be the project lead in the California portion of the PMU.

Procedural Requirements: At the earliest possible convenience NDOW will contact the land management agency on which trapping and collaring will occur. At that time the necessary level of compliance will be determined regarding federal laws.

Level of Partnership Commitment: The Nevada Department of Wildlife has committed to attempting to place radio collars on a minimum of five (5) adult sage-grouse to aid in identification of occupied sage-grouse ranges in the Esmeralda portion of the White Mountain PMU during 2005. The collars for the project were ordered in December 2003.

Funding Sources: NDOW would fund the Nevada portion of the project. It is recommended that CDFG provide funding for collaring a minimum of 5 sage-grouse on the California portion of the project area.

Implementation Process:

1. Project Planning: NDOW, CDFG
    a. Enter into budget planning.
    b. Cooperatively develop data form.
    c. Cooperatively identify priority areas for capturing and collaring sage-grouse.
2. Project Implementation: NDOW, CDFG
    a. Budget for project.
    b. Acquire telemetry collars.
    c. Conduct trapping effort utilizing most current techniques.
    d. Conduct telemetry follow-ups a minimum of biweekly.
    e. Utilize telemetry data for identifying additional project needs.
3. Project Monitoring: NDOW, CDFG.
    a. CDFG compile and evaluate all telemetry data gathered in California.
    b. NDOW compile and evaluate all telemetry data gathered in Nevada.
    c. Provide annual reports to all cooperating agencies.
    d. Report accomplishment to USFWS, Reno Office.

Conservation Action: Increase Aerial And Ground Lek Surveys

Risk: Lack of knowledge concerning all facets of the White Mountain sage-grouse population increases the likelihood of critical breeding habitat being lost through various means. Lack of knowledge concerning lek sites and sizes of this population also makes determination of population status and trend impossible.

Objective: Locate and monitor active sage-grouse leks within White Mountain PMU.

Actions:
1. Continue aerial searches of Esmeralda and Mineral Counties within the White Mountain PMU by the Nevada Department of Wildlife until it is determined that all active primary leks have been located or that active leks do not exist.
2. Initiate aerial lek searches in Inyo and Mono County portions of White Mountain PMU by California Department of Fish and Game.
3. In addition to aerial searches, NDOW, CDFG, USFS (Inyo) and BLM (Tonopah) will conduct ground searches/surveys. Due to budgetary constraints, it may also be necessary to conduct ground searches/surveys in lieu of aerial surveys in some years.
4. Draw up a BLM as-needed Office of Aviation Services contract for wildlife surveys to assist with limited flight budgets and time constraints.
5. Investigate the use of forward looking infrared (FLIR) technology as a method for locating lek sites, nest sites, and winter habitat.
6. Create working partnerships with non-governmental organizations, such as Deep Springs College, to assist with data collection. Land management agencies can provide guidance on data needs and formats.

Rationale: It is critical that active leks be located and monitored in order to accurately assess population status and to protect these critical breeding habitat areas.

Legal Authority: Wildlife population management is under the authority of state wildlife agencies. Public land management is under the authority of federal land management agencies.

Procedural Requirements: BLM. NDOW and CDFG must budget for and schedule flights using their respective policies and procedures.

Level of Partnership Commitment: NDOW has conducted aerial lek surveys for the past three years in the Esmeralda County portion of the White Mountain PMU and is committed to continuing survey efforts within the constraints of budgetary and time limitations. If necessary, NDOW will conduct ground surveys annually.

Funding Sources: NDOW sage-grouse survey activities are funded by W64 grant money. Other agencies' funding would come from their annual wildlife budgets, or from special grants as they deem necessary.

Implementation Process:
1. Project Planning: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. Compile all existing lek location data for PMU area.
    b. Cooperatively identify priority areas for flights and/or ground searches.
    c. Enter into budget planning.
    d. Schedule surveys
2. Project Implementation: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. Budget for surveys
    b. Conduct surveys
    c. Project Monitoring: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    d. NDOW compile and evaluate lek survey data for Nevada portion of PMU.
3. CDFG compile and evaluate lek survey data for California portion of PMU.
    a. Provide written survey narratives to all cooperating agencies.

b. Report accomplishment to USFWS, Reno Office.

Habitat Risks

6.4.5 Marginal/Limited Habitat

Productive sage-grouse habitat is very limited in Esmeralda County. Large portions of the county consist of salt desert and Mojave Desert habitat, which does not support sage-grouse (see section 6.1.4). Much of the sage-grouse habitat in Esmeralda County that does exist occurs along a transition zone where sagebrush habitat and salt desert and/or Mojave Desert habitat intermix. This transition zone is not capable of supporting high densities of sage-grouse.

Conservation Action: Identify Potential Sage-grouse Habitat

Risk: Because of the limited amount of suitable habitat in the White Mountain PMU, any loss of sagebrush habitat may critical to the future of local sage-grouse populations.

Objective 1: Identify all sagebrush habitats that could be occupied by, or is currently suitable for, sage-grouse within the White Mountain PMU.

Actions:
1. Compile, refine, and integrate existing GIS data from BLM and US Forest Service for the PMU.
2. Investigate the use of aerial photo surveys to delineate sagebrush habitats, identify sagebrush islands, look for pinyon-juniper encroachment, and observe any other human caused disturbances that may not be seen from the ground.
3. Conduct ground truthing efforts to verify results of aerial photos and confirm GIS maps.
4. Update GIS layers based on existing aerial photos.
5. Delineate potential sage-grouse habitat while conducting routine fieldwork.

Objective 2: Assess the potential of identified areas to be successfully rehabilitated to suitable sage-grouse habitat.

Actions:
1. Upon identification, rate all potential habitats as R0-R4.
2. Prioritize sites for projects based on project feasibility.
3. Determine project specifics, make project proposal to the appropriate land management agency.

Rationale: A general lack of sagebrush habitat information exists for this portion of the Bi-State planning area. To know the location, condition, and extent of potential habitat is imperative for proper management.

Legal Authority: Federal land management agencies have legal authority over activities and projects occurring on federally managed public lands.

Procedural Requirements: All proposed activities and projects that would occur on public land will be evaluated by the appropriate land management agency through NEPA and other appropriate processes.

Level of Partnership Commitment:

Funding Sources: These activities need to be considered in the budget planning processes of the involved agencies to contract these services out or keep them as part of their internal workload.

Implementation Process:

1. Agencies would plan for the project in their budget planning process.
2. Interested agencies would decide who will be the lead agency for the project.
3. Designate a project coordinator who will be the central contact for the project.
4. Compile and review all existing data.
5. Where data are still needed, investigate means to collect the data, whether it is on the ground or uses technology such as aerial photography.
6. If needed, hire a contractor to take aerial photos.
7. Disseminate data to all interested parties and decide what on the ground projects are needed.

Conservation Action: Implement Habitat Improvement Projects Throughout Occupied Seasonal Sage-grouse Ranges

Risk: Suitable sagebrush habitat is limited within much of the White Mountain PMU. In many areas sagebrush habitat is being lost to Pinyon/Juniper encroachment and degraded in terms of loss of productivity. Loss of good sagebrush habitat threatens the continued existence of sage-grouse in some portions of the PMU.

Objective: Increase quality and availability of suitable sagebrush habitat.

Actions:

1. Design treatments based on individual site potentials using the most current information possible.
2. When necessary, utilize test plot methodology to identify the most effective treatment methods for an area.

Rationale: The limited amount of suitable sage-grouse habitat in some portions of the White Mountain PMU makes it critical that existing areas are not lost and are returned to good quality where necessary. Upon collection of data, these projects can be considered more thoroughly.

Legal Authority: Federal land management agencies have legal authority over activities and projects occurring on federally managed public lands.

Procedural Requirements: All proposed activities and projects that would occur on public land will be evaluated by the appropriate land management agency.

Level of Partnership Commitment: Land and wildlife management agencies who hold any interest in conserving sage-grouse should be committed to providing staff and funding for appropriate projects. Any nongovernmental or private parties who hold interest in conserving sage-grouse would be identified either through direct contact or in public scoping opportunities.

Funding Sources: The projects that could occur based on the results of data collection would be funded through agency budgets, cooperative programs, challenge cost share grants, or other grants.

Implementation Process:
1. Project Planning: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. Compile all existing habitat data for PMU area.
    b. Cooperatively identify priority areas for treatments.
    c. Enter into budget planning.
    d. Schedule treatments.
2. Project Implementation: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. Budget for treatments.
    b. Conduct treatments.
3. Project Monitoring: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. NDOW would compile and evaluate treated area data for Nevada portion of PMU.
    b. CDFG would compile and evaluate treated area data for California portion of PMU.
    c. Provide written survey narratives to all cooperating agencies.
    d. Report accomplishment to USFWS, Reno Office.

6.4.6 Water Distribution

Portions of otherwise suitable habitat in Esmeralda County and Truman Meadows lack optimal water distribution, particularly in drier than normal years. As an example, in the Truman Meadows area of Mineral County, Sagehen Spring was dry during much of 2002.

Conservation Action: Spring Development

Risk: Drought occurs frequently in the rain shadow of the White Mountains and could negatively impact sage-grouse populations.

Objective: Evaluate all existing spring developments occurring in potential or occupied sage-grouse habitat within the White Mountain PMU. Repair or modify as necessary, in order to maintain water and riparian vegetation at the source.

Actions:
1. In cooperation with the water rights owners, identify water rights issues and seek authorization to repair and modify existing development.
2. Make repairs and modifications to water developments as necessary.

Rationale: The limited amount of rainfall in the eastern part of the White Mountain PMU, and the decreased amount of natural water sources available, could impact sage-grouse breeding success, use of otherwise good habitat, and interfere with normal travel corridors. Increasing the amount of available water would allow greater distribution of the birds.

Legal Authority: Federal land management agencies can apply for water rights for wildlife use under Nevada state law.

Procedural Requirements: All proposed activities and projects that would occur on public land will be evaluated by the appropriate land management agency.

Level of Partnership Commitment: Land and wildlife management agencies who hold any interest in conserving sage-grouse should be committed to providing staff and funding for appropriate projects. Any non government or private parties who hold interest in conserving sage-grouse would make themselves known to agencies either through direct contact or as an interested party in public scoping opportunities.

Funding Sources: The projects that could occur based on the results of data collection would be funded through agency budgets, cooperative programs, challenge cost share grants, or other grants.

Implementation Process:

1. Project Planning: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. Compile all existing habitat data for PMU area.
    b. Cooperatively identify priority areas for treatments.
    c. Enter into budget planning.
    d. Schedule treatments.
2. Project Implementation: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. Budget for treatments.
    b. Conduct treatments.
3. Project Monitoring: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. NDOW would compile and evaluate treated area data for Nevada portion of PMU.
    b. CDFG would compile and evaluate treated area data for California portion of PMU.
    c. Provide written survey narratives to all cooperating agencies.
    d. Report accomplishment to USFWS, Reno Office.

6.4.7 Lack of Diverse Age Structure in Sagebrush

The 2,815 acres of suitable habitat identified on the Inyo National Forest in Trail Canyon and in Kennedy and Sage Hen Flats are almost exclusively mature stands of predominantly mountain big sagebrush and low sagebrush. Stand canopy cover is in excess of 25% on the mountain big sagebrush sites associated with rabbitbrush and bitterbrush, and is greater than 35% on snowberry sites on moister slopes. Therefore, mature stands may have higher canopy cover values than are needed for productive sage-grouse habitat (Connelly et al., 2000).

Initial Conservation Strategy: Assess sagebrush habitat for possible treatment to reduce the cover and density of mature and decadent sagebrush.

6.4.8 Non-Native Weed Invasion

Non-native weeds such as cheatgrass *(Bromus tectorum),* Russian thistle (*Salsola ibericus)* and members of the mustard family are found in low density throughout the White Mountains in sage-grouse habitat. They are usually found in areas of disturbance such as roadsides, parking areas, and trails. They do, however, present a potential management problem. An area of cheatgrass was found in Trail Canyon at 9,200 feet where a recent burn had occurred. Even though cheatgrass does not appear to be a problem, any future burn could increase cheatgrass in an area where it currently appears at very low density.

Conservation Action: Noxious Weed Management

Risk: Noxious weeds can replace native plant communities and riparian areas upon which sage-grouse may depend.
Objective: Review management activities that may contribute to the spread of noxious species to determine if additional management measures are necessary to minimize weed infestations and spread rate.
Actions:
1. As scientific knowledge increases, continually review and update management measures to reduce threat of noxious weed invasion.
2. Conduct a weed assessment of the PMU.

6.4.9 Habitat Fragmentation (2)

Natural Fragmentation of Habitat - Numerous areas of sagebrush habitat exist throughout Esmeralda and Mineral Counties, Nevada, which are isolated by large expanses of salt desert shrub and Mojave desert habitat. The isolated nature of these sagebrush "islands" may reduce their usefulness to sage-grouse.

Pinyon Pine Expansion - In the central and northern White Mountains in Mono and Esmeralda Counties, sage-grouse habitats from 8,000 to 11,000 feet are highly fragmented and interspersed with large woodland areas of pinyon pine at the lower elevations, and limber pine, bristlecone pine, and mountain mahogany in the higher elevations. This mosaic limits the value of any sagebrush stand for sage-grouse because of the woodland edge effect.

Substantial areas of previously open sagebrush habitats may have been converted to pinyon pine and mountain mahogany. The full extent and rate of this expansion is unknown but it is hypothesized that it has adversely affected sage-grouse habitat in these areas. It is unknown, however, if sage-grouse historically utilized these habitats to any significant degree.

Of the 2,815 acres of suitable habitat identified by USFS in 2002, 1,015 acres (36%) had young pinyon pine or mountain mahogany expansion gradually diminishing their value for sage-grouse. Pinyon expansion is a common trend in the White Mountains.

Conservation Action: Pinyon-Juniper Evaluation

Risk: Pinyon-juniper communities are expanding into sagebrush habitats in both upper and lower elevations.

Objective: Compare historical and current pinyon-juniper distribution to determine the amount of encroachment that has occurred.

Action: Based on evaluation results, treat pinyon-juniper and mountain mahogany that have encroached into sagebrush to increase habitat continuity and suitability for sage-grouse use.

Rationale: Expansion of pinyon-juniper communities could impact the limited amount of sage-grouse habitat in the eastern part of the White Mountain PMU.

Legal Authority: Federal land management projects are subject to NEPA regulations.

Procedural Requirements: All proposed activities and projects that would occur on public land will be evaluated by the appropriate land management agency.

Level of Partnership Commitment: Land and wildlife management agencies that hold any interest in conserving sage-grouse should be committed to providing staff and funding for appropriate projects. Any nongovernmental or private parties who hold interest in conserving sage-grouse would be identified either through direct contact or in public scoping opportunities.

Funding Sources: The projects that could occur based on the results of data collection would be funded through agency budgets, cooperative programs, challenge cost share grants, or other grants.

Implementation Process:

1. Project Planning: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
   a. Compile all existing pinyon juniper site data.
   b. Cooperatively identify priority areas for treatments.
   c. Enter into budget planning.
   d. Schedule treatments.
2. Project Implementation: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
   a. Budget for treatments.
   b. Conduct treatments.
3. Project Monitoring: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
   a. NDOW would compile and evaluate treated area data for Nevada portion of PMU.
   b. CDFG would compile and evaluate treated area data for California portion of PMU.
   c. Provide written survey narratives to all cooperating agencies.
   d. Report accomplishment to USFWS, Reno Office.

Unnatural Fragmentation of Habitat - The construction of new fences, roads and transmission lines, for example, may fragment occupied or potential sage-grouse habitat within the limited range of the sage-grouse in the White Mountain PMU. A proposed open pit gold mine below Sage Hen Flat in the White Mountains, if ever constructed, will adversely affect the limited sagebrush habitat in that area.

Conservation Action: Protection Of Existing Seasonal Sage-grouse Ranges

Risk: Fragmentation, destruction, and development of sage-grouse habitat will increase likelihood of a downward population trend due to their dependence on large expanses of sagebrush/bunchgrass habitat types.

Objective: Protect occupied sage-grouse seasonal ranges from fragmentation, destruction, and development.

Action: When possible land management agencies will prohibit activities and projects that may fragment or otherwise negatively impact sage-grouse habitat, where the agencies have discretionary authority.

Rationale: Sage-grouse are often dependent on vast expanses of sagebrush/bunchgrass dominated rangeland. Identification of these ranges and their protection from fragmentation, destruction or development is critical to ensure the continued existence of sage-grouse.

Legal Authority: Federal land management agencies have legal authority over activities and projects occurring on federally managed public lands. Within the White Mountain PMU, USFS land is under the legal authority of ________. BLM land ___________[?]

Procedural Requirements: All proposed activities and projects that would occur on public land will be evaluated by the appropriate land management agency through the _____ process.

Level of Partnership Commitment:

Funding Sources:

Implementation Process:

1. The agencies would cooperate to conduct a thorough review of all sage-grouse Information on a case by case basis for proposed projects.
2. Do not allow management actions to adversely affect sage-grouse habitat.

6.4.10 Changing Land Uses (2)

Mining and Minerals Exploration - The Inyo National Forest has received requests to conduct mineral exploration drilling in occupied sage-grouse habitat. Construction of drill roads, pads, etc. will cause a direct loss of habitat.

Conservation Action: Mining And Minerals Exploration

Risk: Sagebrush habitat is severely limited in portions of the White Mountain PMU, and mining and mineral exploration cause direct loss of habitat.

Objective: Preclude or minimize habitat loss due to mining and mineral exploration.

Actions:

1. Delineate critical sage-grouse habitat for possible withdrawal from mineral entry.
2. Use telemetry studies and all other available data to identify critical sage-grouse habitat.
3. Withdraw lands that are determined to be critical sage-grouse habitat from mineral entry where necessary and possible
4. Mitigate authorized mining and mineral exploration impacts to sage-grouse habitats, including unoccupied sagebrush habitats.

Rationale: Mineral exploration activities would cause a direct loss of currently occupied and potential habitat.

Legal Authority: The sage-grouse is a Nevada BLM sensitive species and any potential impacts to the species imposed by a project need to be evaluated to preclude endangerment of the species.

Procedural Requirements: All proposed activities and projects that would occur on public land would be evaluated by the appropriate land management agency.

Level of Partnership Commitment: Land and wildlife management agencies that hold any interest in conserving sage-grouse should be committed to providing staff and funding for appropriate projects. Any non government or private parties who hold interest in conserving sage-grouse would be identified either through direct contact or in public scoping opportunities.

Funding Sources: The projects that could occur based on the results of data collection would be funded through agency budgets, cooperative programs, challenge cost share grants, or other grants.

Implementation Process:

1. Project Planning: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. Evaluate proposed mining related projects for adverse impacts to sage-grouse habitat.
2. Project Implementation: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. During project review determine mitigation measures for the proposed action.
    b. Implement the mitigation measures.
3. Project Monitoring: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. Adverse impacts to sage-grouse habitat will manifest in the form of localized sage-grouse population declines. Sage-grouse population monitoring will be the responsibility of NDOW and CDFG.

Alternative Energy Sources - An increased interest in geothermal and wind generated energy sources has occurred in this area. Projects of this type have the potential to disrupt large areas of sage-grouse habitat.

Agriculture/Ground Water Pumping - Excessive water-intensive agricultural development, for example, center pivot irrigation, affects the groundwater table and riparian areas of the hydrologic zone.

6.4.11 Livestock Grazing/Wild Horses, Burros (2)

Inappropriate grazing levels and/or seasons of use can negatively impact sage-grouse/sagebrush, and riparian habitats. Livestock grazing management was observed to be adversely impacting riparian habitats in Chiatovich, Middle and Trail Canyons in 2002. The recent successive years of drought coupled with trailing and forage utilization impacts may be adversely affecting sage-grouse habitats.

Substantial trailing was observed in Trail Canyon in 2002 on slopes and ridgelines, which may suggest the herbaceous component of the sagebrush stands was being impacted. Wild horses and/or burros may negatively impact sage-grouse/sagebrush and riparian habitats by excessive use if their populations are not managed appropriately.

Conservation Action: Livestock Grazing Management

Risk: Livestock that are grazing in sage-grouse habitat during breeding and nesting periods may negatively impact breeding and nesting success of the sage-grouse.

Objective: Manage sagebrush ecosystems for maximum site potentials in accordance with WAFWA guidelines or locally approved standards.

Actions:

1. Identify ecologic site potential for all key habitats and establish appropriate management standards.

2. Work with federal range lessees and willing private landowners to adjust seasons of use, if necessary.
3. Provide incentives for livestock managers to alter their seasons of use, if necessary, to accommodate sage-grouse breeding and nesting seasons.

Rationale: If cattle are impacting breeding and nesting success, then simple management adjustments may be made to accommodate the breeding and nesting seasons of the sage-grouse.

Legal Authority: Federal land management agencies follow grazing regulations delineated in CFR 43 Group 4100.

Procedural Requirements: All proposed activities and projects that would occur on public land will be evaluated by the appropriate land management agency.

Level of Partnership Commitment: Land and wildlife management agencies that hold any interest in conserving sage-grouse should be committed to providing staff and funding for appropriate projects. Any nongovernmental or private parties who hold interest in conserving sage-grouse would be identified either through direct contact or public scoping opportunities.

Funding Sources:

Implementation Process:

1. Project Planning: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
   a. Compile all existing habitat data for PMU area.
   b. USFS and BLM discuss with their lessees options both sides see as feasible.
2. Project Implementation: USFS (Inyo), BLM (Tonopah)
   a. Federal agencies can offer grazing agreements to lessees that accommodate sage-grouse needs to be completed as a decision.
3. Project Monitoring: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
   a. NDOW would compile and evaluate treated area data for Nevada portion of PMU.
   b. CDFG would compile and evaluate treated area data for California portion of PMU.
   c. Provide written survey narratives to all cooperating agencies.
   d. Report accomplishment to USFWS, Reno Office.

Conservation Action: Wild Horse Management

Risk: Improper management of wild horses may result in degradation of sage-grouse habitat.

Objectives:

1. Ensure appropriate management levels (AML) in existing herd management areas (HMAs) and wild horse territories (WHTs) where sage-grouse occur are such that wild horses do not negatively impact sage-grouse habitat.

2. Do not allow wild horse populations to exceed AML in existing HMAs and WHTs.

Actions:
1. Conduct a wild horse gather for those horses outside of existing HMAs and WHTs.
2. Conduct aerial censuses in HMAs where sage-grouse are known to occur to determine wild horse population levels.
3. Conduct wild horse gathers if populations are over AML.
4. If it is determined that sage-grouse habitat is being negatively impacted by wild horses within an HMA or WHT, appropriate action will be taken by the appropriate land management agency to adjust the AML.

Rationale: Keeping wild horse populations at or below AML within existing HMAs and WHTs will limit their impact on sage-grouse habitat. Subsequently adjusting AML as needed should address any residual impacts.

Legal Authority: This project would include interagency cooperation between the Bureau of Land Management and the US Forest Service.

Procedural Requirements: NEPA would have to be conducted for this project by the US Forest Service and/or BLM.

Funding Source: Funding for this project would be the responsibility of the BLM and US Forest Service.

Implementation Process:
1. Project Planning: BLM and USFS
    a. Request funds to conduct aerial census to determine population numbers, distribution, and range condition.
2. Project Implementation: BLM and USFS
    a. Conduct aerial census of project area or HMA.
    b. If numbers are close to AML or over AML, request to be placed on the gather schedule.
    c. Gather wild horses to appropriate levels.
3. Project Monitoring: BLM and USFS
    a. Monitor area for population growth, any resource damage, and sage-grouse presence.

6.4.12 Fire Ecology (1)
In general, Esmeralda County does not experience very many wildland fires, therefore, fires are considered a low risk for the sage-grouse population.

6.4.13 Human Disturbance (1)
Disturbance such as residential development is very low in the White Mountain PMU. The major type of disturbance in the area is recreational use, such as fishing, off-road vehicles, and camping.

Conservation Action: Minimize Human Disturbance (Recreation, Roads, Fences)

Risk: Many types of human disturbance such as recreation, road construction, and fences can potentially negatively impact sage-grouse populations or habitat.

Objective 1: Minimize recreation impacts to existing sage-grouse activities and habitat.

Actions:
1. Evaluate areas for seasonal closures to known sage-grouse use areas during strutting and nesting seasons between February and May.
2. Where land and wildlife management agencies have discretionary authority and determine it to be prudent and necessary, areas of critical sage-grouse habitat will be seasonally closed to recreational use.

Objective 2: Minimize impacts due to new road construction or creation.

Action: Where land management agencies have discretionary authority, no new two-track or bladed roads will be allowed in sage-grouse habitat.

Objective 3: Minimize impacts to sage-grouse from fences as perch sites for avian predators.

Actions:
1. Land management agencies will identify all fences occurring within known occupied or potential sage-grouse habitat.
2. By 2005, determine if any fences near known occupied or potential sage-grouse habitat contribute to sage-grouse mortality directly or by providing perch sites for avian predators.
3. When and where necessary, land management agencies will modify fences with Nixalite or other similar devices to make them less predator friendly and reduce mortality potential.
4. Any new fence construction will be made grouse friendly.

Rationale: Human caused disturbances may be interfering with breeding and nesting success of sage-grouse. New road development and OHV use may degrade existing or potential habitats. Fences may contribute to sage-grouse mortality directly or indirectly. These actions will minimize these risks within the authority of regulatory agencies.

Legal Authority: Federal land management agencies work under the authority of CFR.

Procedural Requirements: All proposed activities and projects that would occur on public land will be evaluated by the appropriate land management agency.

Level of Partnership Commitment: Land and wildlife management agencies who hold any interest in conserving sage-grouse should be committed to providing staff and funding for appropriate projects. Any nongovernmental or private parties who hold interest in conserving sage-grouse would be identified through direct contact or public scoping opportunities.

Funding Sources: The projects that could occur based on the results of data collection would be funded through agency budgets, cooperative programs, challenge cost share grants, or other grants.

Implementation Process:
1. Project Planning: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. Compile all existing habitat data for PMU area.
    b. Cooperatively identify priority areas.
    c. Enter into budget planning.
    d. Schedule plans and events.

2. Project Implementation: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. Budget for plans and events.
    b. Conduct treatments.
3. Project Monitoring: NDOW, CDFG, USFS (Inyo), BLM (Tonopah)
    a. NDOW would compile and evaluate treated area data for Nevada portion of PMU.
    b. CDFG would compile and evaluate treated area data for California portion of PMU.
    c. Provide written survey narratives to all cooperating agencies.
    d. Report accomplishment to USFWS, Reno Office.

6.4.14 Climate/Weather (2)

All limited populations are at risk to stochastic events, whether they are caused by the weather or disease or any other reason. Any weather event that might cause mortalities in sage-grouse is a risk to the population. The most probable weather events would be extreme hot or cold spells or a blizzard. Drought can also affect this population.

7.0 MOUNT GRANT PMU

7.1 PMU Description

7.1.1 Physical Location And Boundary

The Mount Grant PMU is approximately 699,079 acres in size and occurs entirely within Lyon and Mineral Counties, Nevada. The boundary encompasses the Wassuk Mountain Range and a portion of the Excelsior Mountains. The northeast boundary of the PMU is Walker Lake. The southeastern boundary passes the town of Hawthorne, Nevada and runs south toward Whiskey Flat, and on to Huntoon Valley. From the Nevada/California state line, the boundary follows the state line to the East Walker River, following the river to the Cambridge Hills, north to Highway Alt. 95, and on to Walker Lake. There are no towns within the boundary of the PMU.

7.1.2 Land Ownership And Regulatory Jurisdictions

Land ownership within the Mount Grant PMU is primarily under federal management, as shown in Table 7-1. Approximately 43 percent of the PMU is National Forest land managed by the Humboldt-Toiyabe National Forest, Bridgeport Ranger District. The BLM Carson Field Office manages an additional 40 percent of the PMU as public land. The remainder of the PMU is 7 percent military land under jurisdiction of the Department of Defense; 6 percent private land; and 4 percent Walker River Paiute Tribal Land.

Table 7-1. Land ownership in the Mount Grant PMU.

LAND MANAGER OR OWNER	ACRES	PERCENT OF PMU
National Forest	300,910	43
Bureau of Land Management	279,916	40
Private	41,945	6
Department of Defense Hawthorne Army Depot	48,936	7
Walker River Paiute Tribe	27,963	4
State and County Land	unknown	>1
Total Acres	699,079	100

Herd Management Areas and Territories - Three wild horse herds occupy the Mount Grant PMU: the Wassuk HMA, Powell Mountain Wild Horse and Burro Territory and Montgomery Pass Wild Horse Territory (Table 7.2). Only a small portion of the Montgomery Pass Territory is found in the Mt. Grant PMU.

Table 7-2. Powell Mountain Wild Horse and Burro Territories

HORSE TERRITORY	AUM	ACRES	APPROPRIATE MANAGEMENT LEVEL	RESPONSIBLE AGENCY
Powell Mountain Wild Horse and Burro	435	132,800	29	USFS – Humboldt-Toiyabe
Wassuk Wild Horse and Burro	72	24,954	109-165	BLM - Carson
Montgomery Pass		1,570	184	USFS – Inyo BLM- Bishop and Carson

There are ten livestock grazing allotments present on lands administered by the US Forest Service, Bridgeport Ranger Station and _____ allotments administered by the Bureau of Land Management, Carson District Office.

Table 7-3. Domestic livestock grazing allotments managed by the USFS Bridgeport Ranger District in the Mount Grant PMU

ALLOTMENT	SAGE-GROUSE SEASONAL HABITAT	CLASS OF LIVESTOCK	NUMBERS	SEASON OF LIVESTOCK USE
East Walker C&H*	TBC*	Cattle	452	12/1-3/31
Huntoon C&H*	TBC	Cattle	165	11/16-4/15
Larkin Lake C&H	TBC	Cattle	446	11/1-11/30
Masonic C&H*	TBC	Cattle	80	7/1-10/15
Nine Mile C&H*	TBC	Cattle	1076	4/1-5/31
Nine Mile C&H*	TBC	Cattle	102	10/1-11/30
Powell Mountain C&H	TBC	Cattle	151	6/1-10/15
Rough Creek C&H	TBC	Cattle	33	6/1-10/15
Whiskey Flat C&H	TBC	Cattle	203	11/1-4/15
Wildhorse C&H	TBC	Cattle	50	12/1-5/31

* To be completed.

7.1.3 Topography And Climate

Elevations within the PMU range from 1,250m (4,100 feet) to 3,609m (11,230 feet). Approximately one-third of the PMU is characterized as steep slopes, ranging between 10 and 35 percent. The remaining area consists of gentle slopes and flats. The predominant aspects are east, and west. The highest peak is Mount Grant at 3,426m (11,239 feet) in the Wassuk Mountains. Other dominant mountain peaks include Mount Moho in the Excelsior Mountains at 2,684 m (8,805 feet, and Aurora Peak at 2,667 m (8,750 feet).

7.1.4 Vegetation Communities and Distribution

The vegetation in the Mount Grant PMU varies from salt desert shrub at the lower elevations of the Wassuk Mountains to alpine vegetation on the highest peaks.

Salt Desert Shrub: The salt desert shrub communities include shadscale *(Atriplex confertifolia)*, Baily greasewood *(Sarcobatus baileyi)*, bud sagebrush *(Artemisia spinescens)*, winterfat (*Krascheninnivovia lanata*), Indian ricegrass *(Achnatherum hymenoides)*, bottlebrush squirreltail *(Elymus elymoides*), and lupine *(Lupinus spp.)*. Annual precipitation is 5-8".

Sagebrush: Sagebrush sites are found on slightly higher elevations with an increase in precipitation. Wyoming big sagebrush *(Artemisia tridentata wyomingensis)* occupies the deeper soils and Lahontan sagebrush (*A. arbuscula longicaulis*) is the dominant shrub species on the shallow soils. Wyoming big sagebrush is generally found on soils that are shallow, gravelly to stony, with low water holding capacity. Annual precipitation varies from 8-12 inches. Other associated species on these sites are Anderson peachbrush *(Prunus andersonii)*, Mormon tea *(Ephedra spp.*), antelope bitterbrush *(Purshia tridentata)*, Standberry cliffrose (*P. stansburiana*), Thurber needlegrass *(Achnatherum thurberianum*), desert needlegrass *(A. speciosa),* phlox *(Phlox spp.)*, biscuit root *(Lomatium spp.)* and lupine (Lupinus spp.).

Above 6,000 feet in elevation, Lahontan sagebrush transitions into low sagebrush site *(A. arbuscula)* on the shallow soils. Low sagebrush grows on dry, sterile, rocky, often alkaline soils that range from shallow to moderately deep. Hardpans at 10-15 inches depth are not uncommon and they create a condition of saturated soil for a considerable period in the spring. Annual precipitation varies from 7-18 inches.

Mountain big sagebrush *(A. tridentata vaseyana)* is the dominant shrub on deeper, mesic soils generally found at higher elevations from the foothills to timberline. Annual precipitation varies from 10-20 inches. Soils are generally deep, with good water holding capacity.

Basin big sagebrush (*A. tridentata ssp. tridentata*) is found on well drained, deep soils on plains, in valleys, canyon bottoms, and foothills in 9-16 inch precipitation zones, frequently associated with drainages. Associated species on these sites include antelope bitterbrush, snowberry *(Symphoricarpos sp.)* currant *(Ribes sp.)*, spike fescue (*Festuca kingii*), mountain brome *(Bromus marginatus)*, bluegrass *(Poa sp.)*, Idaho fescue *(F. idahoensis)*, and needlegrass species. A few of the forbs found include mule's ear *(Wyethia sp.)*, balsamroot *(Balsamorhiza sp.)*, phlox and lupine.

Silver sagebrush (*Artemisia cana) occurs i*n the more mesic soils with a seasonal high water table. Shrub species associated with these sites include snowberry *(Symphoricarpos sp.*), elderberry (*Sambucus spp*.), silver buffaloberry (*Shepheria spp*.), currant *(Ribes sp*), chokecherry (*Prunus virginiana*), woods rose (*Rosa spp*.) and willow *(Salix sp).* The herbaceous species can include sedges *(Carex sp.)*, bluegrass, lupine, clovers *(Trifolium sp),* wild iris *(Iris sp),* rushes *(Juncus sp), and* dandelion (*Taraxacum sp).*

On very rocky sites, sagebrush is replaced by mountain mahogany *(Cercocarpus ledifolius)* stands.

Woodlands - Woodlands found in the PMU include pinyon pine *(Pinus monophylla)* and Utah juniper *(Juniperus osteosperma)* at elevations up to 8,000 feet with annual precipitation of 10-16 inches. The pinyon/juniper exceeds its historical distribution and density in the area. This especially is the case at the lower and mid elevation where the woodlands encroach into the sagebrush communities. This expansion and an increase in the stand density has resulted in a reduction of the understory component. Erosion rate has been accelerated due to lack of understory. Fire frequency may also be less than reference conditions due to a reduction of the fine fuel that once carried the fires.

Sub alpine and Alpine Zone - Limber pine (*Pinus flexilis*) can be found on mountain summits and side-slopes at 9,000 to 10,000 feet elevation. The subalpine zone, from 10,000 feet to the top of Mount Grant, receives 16-20 inches annual precipitation and is characterized by wax currant (*R. cereum*), Douglas rabbitbrush (*Chrysothamus viscidiflorus*), prickly gillia (*Leptodactylon spp*.) and hairy goldenaster (*Heterotheca villosa var.villosa*). Common grasses include skyline and timberline bluegrasses (P. and *P. rupicola*), prairie junegrass (*Koleria macrantha*), alpine fescue (*F. brachyphylla*), mat muhly (*Muhlenbergia richardsonis*), rushes (*Juncus sp),* and Ross and dunhead sedges (*Carex rossii* and *C. phaeocephala*).

Riparian Zones - Streams, wet meadows, dry meadows, springs and seeps are interspersed throughout the PMU. Vegetation associated with these areas includes aspen (*Populus tremuloides*), willows *(Salix sp)* and cottonwoods *(Populus sp).* Similar habitats include irrigated pastures and hay fields.

7.2 Sage-grouse Habitat Description and Condition Assessment.

The Mount Grant PMU includes a good distribution of seasonal ranges for sage-grouse. Overall, sagebrush habitats within the Mount Grant PMU are considered to be in good condition relative to the WAFWA guidelines. The most critical limiting factor to sage-grouse populations is the availability of water.

Habitat in the Mt. Grant PMU Complex is a mixture of mountain big sagebrush, Wyoming sagebrush, low sagebrush and a mixture of bitterbrush, service berry and desert peach. with encroaching pinyon/juniper trees. Habitat has been assessed as RO, R1, R2, R3 and RO (agriculture).

Research is needed to further define the parameters of this population of grouse in order to develop corrective measures to help the population stabilize and increase to somewhere near levels prior to the recent decline.

7.2.1 Breeding Habitat

Sage-grouse leks in the Mt. Grant PMU are from 6,500 feet in the Nine Mile area to 8,800 feet in the Aurora and Mt. Grant areas; these are precluded from motor vehicle access.

Overall the sagebrush communities in this PMU are good. The Mt. Hicks area is an example of this. The lower areas of China Camp and the Aurora area have lower quality sagebrush habitat.

The *North Leks* consist of several individual leks (primary and satellite?) on a ridge overlooking Lapon Meadows, documented in a 1993 helicopter survey. Approximately 30 birds were observed on this ridge during a 2001 helicopter survey. The ridge is probably bare of snow in all but the heaviest snowfall years. There is some speculation that in years when this lek is covered with deep snow, the Baldwin Canyon lek is used as an alternative site. These leks are adjacent to ideal nesting habitat.

7.2.2 Summer / Late Brood Habitat

The quantity of meadow habitat is not limiting in the Mount Grant PMU. Most of the year round habitat for sage-grouse within the Mount Grant PMU is considered to be in fair to good condition with the exception of adequate brood rearing sites. Brood meadows mostly occur between 8,000 and 9,000 feet, with short growing seasons. The alfalfa pivot on the Nine-Mile Ranch provides summer brood habitat for sage-grouse.

The Flying M ranch is in the process of establishing a new pivot sprinkler system to the east of the present pivot sprinkler system. This is an effort to establish an additional pasture feeding process similar to the existing system. The irrigation pivot is intended to produce a hay pasture system to produce what is commonly known as pasture hay. This involves the production of common grasses and forbs and is harvested once or twice a season to produce a baled hay product that is intended to feed livestock during the winter period. Part of this process is intended to provide feed for cattle during the growth period of this pasture. This type of habitat manipulation is thought to provide a benefit for mid to late brood rearing for sage-grouse. The pasture system will provide important forbs and insect production necessary to juvenile sage-grouse survival.

Of most concern are the poor quality riparian zones southeast of the Aurora Mine. The condition of the Aurora Meadows is in a downward trend due to a suspected drop in the water table. This could be attributed to impacts from mining, and a Forest road that traverses the meadow.

7.2.3 Winter Habitat

Within winter areas there has to be an abundance of available sagebrush for food and cover. When snow covers the upper elevations within the Mount Grant PMU, the Nine Mile Flat and Elbow regions become important winter use areas for sage-grouse.

7.3 Sage-grouse Populations

7.3.1 Historical Distribution

Historic records indicate that there has never been a large population of sage-grouse throughout this unit. Mount Grant has had higher bird populations in the past. Since hunting has been curtailed for the last five years, it is difficult to determine population status on Mount Grant.

7.3.2 Current Distribution

The 2002 sage-grouse population for the Nevada portion of the Mount Grant PMU was estimated to be between 210 and 280 birds. This estimate was produced using a population estimator created by the technical committee of the Western States Sage-grouse Team. A three-year average of the observations from 2000, 2001, and 2002 was used. An updated estimate produced using 2003 data gives a low estimate of 358 and a high estimate of 249.

These estimate may be low since the Mount Grant strutting grounds have not been monitored consistently over the years due to the inaccessibility of these areas. It is probable that the total population for the Mount Grant PMU is two to three times the estimates given above.

The population from the Nine Mile Flat portion of this PMU has declined over the years, with the decline attributed mainly to the mining activities around the Aurora Complex and past livestock operations. Of the five general lek locations, two have remained active over the past several years.

Trend. Monitoring of the strutting grounds for this population has been irregular over the years. Lek attendance monitoring began in 1969. These leks were monitored annually for the next eight years. There was no census during the following eleven years. The record indicates that strutting activity was recorded for 1988, 1989 and 1991 with no subsequent observations until 1999. Censuses have been conducted annually since then.

The peak number of strutting males observed occurred in 1972 when a total of 65 were recorded. The average for the period of 1969 to 1970 was 18 strutting males. The next two decades saw the average increase to 31 and 32 strutting males, based on six years of data for 1971-1980, and only two years for the 1980s. The average for the 1991-2000 decade decreased to 12 strutting males, based on three years of observations. The average number of strutting males in 2002 was 24, in 2003 was 46 (a new lek was located), and in 2004 was 48 including the new lek. The long-term average over the 34-year period since 1969 is 24. This population seems to be stable at a reduced level compared to the all-time high count.

Summer brood counts for this PMU are extracted from the Mount Grant area or more specifically the Lapon Meadows Complex. Data are unavailable for the area surrounding Nine Mile Flat.

During the 1960s, brood counts were very low. This could be an artifact of low effort at that time. The 1970s showed increases in sample size and the number of chicks per hen. Average sample sizes rose from 33 for the 1960s to 83 in the 1970s. In the 1980s, the average sample size rose to 140 birds and 38 chicks per 100 hens. During the 1990s a decline in the average sample size to 84 total birds and 22 chicks per 100 hens was recorded. During 2001 and 2002, the total number of birds observed declined to an average of 32 birds and 7 chicks per 100 hens. These data suggest the population may be stable at a reduced level at this time.

An apparent decline in numbers over the past few years, especially since the mid 1990s, was observed. Climate is a determining factor for the summer brood counts. It should be noted that this was a period of low annual precipitation resulting in poor vegetation production.

Over the long term, summer brood counts have shown similar trends to those observed for strutting activity. The data suggest a general seven to ten-year cycle with rises and declines in production. Both lek counts and brood counts are low compared to all-time highs in the 1970s but seem to be currently stable. Climate certainly has an impact on production for this population. Drought and deteriorating habitat throughout the area may explain the general decline of sage-grouse for this PMU. Additional research is needed to identify population risks and mitigation to allow the population to increase to its previous higher levels.

Harvest. Harvest data come primarily from the Mount Grant (Lapon Meadows) area. However the data from the 1970s and the early part of the 1980s may include the Aurora and Nine Mile Flat areas.

Past data showed the average harvest in the 1970s to be 207 birds per year and an average of 156 hunters per year. The following decade had an average harvest of 131 birds per year and an average of 90 hunters per year. During the 1990s the harvest decreased to an average harvest of 61 birds per year with and average of 46 hunters per year.

There has not been a season in this PMU since 1978. According to lek counts and brood surveys the population in this PMU is in a low but stable state at this time.

7.4 Mount Grant PMU Risk Assessment and Conservation Actions

Existing and foreseeable risks evaluated for the Mount Grant PMU include pinyon-juniper encroachment, power lines, mining, off road vehicles, wild horses, livestock grazing, wildfire, predation, hunting and poaching, and a shortage of brood habitat. Each is discussed in detail below.

7.4.1 Pinyon – Juniper Encroachment

Pinyon-juniper encroachment onto leks will potentially impact lek activity. One historically used meadow above the China Camp lek is cut off by P-J expansion into traditional sagebrush habitat.

No sage-grouse have recently been observed on Powell Mountain, although a historic population is documented. Powell Mountain is surrounded by P-J encroachment that may have fragmented the population.

Mount Hicks also had a historic sage-grouse population. This lek has not been surveyed for quite some time. It is difficult to access by ground. Views from the air appear to show increased pinyon-juniper invasion.

Mount Grant is separated from adjoining occupied habitat in Nine Mile Flat and other areas of the PMU by a broad band of pinyon pine. Biologists do not believe that the pinyon band impedes movement between habitat segments. However, it is believed that a broader corridor of sagebrush connecting the segments would benefit the bird. Pinyon has also invaded the bottom of Cottonwood Canyon.

Conservation Action: Pinyon – Juniper Encroachment

Risk: Loss of Sagebrush habitat in the Mt. Grant PMU breeding area complexes due to encroachment of pinyon pine.

Objective: Convert or remove pinyon pine where it is encroaching into breeding area complexes. Treat approximately 5,000 acres over the next 15 years.

Action: Remove pinyon overstory with most appropriate technique (cutting, burning, chaining, pesticide, etc.) See individual Activity Plans for each project area, below.

Rationale: Those areas within two miles of the lek, that are classified as Phase I (few to many small trees not affecting understory, < 11% canopy cover) and Phase II (12-54% canopy cover, rapid tree growth, declining understory) were selected for removal of pinyon overstory. Treating Phase 1 and II is more effective than treating Phase III (tree dominance, little understory, > 55% canopy cover). Treatment of Phase I will maintain existing habitat and treatment of Phase II will increase the amount of habitat in the Mt. Grant PMU Complex.

Legal Authority: Projects addressing this risk are within the management responsibility of the Bridgeport Ranger District, Humboldt-Toiyabe National Forest and some private parcels scattered within the Forest Service boundaries.

Procedural Requirements: Projects addressing this risk are within the management responsibility of the Bridgeport Ranger District, Humboldt-Toiyabe National Forest and some private parcels scattered within the Forest Service boundaries.

Level of Partnership Commitment: It is believed that the private landowners will be willing to partner with the Forest Service and the local planning group. Agreements will be solicited prior to project approval. The Nevada Division of Forestry Inmate Crews will be considered for some project-work.

Funding Source: The Forest Service needs to plan for and request FY 2005-2015 funding as projects are developed, approved and budgeted for by the Forest Service. A small grant may be forthcoming from the Nevada Wildlife Federation.

Implementation Process:

1. Project Planning: Forest Service

   2005

   a. Identify action location
   b. Enter into budget planning

   2006

   a. Schedule Heritage and Biological surveys

   2007

   a. Identify Proposed Action for treatment
   b. Complete Environmental Analysis

2. Project Implementation: U.S. Forest Service, NDOW, Nevada Division of Forestry (NDF) Partners (2006-2015)

   a. Budget for Projects
   b. Plan for Partnership
   c. Implement Project(s)

3. Project Monitoring: Forest Service/NDOW (2006-2015)
   a. Forest Service will monitor implementation for consistency with the proposed action. Monitor change in percent canopy cover of pinyon before treatment and one year after treatment. Complete additional treatment required to accomplish the project proposal.
   b. NDOW continue monitoring sage-grouse populations through lek counts for
   changes in numbers of males visiting leks. NDOW to maintain trends and reports.
   c. Report accomplishments to US Fish & Wildlife Service (USFWS), Reno NV.

Activity Plans:

1. *Activity Site P1: China Camp Lek* - Approximately five road miles SW from the Ninemile Ranch on FS Road 045 (DeLorme & USFS topo maps, T6N, R27E, NW 1/4 Sec29 at the old FS boundary (cattle guard), progressing directly south on FS Road 045 to the China Camp Meadow (SW ¼ Sec 29). The project goes west into the draw of the intermittent creek below FS Road 045. Lek site UTM: Easting 326050, Northing 4247300, directly north of the cattle guard. High Priority
   a.
   b. Elevation 6,550-6,800 feet.
   c. Aspect West
   d. Dominant understory: Primarily mountain big sagebrush/Wyoming big sagebrush and some forb/grass component.
   e. Pinyon Phase: Phase II and moving up slope to Phase III. The removal of trees between the lek and the meadow will open up the area to allow for sage-grouse to walk broods to the meadow from the nesting sites.
   f. Acres: 130
   g. Soil Type: 3110 from the Mineral County Soil Survey
   h. Other Existing Uses:
      - Livestock grazing: Flying M from June- September
      - Deer: Limited use for winter range
      - Pronghorn antelope: Year-round

2. *Activity Site P2: China Camp Lek 2* - Approximately four miles form Ninemile Ranch west to FS Road 154, 1.7 miles from the Walker River Road, then west to the ridge top. UTM: N 4249800, E 326700 (Delorme & USFS topo maps, T7N, R27E, and SE ¼ SEC 17). Medium priority.

   a. Elevation 6310 feet
   b. Aspect: Northeast
   c. Dominant Vegetation: Low sagebrush.
   d. Page 3
   e. Pinyon Encroachment
   f. Pinyon Phase: Not affecting the understory; however, trees are encroaching onto the lek and should be removed before a problem develops. No more than 20 trees. Can be done by a small volunteer group (Gale Dupree).
   g. Acres: 20

h. Soil Type: 3110 on the Mineral County soil map.
i. Other Existing Uses:
   - Livestock grazing: Flying M June to September
   - Deer: Some winter use
   - Pronghorn antelope: Year-round

3. *Activity Site P3:* Meadow south of Gregory Flats; approximately one mile from the Aurora Mine pit or the mine office. The meadow is believed to be managed by the Forest Service (it could be mine property) and consists of 20 acres of mixed forbs, Carex, Juncus and grasses. Some sagebrush is encroaching onto the meadow along with pinyon encroachment from the south and east. (DeLorme & USFS topo maps, T5N, R28E, center of Sec 17). Medium priority.

   a. Elevation 7,200 feet
   b. Aspect West
   c. Dominant understory: Primarily mountain big sagebrush adjacent to the meadow.
   d. Pinyon Phase: Phase II moving down slope towards the meadow. The removal of all trees within 100-200 yards of the meadow would put predator perches farther from the meadow and reduce concealment for ground predators. More ground water may become available for the meadow.
   e. Acres 10
   f. Soil type
   g. Other existing uses:
      - Mining: potential for startup with gold prices above $300 per ounce.
      - Livestock and wild horse use appears to be limited on this meadow; however, elsewhere in this plan we propose to move the wild horse herd boundary to the east and ask that wild horses be restricted from the area until it can be determined what impact the horses have had on this area. Meadows above this meadow appear to have been impacted by wild horse use.
      - Deer and pronghorn antelope: Limited summer use.

4. *Activity Site P4:* Chinese Camp mostly on private property and some USFS. T6N, R26E, Sec. 26, SE ¼. Need to identify ownership of the land and spring. Obtain approval of the project. Low priority.

   a. Elevation 6500 feet.
   b. Aspect: East
   c. Dominant Overstory is Great Basin big sagebrush and scattered pinyon pine. Understory is rye grass and other grasses. It is uncertain how the understory would change with overstory removal. This spring site is filled in by large Great Basin big sagebrush and pinyon pine. Removal of these species would allow for meadow restoration. Estimate 40 acres of clearing. A more detailed treatment plan is needed. It is questionable if sage-grouse will return to this site unless considerably more acres of trees are removed.
   d. An archeological survey is needed

e. Acres: 200
f. Other existing uses:
   - Livestock grazing by Flying M Ranch
g. Costs: $12,000

7.4.2 Power lines
The California power transmission line fragments the Mt. Grant PMU. Several power transmission lines within the unit provide perches for raptors to be in a position to prey upon sage-grouse activity, resulting in loss of production. During the previous three years of lek counting a raptor has not been observed watching leks. This does not account for the period of hatching and early and mid brood rearing.

Initial Conservation Strategy
The Bi-State planning group would like to encourage the power company responsible for the power transmission lines to provide anti roosting devices where the lines traverse through critical sage-grouse habitat. The group would be willing to provide advice as to where these devices would be needed.

7.4.3 Mining
Two mining operations are present in the Mt. Grant PMU: Borealis and Metallic Ventures Inc., near Aurora, NV. Currently there is mining activity occurring in the Aurora area by Metallic Ventures Inc. Historic mining activities have occurred throughout this area and consisted mainly of open pit mining.

Recent mining by Metallic Venture Mining Company has impacted hundreds of acres of habitat. The mine pit is in an area that was once a surveyed brood site. Questions have been raised as to whether the mine pit, now approximately 148 feet deep and full of water, indirectly impacted groundwater availability for the meadows between Aurora Peak and Brawley Peak.

A Metallic Ventures (U.S.) Inc. representative informed the Mount Grant PMU Committee that the company is preparing to resume mining in the pit. Current and future mine exploration activities may result in new mines with the potential to impact additional acreage that will further reduce and fragment sage-grouse habitat.

Extreme caution needs to be taken when approving future and current exploration activities in order to protect important sage-grouse habitat. Current and future mining activities also need to be monitored to insure that important sage-grouse habitat is not forfeited.

Initial Conservation Strategy
Work with mine operators during the permit process to avoid, minimize and mitigate direct impacts to critical sage-grouse habitat.

7.4.4 Off Highway Vehicles
Off Highway Vehicle (OHV) use in the Mt. Grant PMU is restricted to designated routes. There are several roads that are used which are not in designated areas. These roads are causing damage to meadows, which may have the potential for sage-grouse use. The roads having the largest concern in this PMU are located in the Aurora area. Several of these roads run through meadows, but are located on private property.

Initial Conservation Strategy
Provide alternate routes around meadows and reclaim exiting roads through meadows.

Conservation Action: Educational Programs For OHV And Recreational Users

Risk: OHV use within the PMU is causing habitat damage to some meadows.

Objective: Educate private landowners of road damage and repair to improve these areas. Educate OHV users and recreationists of the importance of maintaining sage-grouse habitat within this area, and that they should remain on the designated routes.

Action: Education programs can be run by both NDOW and the US Forest Service. Private property programs can be presented by NRCS and the FWS on the importance of maintaining and improving sage-grouse habitat on their lands.

Rationale: Educating the public and private landowners can increase awareness of maintaining critical habitat for sage-grouse.

Legal Authority: NDOW, US Forest Service, NRCS and FWS all can play a part in this project.

Procedural Requirements: Education programs will have to be organized with co-operation with all agencies involved.

Funding Source: Funding may come from many different sources and all will be considered when implementing this project.

Implementation Process:
1. Project planning (2006)
2. Project implementation (2007)
3. Project monitoring: Forest Service/NDOW (2007-2010): NDOW continue monitoring sage-grouse populations through lek counts and brood counts. Report accomplishment to USFWS, Reno Office.

7.4.5 Livestock Grazing
There are nine permitted livestock grazing allotments administered by the Forest Service within this PMU. BLM administers 10 livestock grazing allotments. Livestock grazing utilization standards for the Forest Service allotments can be found in the Toiyabe Land and Resource Management Plan (1986) and BLM standards are found in the ____. Impacts from livestock grazing can include trampling of nests and reduction of understory cover available for nesting sage-grouse.

Currently the US Forest Service, Bridgeport Ranger District is conducting an Environmental Assessment (EA) of the livestock grazing allotments in this area. New grazing utilization standards are being considered in the proposed action and will help improve habitat for sage-grouse. This EA will be signed in 2004.

In the Mud Springs area there are several trespass livestock present, which may also be impacting sage-grouse habitat. The US Forest Service and the BLM are responsible for alerting the owner of the trespass livestock and then the owner is responsible for removing the livestock.

Additional Data Needs to Verify and Further Characterize the Risk:
Identify nesting habitat through telemetry studies.

Initial Conservation Strategy:
Manage distribution of livestock to avoid critical nesting habitat.

7.4.6 Wild Horses

Three wild horse and burro territories are present within this PMU. There are several horses located outside the Powell Mountain Territory that are negatively impacting sage-grouse habitats. Impacts of wild horses to sage-grouse habitat are the same as with livestock grazing.

The Humboldt-Toiyabe National Forest (HTNF), Bridgeport Ranger District, manages the Powell Mountain WHT with the Appropriate Management Level (AML) goal of 26 horses. The Bureau of Land Management (BLM) and National Forest management goal is zero horses outside of the established territory boundaries. Federal horse removal programs are active in attempts to meet these goals. In July 2003, BLM Wild Horse and Burro specialists from Ridgecrest, CA captured and removed 26 horses from the Powell Mountain WHT. An additional 7 horses were captured and removed from the Bodie Hills outside of the designated territory. An estimated 30 horses remain in the Powell Mountain WHT and an estimated 11 horses remain in the Bodie Hills outside of the territory. During the course of the capture, 10 of the remaining Bodie Hills horses were at least temporarily driven into the Powell Mountain WHT. Future management should focus on removing all feral horses outside of established territory boundaries and maintaining AML goals within the Powel Mountain WHT.

The wild horse and burro territory boundaries have been determined under the Wild Horse and Burro Act and cannot be changed or altered unless Congress approves the change. It is the responsibility of the US Forest Service and the BLM to remove any wild horses located outside of the territory boundaries.

Initial Conservation Strategy
Restore meadow habitat located within the Powell Mountain Wild Horse Territory on lands administered by the U.S. Forest Service.

Conservation Action: Removal Of Wild Horses Outside Of Wild Horse And Burro Territories

Risk: Wild horses may trample nests, reduce understory cover and impact forage needed for sage-grouse.

Objective: Limit impacts of wild horses on sage-grouse habitat outside of a Wild Horse and Burro Territory

Action: Conduct a wild horse gather for those horses outside of the designated Powell Mountain Wild Horse Territory, in the Baldwin Lek area within the Ninemile Cattle & Horse Allotment.

Rationale: The Baldwin Lek area has 9-11 wild horses using it during the nesting and brooding season. Removing them complies with USFS and BLM horse management goals and protects sage-grouse habitat outside the WHT from wild horse impacts.

Legal Authority: This project would involve interagency corporation between the Bureau of Land Management and the US Forest Service. Horses outside of this territory are on both BLM and Forest Service administered lands.

Procedural Requirements: NEPA would have to be conducted for this project by the US Forest Service.

Funding Source: Funding for this project would be the responsibility of the BLM and US Forest Service agencies. The costs are:

1. Wild horse removal: $1,500/ head (this includes capture, removal, adoption)
2. Equipment: Trailer
3. Labor: BLM and US Forest Service

Implementation Process:

1. Project Planning: Forest Service and BLM
   2008
   a. Identify action location
   b. Enter into budget planning
   c. 2009
   d. Schedule Heritage and Biological surveys
   e. 2010
   f. Identify Proposed Action for treatment
   g. Complete Environmental Analysis
2. Project Implementation NDOW/Partners (2006)
   a. Budget for project
   b. Budget for partners
3. Project monitoring: NDOW (2006-2014): NDOW continue monitoring sage-grouse populations through lek counts and brood counts.

7.4.7 Wildfire

Wildfire has not been a past problem in the Mount Grant PMU. Limited access lowers the risk of man-caused fires. Lightning strikes usually coincide with thunderstorms. Only three recent fires have been identified in the PMU. One fire was approximately 10 acres on Mount Grant. It was controlled. A second 10-acre fire near Aurora Peak was controlled. The third fire, northwest of Mt. Hicks in the P-J woodlands, was also controlled. The largest and most recent fire was the 400-acre Aurora fire.

The Cottonwood Canyon fire was man-caused approximately 10 years ago. Recent observations of the burn showed extensive invasion of cheatgrass. At another site, cheatgrass was observed at an elevation of 9,080 feet indicating that there is no elevation limit on the potential for cheatgrass establishment.

Initial Conservation Strategy
Implement fuel reduction treatments if determined beneficial for the protection of critical habitat.

Use prescribed fire in accordance with the WAFWA Guidelines in areas that can benefit from fire treatment.

7.4.8 Predation
Predation has not been documented to be a problem in this PMU. Ravens are not abundant. Coyotes occasionally take sage-grouse on a year round basis.

Under current conditions, predation is not thought to be a problem. Monitoring is necessary to determine the predation threat. As populations increase it is necessary to continue population monitoring efforts in order to evaluate the threat. If predation is deemed to be a population limiting factor, then it will become necessary to provide whatever methods are needed to address the threat.

7.4.9 Hunting / Poaching
There has been no hunting season for sage-grouse in the Mount Grant PMU for over five years. Falconry has recently been disallowed in the PMU. It is recommended that this restriction remain in place until such time that this population reaches a level that is considered huntable. At that time general harvest regulations will be acceptable including the take of sage-grouse by the use of falconry.

Acceptable harvest regulations should be considered when the population reaches levels as described by WAFWA guidelines. California and Nevada should develop a standardized approach to a harvest program agreeable to both states.

Poaching is not considered to be a significant risk in the PMU since much of the access is restricted. However, good access to the Nine Mile Flat area has resulted in documented poaching. Continued law enforcement efforts need to be directed to areas which are considered sensitive in relation to population status. This would especially include the Bi-state conservation area.

Initial Conservation Strategy
Expand public information and awareness on Project Game Watch and the objectives for sage-grouse conservation.

7.4.10 Shortage of Good Quality Brood Habitat
Lowering water tables, historic grazing, and pinyon invasion have impacted meadows throughout the PMU. Headcutting has been observed in limited locations. Sagebrush encroachment was observed in the Upper Lapon Meadow Complex.

<u>Conservation Action: Meadow Restoration - Aurora Meadow Complex</u>

<u>Risk:</u> Loss of meadow habitat (nesting and breeding) for use by sage-grouse in the spring and summer within the Mt. Grant PMU. Sagebrush is the dominant vegetation type within this project area. The area has been used by Off Highway Vehicles (OHV) which have caused damage to a few meadows. The water level in many of these meadows appears to have lowered; many have become dry and are being encroached upon by sagebrush. One meadow, the "Barrel Meadow," has a deep gully and water is not flowing across the entire

meadow area. An old fence encloses the top portion of the gully and is in disrepair. In Aurora Valley many of the meadows have roads running through them, and appear dry.

Objective: Restore meadow habitats located in T5 N., R28 E, sections 28, 29, 32 and 33 on private property to Proper Functioning Condition (PFC).

Action: Conduct PFC assessment for each meadow and take corrective measures. See individual action statements for each project area location, below.

Rationale: By using the PFC method of assessing these meadows we will be able to determine the priorities and the problems facing them more accurately, and what can be done to bring them to Proper Functioning Condition. Individual actions prescribed below are expected to improve meadow conditions for sage-grouse.

Legal Authority: Primarily private land owner.

Procedural Requirements:

1. Private landowner will have to obtain the permits needed for construction or project work that may be applicable to this project.
2. For re-routing the road, the landowner will have to consult with the US Forest Service, Bridgeport Ranger District, Humboldt-Toiyabe National Forest. The US Forest Service is responsible for allowing road access to private property, but re-routing roads is a possibility in areas were resource damage is occurring.

Funding Source: Funding projects on private property will be at the landowner's expense (Grant request). Volunteer workers can be used for labor where necessary.

Implementation Process:

1. Project planning (2006)
2. Project implementation (2007)
3. Project monitoring: Forest Service/NDOW (2007-2010): NDOW continue monitoring sage-grouse populations through lek counts and brood counts. Report accomplishment to USFWS, Reno Office.

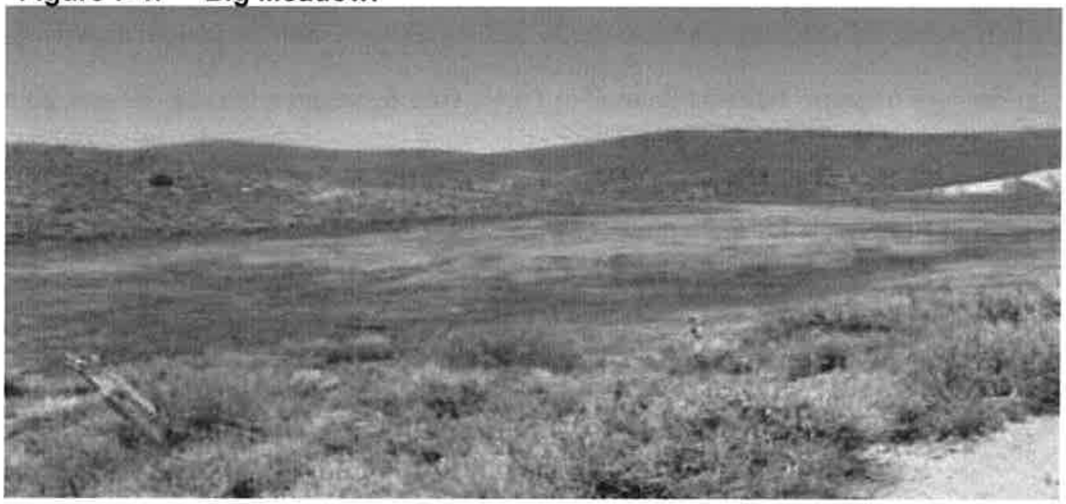
Project Area Locations:

Aurora Meadow Restoration- Big Meadow (M1)- in T. 5N R. 28 E. Section 28 above Aurora, NV. Meadow vegetation includes sedge species and some grass species. The meadow is in good condition with only one swell, which is draining water from the meadow. This meadow has the highest potential for sage-grouse use in the Aurora area. Some sage-grouse where flushed during a field trip in 2002. See photo M-1. High priority.

Action:

Remove the old boundary fence surrounding the meadow and build a sage-grouse "friendly" fence if it is necessary to have the area fenced off. Build loose rock check dams in swells found within the meadow no larger than a few inches high. These create an area in which water can spread to a small area and keep water in the meadow for a while longer.

Figure 7-1. Big Meadow.



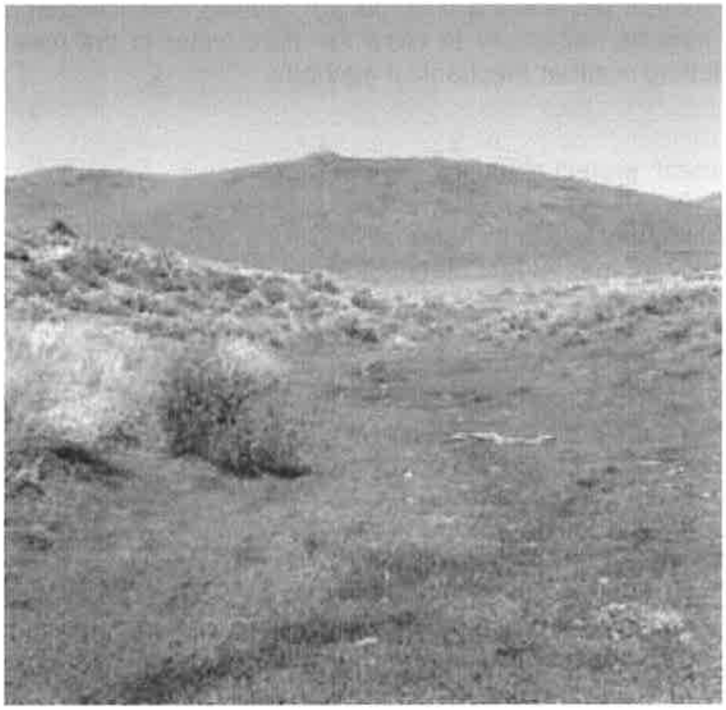
Project:
Aurora Meadow Restoration- Aurora Peak Meadows (M2)- This meadow is located below a stream runoff. A barrel has been placed in the stream channel and is preventing water from reaching the meadow. There are some side-channels and the meadow is becoming dry with sagebrush encroachment. This area is approximately 150 acres. See photo M-2. T. 5N R. 29 E. Section 28 above Aurora, NV. Medium priority.

Action:
Remove the barrel that has been placed in the stream channel. This may allow more water to flow into the meadow. Re-contour areas with headcuts and side channels to allow for water runoff to remain in the meadow for a longer period. Also place loose rock dams where they may help water remain in the meadow. Prescribe a sagebrush treatment with herbicide, cutting or other mechanical treatments to help restore meadow vegetation.

1. Remove barrel in stream channel
2. Re-contour areas with headcuts and side channels
3. Construct loose rock dams in swells
4. Sagebrush treatment (herbicide, cutting or other mechanical treatments)

Schedule:
1. Project planning (2008)
2. Project implementation (2009)
3. Project monitoring: Forest Service/NDOW (2009-2010):NDOW continue monitoring sage-grouse populations through lek counts and brood counts. Report accomplishment to USFWS, Reno Office.

Figure 7-2. Aurora Peak Meadow.



Project:
Aurora Meadow Restoration- Junction Meadow (M3). This meadow area is located at the junction of two US Forest Service roads T. 5N R. 28 E. Section 29 above Aurora, NV. above the Aurora area. It is located on private property. The meadow has severe headcuts and channeling preventing water from moving across the meadow. Approximately 60 acres. Low priority.

Action:
Re-contour the headcuts and channeling to allow for water to move across the meadow. Place loose rock dams in any swells to help water remain in the meadow for a longer period of time.

Schedule:
1. Project planning (2009)
2. Project implementation (2010)
3. Project monitoring: Forest Service/NDOW (2010-2017):NDOW continue monitoring sage-grouse populations through lek counts and brood counts. Report accomplishment to USFWS, Reno Office.

Project:
Aurora Meadow Restoration – Top Meadow (M4)- This meadow has many swells and ruts that are causing early water run-off and not allowing water to spread through the meadow. This meadow appears dry and has encroaching sagebrush. See photo M-3. T. 5N R. 28 E. Section 29 above Aurora, NV. Approximately 60 acres. High priority.

Action:

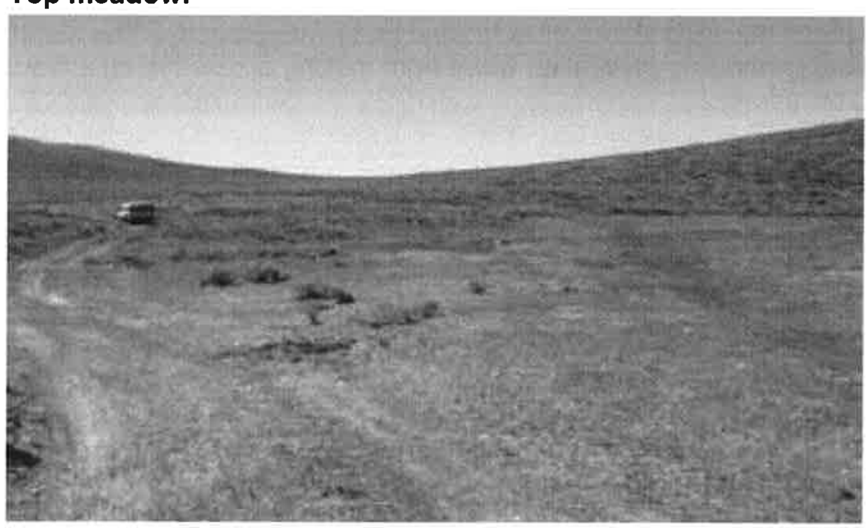
Construct loose rock dams in swells, which allow water to stay in the meadow longer and move across the field. Realign the road running through the meadow. This is causing ruts in the meadow. Re-contour the areas where ruts are causing meadow damage. Sagebrush removal treatments may be necessary to allow for more water in the meadow. This may include herbicides, cutting or other mechanical methods.

Schedule:

1. Road realignment project planning: Forest Service
   2010
   a. Identify action location
   b. Enter into budget planning
   2011
   a. Schedule Heritage and Biological surveys
   2012
   a. Identify Proposed Action for treatment
   b. Complete Environmental Analysis
2. Project Implementation Forest Service/Partners (2011)
   a. Budget for project
   b. Budget for Partners
3. Project monitoring: Forest Service/NDOW (2012-2014):
   a. NDOW continue monitoring sage-grouse populations through lek counts and brood counts.
   b. Report accomplishment to USFWS, Reno Office.

4. Project monitoring: Forest Service/NDOW (2007-2010): NDOW continue monitoring sage-grouse populations through lek counts and brood counts. Report accomplishment to USFWS, Reno Office

Figure 7-3. Top meadow.



Project:
Aurora Meadow Restoration – Barrel Meadow (M5)- This meadow is located on private property and borders the US Forest Service, Bridgeport Ranger District, Humboldt-Toiyabe National Forest. This meadow has many swells and headcuts. A large water tank and trough are located in the meadow and a large pool is located at the northern end of the meadow, which may be preventing water from flowing over the meadow. See photo M-4. T. 5N R. 28 E. Section 32 above Aurora, NV. Medium priority.

Action: Fill in pool located at the northern end of the meadow. Remove fence around pool and if necessary replace it with a sage-grouse "friendly" fence. If not in use at the present time, remove water tank and trough located in the meadow. Try to re-contour areas where ruts or large headcuts occur. Place loose rock dams in swells.

Schedule:
1. Project planning (2010)
2. Project implementation (2011)
3. Project monitoring: Forest Service/NDOW (2011-2018):NDOW continue monitoring sage-grouse populations through lek counts and brood counts. Report accomplishment to USFWS, Reno Office.

Figure 7-4. Barrel Meadow.

Project:
Meadow Restoration SW of Gregory Flat (M6)- High priority. T. 5 N R. 27 E. Sections 16 & 17 south of Humboldt Hill. It is believed to be located on both forest service and mine property

Description: Estimate 16 acres or more of meadow restoration. A good flowing spring feeds the meadow. The meadow is being encroached by sagebrush on all sides. The west end is cut by a road and a mine road above the meadow parallels the north edge. Pinyon pine is advancing onto the meadow from the south.

Action: Remove sagebrush from all sides of the meadow for a 100 yard radius from the edges of the grassy vegetation. Remove all pinyon within the meadow area and up slope from the medow for 400 yards. The spring head was dammed many years ago to create a pond which is now heavily surrounded by large sagebrush bushes. It is recommended removing the sagebrush and replacing with a planting of native grass and forbs seeds. The meadow is infested with thistle (Scotch thistle (?), *Onopordum acanthium L.*) just sprouting during the last visit. The thistle can be dug up, bagged and removed from the site. It will probably take a few years of continued removal in the early spring before all of the thistle will be removed due to seed spread. This action can be done immediately with mine approval for access (Gale Dupree and Fred Smith will pursue).

A few plants of Tall white top, *Lepidium ledifolious L.* were found growing on the far southwest edge of the meadow. The FS was to take note of this and take action to stop this spread. Follow-up is needed to confirm any action. Digging is not recommend; however, with a few plants currently present, digging and pulling it up now and with an annual follow-ups could eliminate this invasive plant from the meadow.

It is recommended that the meadow area can be increased in size by the above noted actions. The dryer areas of the meadow would them be irrigated with water pumped form a capped forest service well about ½ mile east of the meadow. There is electricity to the well. An aeration wind mill could be procured form Canada for around $1,000 and installed at the well and it would pump sufficient water to irrigate the meadow. These windmills are virtually maintenance free. Once the meadow returns to a desired state, the well could be capped again.

A meadow restoration expert is required to write a prescription for more detailed needs, such as how to distribute the spring water evenly across the meadow and what plant mixture is desired and how to obtain the mix. The prescription should probably include some short term grazing by livestock.

Scheduling and costs:
1. Project planning: NDOW/FS
   2005
   a. Identify action location
   b. Enter into budget planning
   c. Identify proposed action for treatment
   d. Complete Environmental Analysis
2. Project Implementation NDOW/Partners (2006)
   a. Budget for project
   b. Budget for partners
3. Project monitoring: NDOW (2006-2015)

Description: Estimate 16 acres of meadow restoration. A separate project to remove pinyon will be found under Pinyon-Juniper Encroachment.

Project:
Powell Mountain Spring Restoration (M7). Estimate two acres of spring needing restoration by fencing to keep wild horses and livestock out of the spring. Location is south of Powell Mountain. T5N R30E, Sec. 1 SE ¼ SW ¼. The spring is thought to be in the NE corner of private property. If this is correct, the landowner needs to be contacted for approval of any improvements and water rights must be determined. The spring needs further identification to properly locate it. Medium priority.

Action:
Remove the old fencing material around the spring. Sink a pipe ant the source of the spring with a minimum diameter of 6" to be used for solar pumping that could distribute water to other areas of this high sagebrush flat. The spring source area to be fenced is a minimum of two acres. The permittee or private landowner will maintain these structures during their period of use.

Project:
Ninemile Ranch, Rough Creek Meadows and Alfalfa Pivot (M9): This project area is on private property owned by the Flying M Ranch. 1300 acres of meadow area on both sides of Rough Creek. There is a 150-acre alfalfa field irrigated by a center pivot system, which is watered all summer producing two crops per season. Following the cutting, sage-grouse feed on insects and the low growing alfalfa in the cut field for several days. In 2002 and 2003, 155 sage-grouse were counted on the cut field. The alfalfa field is a collecting area for sage-grouse right after the meadow is mowed. It is important that this use continues in the future as it appears to be sustaining the present population of sage-grouse. This could be a conservation easement to keep the land as is. This is a very high priority for telemetry work. We do not know where nesting, wintering or brood rearing occurs, except for the alfalfa field in the summer.

Currently, the ranch does not use insecticide and is asked not to use any in the future as it could have a negative impact on the sage-grouse using this field.

The newly discovered Ninemile Lek on BLM land is less than one mile from the ranch property.

Action:
Discovery of the Ninemile Lek shows a need for more data on the sage-grouse use for the Rough Creek Meadow area. A study needs to be conducted to determine if and when the sage-grouse use the remainder of the Rough Creek Meadow, including conducting surveys to find nesting and brooding sage-grouse within the lek complex.

Schedule:

1. Project planning: NDOW

2005

a. Identify action location
b. Enter into budget planning

   c. Identify Proposed Action for treatment
   d. Complete Environmental Analysis
2. Project Implementation NDOW/Partners (2006)
   a. Budget for project
   b. Budget for partners

3. Project monitoring: NDOW (2006-2014)
   a. NDOW continue monitoring sage-grouse populations through lek counts and brood counts.

Projects: Hawthorne Army Ammunition Depot (HAAD) has some of the best sage-grouse habitat on the Mount Grant PMU due to the exclusion of livestock grazing and the public; however, some of the meadow areas have become decadent due to various non-uses.There are three meadow restoration projects on Mount Grant, Hawthorne Army Ammunition Depot. The projects are located on R. 28 E. T. 8 N., Section 24, Lapon Meadows. More forbs are needed to improve the habitat for sage-grouse.

Conservation Action: Powell Mountain Guzzler Installation

Risk: Loss of sage-grouse due to lack of water in the habitat area. Priority is low.

Objective: This project will help spread water to critical areas.

Action: The U. S. Forest Service and NDOW should provide a minimum of two big game guzzlers on this relatively dry mountain for use by other species of wildlife including sage-grouse and pronghorn antelope. Solar power possibilities should be explored in the use and distribution of guzzlers

Rationale: Both of these species were in this area in recent times.

Legal Authority: U.S. Forest Service and NDOW will have responsibility for this project. Implementation will be done by the Forest Service and project monitoring and help of construction will be provided by NDOW.

Procedural Requirements: Areas need to be determined for placement of these guzzlers. NEPA will need to be conducted for the placement of these guzzlers.

Funding Source: NDOW, Bridgeport Ranger District Humboldt-Toiyabe National Forest

Implementation Process:
1. Project Planning: Forest Service
   2009
   a. Identify action location
   b. Enter into budget planning
   2010

a. Schedule Heritage and Biological surveys

2011

a. Identify Proposed Action for treatment

b. Complete Environmental Analysis

2. Project Implementation Forest Service/Partners (2009-2011)
    a. Budget for project
    b. Budget for Partners
3. Project monitoring: Forest Service/NDOW (2011-2013):
    a. NDOW continue monitoring sage-grouse populations through lek counts and brood counts.
    b. Report accomplishment to USFWS, Reno Office.

Conservation Action: Sage-grouse Telemetry Study

Risk: There is a lack of knowledge in this PMU regarding sage-grouse distribution.

Objective: This project will help determine the locations of sage-grouse throughout the PMU. Critical habitat locations will be identified, such as wintering areas.

Action: NDOW will provide the collars and telemetry equipment. Ten birds will be collared the first year of the study and in subsequent years more birds will be collared. Tracking will then take place for one year or for the life of the collaring equipment.

Rationale: Information is needed for the location of critical areas, such as wintering areas, in order for land managers to protect and maintain those areas for sage-grouse. This project will also help determine future projects.

Legal Authority: NDOW will be the lead on this project. This project has the potential to be a University of Nevada, Reno (UNR) Graduate project as well.

Procedural Requirements: Areas where birds are most likely to be captured will have to be determined. If a UNR graduate student is conducting the project then any state permits will have to be obtained.

Funding Source: NDOW will be the lead for a funding source.

Implementation Process:

1. Project Planning: Forest Service 2005
   a. Identify action location
   b. Enter into budget planning
2. Project Implementation 2006
   a. Budget for project: Nevada BLM request for $25,000
   b. Budget for Partners
3. Project monitoring: Forest Service/NDOW (2006-2011)
   a. NDOW continue monitoring sage-grouse populations through lek counts and brood counts.
   b. Report accomplishment to USFWS Office Reno, Nevada

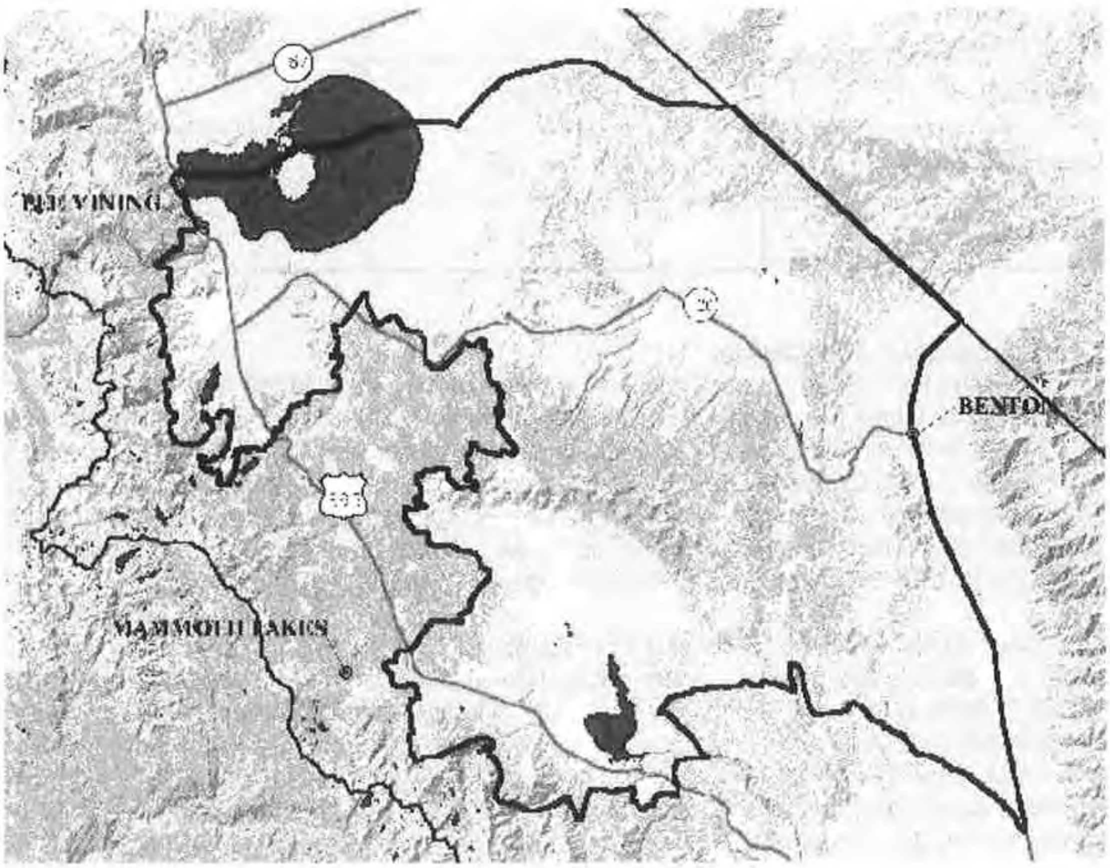
8.0 SOUTH MONO PMU

8.1 PMU Description

8.1.1 Location and Boundary

The South Mono PMU is approximately 582,768 acres in size and is located entirely in Mono County, California. The southern boundary extends from Highway 6 east to the California/Nevada border, north along the state line to the south side of Mono Lake then west towards Grant Lake, then south to Bishop (Figure 8-1).

Figure 8-1. South Mono PMU.



8.1.2 Land Ownership and Regulatory Jurisdictions

The majority of land within the South Mono PMU is National Forest land managed by the Inyo National Forest (Table 8-1). The Bureau of Land Management manages 34 percent of the PMU while County/City land (including LADWP holdings) makes up 8 percent. Private lands make up only 3 percent of this PMU.

Table 8-1. Land ownership in the South Mono PMU.

LAND MANAGER OR OWNER	PMU TOTALS	
	ACRES	PERCENT OF PMU
Total PMU Acres	**579,483**	
National Forest	312,084	54
Private	17,662	3
Bureau of Land Management	200,775	34
State Land	3,944	<1
County/City Land	44,578	8
Tribal Lands	441	<1

8.1.3 Topography and Climate

Elevations within the South Mono PMU range from 1300 meters (4250 feet) to 3400 meters (11,100 feet) at Glass Mountain. Average elevation within the PMU is 2150 meters (7000 feet). Major features within the PMU include Long, Adobe and Benton Valleys, the south end of Mono Lake; Crowley Lake, and the Benton and Glass mountain ranges. Large valleys characterize the region with gentle slopes separated by steep ranges. Annual precipitation is 14 inches, mostly falling as snow. Average maximum temperature is 83 degrees (F) in July. Average minimum temperature is 8 degrees (F) in January.

8.1.4 Vegetation Communities and Distribution

Several vegetation communities exist within the South Mono PMU including shrublands (170,000 hectares), grassland (12,981 hectares), pasture/hay (2,483 hectares) and forested areas (29,000 hectares) (Vogelmann et al. 2001). The shrubland habitat within the South Mono PMU consists primarily of five main types of sagebrush including low sagebrush (*Artemesia arbuscula spp. arbuscula*), Wyoming big sagebrush *(Artemesia tridentata spp. wyomingensus*), silver sagebrush (*Artemesia cana spp. viscidula*), mountain big sagebrush (*Artemesia tridentata spp. vaseyana*), and basin big sagebrush (*Atremesia tridentata tridentata*). Mountain big sagebrush and Wyoming big sagebrush are nearly equal in proportion while an impressive mosaic of the five types of sagebrush exists, especially mountain big and low sagebrush. Pure stands of sagebrush are rare in this PMU with most of the areas containing a mixture of other shrubs as well (primarily bitterbrush, Purshia tridentata).

Much of the low sagebrush in the PMU exists within Long Valley. Wyoming big sagebrush is common in the lower elevations throughout this PMU. In Long Valley, Wyoming big sagebrush is found primarily along the base of the Glass Mountain range. Mountain big sagebrush seems to dominate the mid-elevation levels within this PMU while higher elevations tend to be a mixture of mountain big sagebrush and low sagebrush. At higher elevations, other plants are also common, including plateau gooseberry (*Ribes velutinum*), and balsamroot *(Balsamorhiza sagittata).*

Meadow habitats are limited in distribution throughout most of this PMU. Adobe Valley offers very little meadow habitat with some narrow riparian/meadow fringe areas, including irrigated meadows, along Adobe Creek and Indian Creek. Mono Basin area meadows exist primarily along Parker and Walker Creeks, and potentially some areas on the fringe of Mono Lake. Parker Meadow offers one of the few extensive irrigated meadows in the northern portion of this PMU. Meadow habitat is limited in the Glass Mountain range to small creeks and drainages. Meadow habitat is fairly extensive in the Long Valley portion of this PMU. A significant portion of the meadow habitat in Long Valley is due to extensive irrigation. Natural meadows occur in areas around Convict Creek, McGee Creek, Hot Creek and the Owens River.

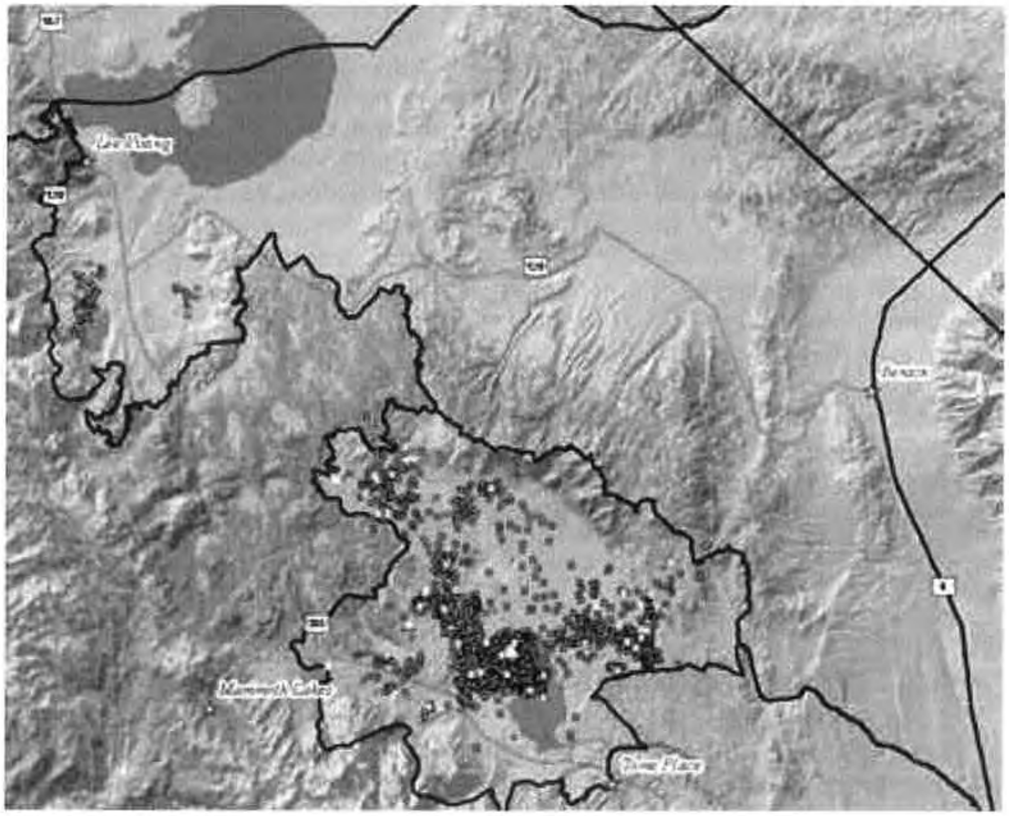
Although cheatgrass is present throughout this PMU, it has not established itself as a dominant vegetation type in any extensive areas. The vegetation communities within this PMU have responded well to fire events, with sagebrush communities re-establishing themselves in previously burned areas including past fires in the east Mono Basin and the McLaughlin fire.

8.2 Sage-grouse Habitat Description and Condition Assessment

Long Valley is primarily R0 (key) and R2 (understory limited) sagebrush habitats, with small amounts of R3 (Pinyon-juniper encroached) and R4 (potential sagebrush sites without sagebrush) areas. R1 (sagebrush limited) sagebrush conditions in the Long Valley area are the result of past fires, or chemical or mechanical treatments.

Radio telemetry has been used to identify seasonal use areas for sage-grouse throughout the South Mono PMU. Location data for sage-grouse were obtained by Gibson (unpublished data, 1984-2000) and the USGS (unpublished data, 2003). Individual bird locations as well as nest locations are given in Figure 8-2.

Figure 8-2. **Radio-marked grouse locations in the South Mono PMU. (circles = USGS bird locations, triangles = USGS nest locations, squares = Gibson bird locations, star=Gibson nest locations)**



8.2.1 Breeding Habitat

There are nine consistently counted active leks in Long Valley, one in the Parker Meadows area, and two in the Granite Mountain area. Table 8-3 lists the leks identified within the PMU and their status. Detailed lek count data can be found in Appendix ____.

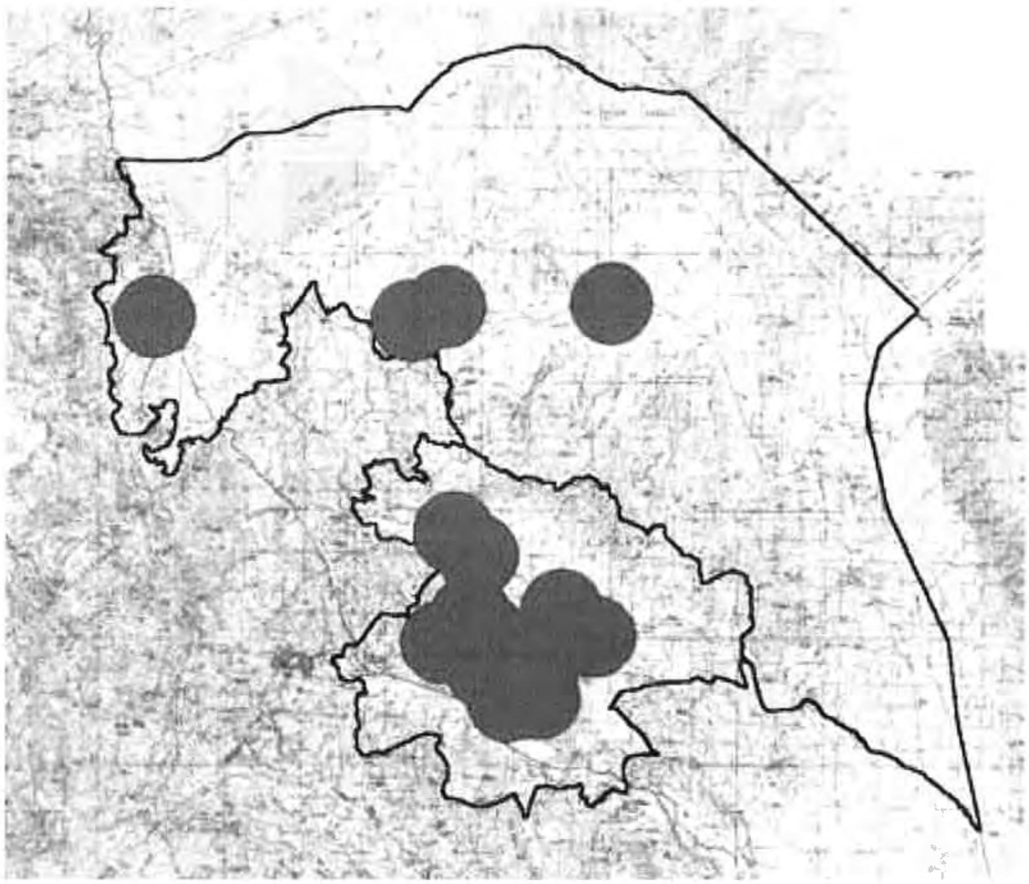
Table 8-3. Activity status of known leks in the South Mono PMU.

LEK NAME	STATUS **
Long Valley 1	ACTIVE
Long Valley 2	ACTIVE
Long Valley 3a	ACTIVE
Long Valley 4	ACTIVE
Long Valley 5	ACTIVE
Long Valley 6	INACTIVE
Long Valley 7	INACTIVE
Long Valley 8	ACTIVE
Long Valley 9	ACTIVE
Long Valley 10a	ACTIVE
Long Valley 11	INACTIVE
Long Valley 12	INACTIVE
Long Valley 13	ACTIVE
Long Valley 14	INACTIVE
Parker Meadows	ACTIVE
Adobe (Granite Mountain)	ACTIVE
Gaspipe (Granite Mountain)	ACTIVE

"ACTIVE" leks are those where male birds have been observed during the strutting season within the last 5 years

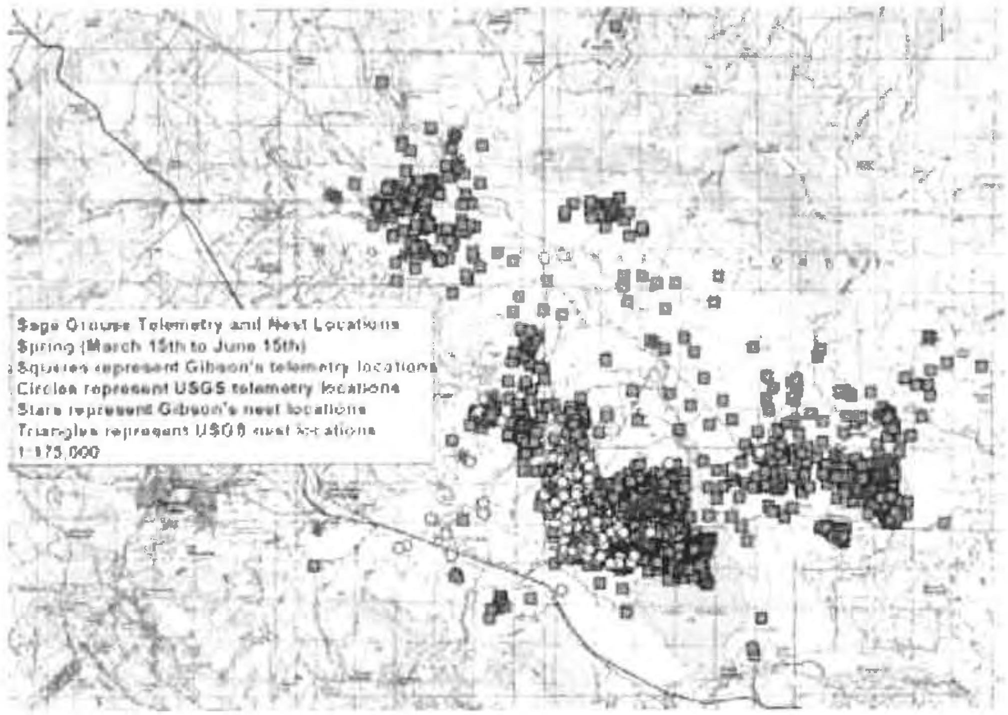
Conelly et al. (2000) suggests that for all non-migratory populations of sage-grouse, habitat within 3.2 km of known leks should be given a high priority for protection. Figure 8-3 shows 3.2 km buffers around all known leks in the South Mono PMU to provide a basis for identifying critical breeding habitat.

Figure 8.3. Active leks in the South Mono PMU with 3.2 km buffer.



Radio-marked sage-grouse in Long Valley nested in close proximity to known leks (Table 8-4). Seasonal habitat use by radio-marked sage-grouse indicates several high use areas within Long Valley during the breeding season (Gibson, unpublished data, USGS unpublished data) (Figure 8-4).

Figure 8-4. **Radio-marked sage-grouse locations during Spring (March 15th to June 15th) in the Long Valley region (Gibson 1984-2000, USGS 2003 unpublished data) N=112 birds.**



The following areas were of particular importance: the area northwest of Crowley Lake and South of Benton Crossing Road; northwest of Benton Crossing Road between Whitmore Hot Springs and Alkali Lakes; the north end of Hot Creek downstream of Hot Creek Gorge; both north and south of Little Hot Creek; the south slope and foot of Bald Mountain down into the north end of Long Valley especially between Clark Canyon and McLauglin Creek; near the butte 2.5 km NE of the Owens River and 2.75 km NW of O'Harrel Canyon; the Watterson Canyon area south and east of lek 10A. These are just some of the important breeding habitat use areas which are derived from radio-tracking information. Sage-grouse were not marked at all leks and we would expect that even more areas would be considered critical nesting habitat.

Table 8-4. Mean distance from nest to nearest known lek within Mono County. (Gibson, unpublished data 1984-2000, USGS unpublished data 2003).

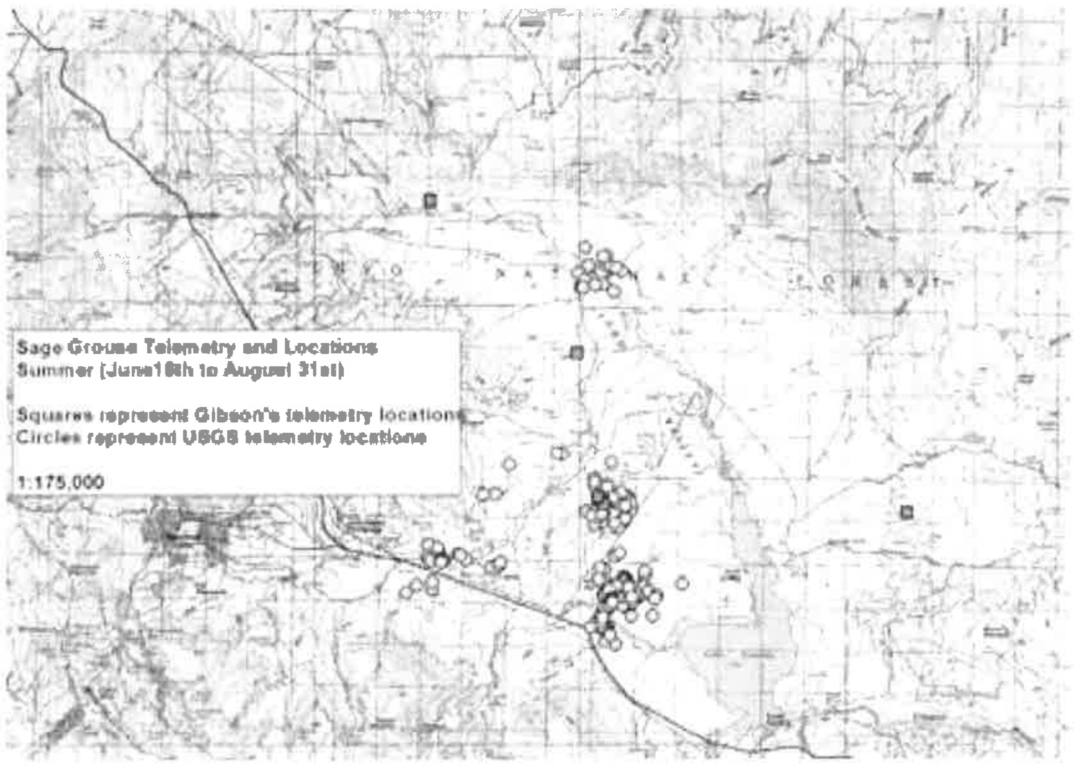
YEAR	NUMBER OBSERVED	DISTANCE TO NEAREST LEK (KM)
1984	3	3.18
1985	8	2.32
1986	11	2.92
1991	8	3.35
1993	4	2.36
1997	2	3.42
1998	6	2.63
2000	3	3.26
2003	26	1.53
Average for All Years	71	**2.38** (standard deviation = 1.77km)

Vegetation sampling conducted by the BLM in the early 1990s indicates that canopy cover within one mile of leks was within the WAFWA guidelines or 30-40 percent canopy closure. They also sampled areas 1-2 miles from the known leks in the area and found that canopy closure again was in the range of the guidelines or 20-50 percent. The grass component of the vegetation sampling did not meet objectives in the guidelines, with the grass spacing less than objectives, however, this may be due to a variety of factors including site potential, extended drought, or grazing effects (BLM unpublished Progress Report). Vegetation data recorded at nest sites in Long Valley (n=11) indicated an average shrub canopy cover of 46% (USGS unpublished data).

8.2.2 Summer/ Late Brood Habitat

Locations of radio-marked sage-grouse during the late brood rearing and summer season are concentrated in several areas of Long Valley, although sample size is small (n=15). Sage-grouse observations during late brood rearing are shown in Figure 8-5.

Figure 8-5. Radio-marked sage-grouse locations during late brood rearing and Summer (June 16th to August 31st) in the Long Valley region (Gibson 1984-2000, USGS 2003 unpublished data) N=15 birds.

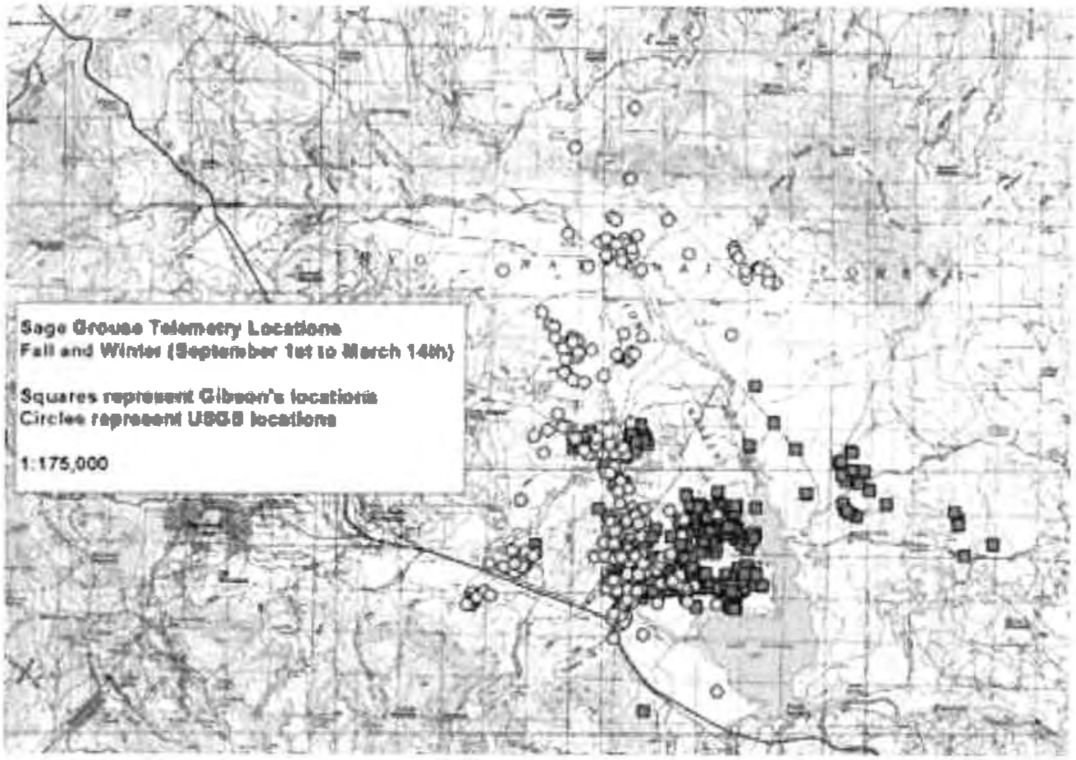


The following were highly used areas by radio-marked grouse during summer: north of Highway 395 between Mammoth Airport and the fish hatchery and west of the hatchery to Mammoth Creek; south of Highway 395 and west of Laurel Lake; between Whitmore Hot Springs and Alkali Lakes northwest of Benton Crossing Road; south of lek 5; north, east and west of lek 1; west and southwest of lek 2; Owens River 3 km upstream from confluence with Little Hot Creek at power lines; north and south of Convict Creek.

8.2.3 Winter Habitat

Fall and winter sage-grouse use areas within Long Valley derived from radio telemetry studies are depicted in Figure 8-6.

Figure 8-6. Radio-marked sage-grouse locations during Fall and Winter (September 1-March 15) in the Long Valley region (Gibson 1984-2000, USGS 2003 unpublished data) N=49 birds.



The following areas were used extensively by radio-marked grouse over the fall and winter periods: near Benton Crossing Road, north of lek 2 and east and west of leks 3 and 3A; between lek 4 and 4A, north of Benton Crossing Road; between Whitmore Hot Spring and Alkali Lakes; north of Little Hot Creek about 4km west of the confluence with the Owens River; the Owens river area about 4km linear upstream of confluence with Little Hot Creek (near power lines); southeast of O'Harrel Creek; Hot Creek downstream of Hot Creek Gorge; between the Mono Airport and Hatchery north of Highway 395; and east of Laurel Ponds south of Highway 395.

Winter habitat in the Long Valley portion of the PMU likely consists of the mountain big sagebrush and Wyoming sagebrush areas throughout the valley. Extremely deep snow may drive sage-grouse out of the valley in some years. During winters of heavy snowfall in Long Valley sage-grouse have been observed east of the Benton Range, and in Adobe Valley in unexpected numbers. Sage-grouse in the Parker Meadows area were observed on the east side of Highway 395 during much of the winter in 2003 in the area just west of the Mono Craters.

8.3 Sage-grouse Population

8.3.1 Historical Distribution

Sage-grouse were likely distributed in many of the same areas where they are found today. Little information exists on the detailed distribution and relative population size of sage-grouse in this PMU prior to lek counts which began (recorded data) in 1953.

8.3.2 Current Distribution

Annually, the Department of Fish and Game, Bureau of Land Management and other resource agencies assess the status of sage-grouse breeding populations in Mono County, California, by surveying all known leks for activity, searching for new leks, and obtaining peak counts of the number of males attending each known lek. Three apparently distinct breeding populations have been identified within the South Mono PMU, including Long Valley, Parker and Granite Mountain. Long-term lek data for Long Valley are available annually from 1953 through the present. For Granite Mountain, lek counts were first conducted in1984, and data have been collected annually since that time. Lek data for the Parker population extend back only as late as 2002 when formal counts were first conducted.

Beginning in 1987, the method for conducting lek counts in Mono County was standardized in an attempt to obtain the annual peak high male count for all known active leks in the Long Valley and Granite Mountain portions of the PMU. Annual monitoring efforts prior to 1987 did not always involve multiple lek counts because of problems associated with personnel and weather constraints. The method used to establish the peak single day count typically involved 1 experienced person counting at each lek on at least 3 separate days conducted during the period when female and male presence was at a maximum (Connelly et al. 2003). The peak single day count was taken on the day with the highest cumulative number of males counted on all leks visited within the PMU. Leks were monitored for activity from early March to judge the likely period of peak lek occupation.

The Long Valley breeding population occurs in the southern portion of the PMU, generally within the area known as Long Valley. Long Valley is an east-west oriented caldera situated between the Glass Mountain range on the north and the Sierra Nevada on the south (see Section _____ for a complete description of location and habitats within the PMU). It is located approximately 30 miles (48 km) north of Bishop and 5 miles (8 km) east of Mammoth Lakes. Major land marks within the Long Valley portion of the PMU include the Owens River, Hot Creek, Crowley Lake and Little Antelope Valley. Land within the PMU is administered by the U.S. Forest Service (USFS), Inyo National Forest, Mammoth Ranger District; the Bureau of Land of Management (BLM), Bishop Field Office; the Los Angeles Department of Water and Power (LADWP); and numerous private individuals. To date, a total of 14 strutting grounds have been identified in the Long Valley breeding complex. Of these, a total of 6 are dependable, long-term leks. Initial population monitoring efforts in Long Valley began in 1953 with the counting of just 1 lek. In 1956, another large lek (# 2) was added to the survey, followed by 5 more leks (#'s 3a, 4, 5, 6 and 7) in 1957. In 1960, two large leks (#'s 8 and 9) were discovered. Lek 10a was added to the survey in 1973 followed by leks 11 and 12 in 1979 and lek 13 in 1981. A final lek, #14, was discovered and added to the survey in 1989.

The Parker breeding population is located in the extreme northwest portion of the PMU in vicinity of the north June Lake Loop, around Grant Lake and Parker Creek, and the southern half of the Mono Basin. It is located approximately 10 miles (16 km) north of June Lake and 6 miles (9.6 km) south of Lee Vining. CDFG file information indicates that biologists were aware of strutting activity in the Parker Meadows as early as 1953. However, because the Parker population provided little in the way of hunting opportunity when compared with the Long Valley and Bodie Hills segments, formal lek counts were not conducted. As a result, long term lek data for determining trend is not available for the Parker breeding population. Beginning in 2002, a heightened awareness regarding the questionable status of sage-grouse in Mono county, lead to increased monitoring of known lek sites and increased efforts to identify new grounds. According to CDFG file information, only two years of lek data (2002 and 2003) exist for the Parker breeding complex where a total of 3 strutting areas have been identified. Of these 3 sites, only one of the grounds appears to be a dependable, long term lek based on the number of breeding males counted there in the past two years.

The Granite Mountain breeding complex is located south of Mono Lake along the northern flank of the Glass Mountain range, from Big Sand Flat east to Adobe Valley. To date, two lek sites, Adobe and Gaspipe, have been identified in the Granite Mountain area. Adobe Lek, the easternmost site, has been monitored annually since 1984. Gaspipe Lek, discovered in 1990, has been monitored annually since that time. An historic lek in Big Sand Flat has not been active in recent years. Although the Granite Mountain area is treated as a breeding complex for the purpose of this discussion, it is unknown whether sage-grouse using Adobe and Gaspipe Leks interact with each other and/or with the Long Valley, Parker or Bodie Hills populations. There is some evidence that Adobe Valley is used by sage-grouse from Long Valley during winters of heavy snowfall. The wintering area identified in 2003 for Parker Meadows sage-grouse is very near the area known to be used by Gaspipe sage-grouse in the spring.

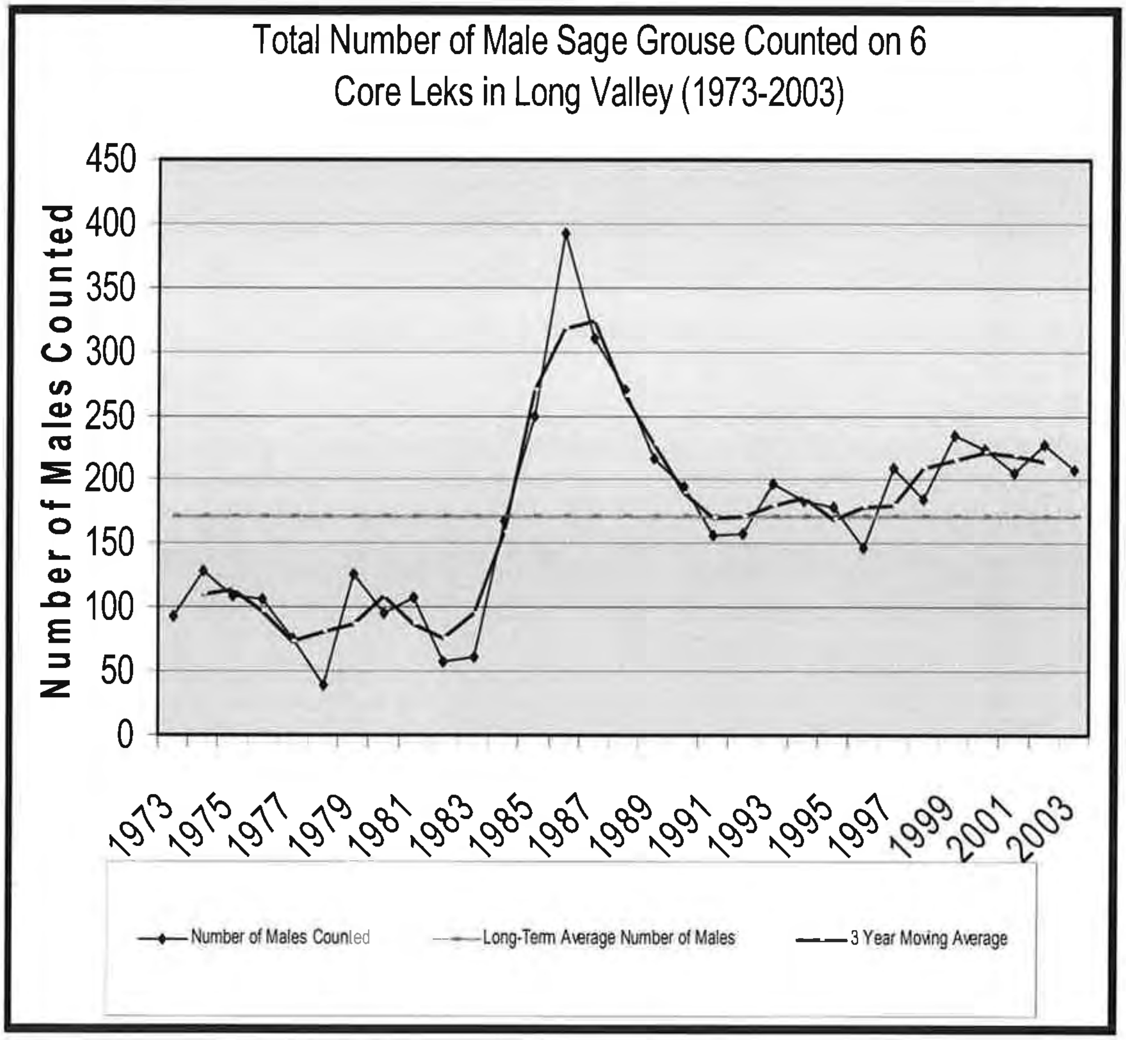
Population Estimates

Two population expansion estimators, Emmons and Braun (1984) and Walsh (2002), were used to estimate the upper and lower limits of the most recent spring sage-grouse population in the South Mono PMU. The low estimate (Emmons and Braun 1984) assumes that there are 2.00 hens per male, while the number of undetected males (adult males not attending leks and immature males) is 25% that of visible males. The high estimate (Walsh 2002) assumes that only 50% of all males attend leks and that there are 2.73 hens per male. The assumption that 10% of all leks in the PMU are still undetected was applied to both estimators.

Based upon the average of peak lek counts conducted from 2001-2003, the most recent spring population estimate for the Long Valley was between 1,015 and 1,515 grouse. For Parker, the most recent spring population estimate, based on only two years of available data, was between 71 and 106 grouse. For Granite Mountain, the most recent spring population estimate based on the last three years of data was between 39 and 58 grouse. Thus, cumulatively, these three subpopulations comprise a current spring population estimate of between 1,125 and 1,680 grouse in the South Mono PMU. Of these, approximately 90% occur within the Long Valley breeding complex.

Long Valley Population Trend. Six core leks (1, 2, 4, 8, 9 and 10a) were used to assess the long term breeding population trend in Long Valley from 1973 to the present. These six leks were used for establishing long term trend because they have 1) been counted by sage-grouse managers on a consistent basis since 1973, and 2) functioned as core leks combining to average 87% of all breeding males counted annually in the Long Valley breeding complex. The highest total number of strutting males observed on the 6 core leks combined, for years in which adequate sample size was obtained, was 363 grouse in 1986 (Figure 8.3.1). Since 1973, the average number of males, hereafter referred to as the long term average, counted on the 6 core leks combined was 171 grouse (Figure 8-7).

Figure 8-7. Total Number of Male Sage-Grouse Counted on Six Core Leks in Long Valley (1973-2003).

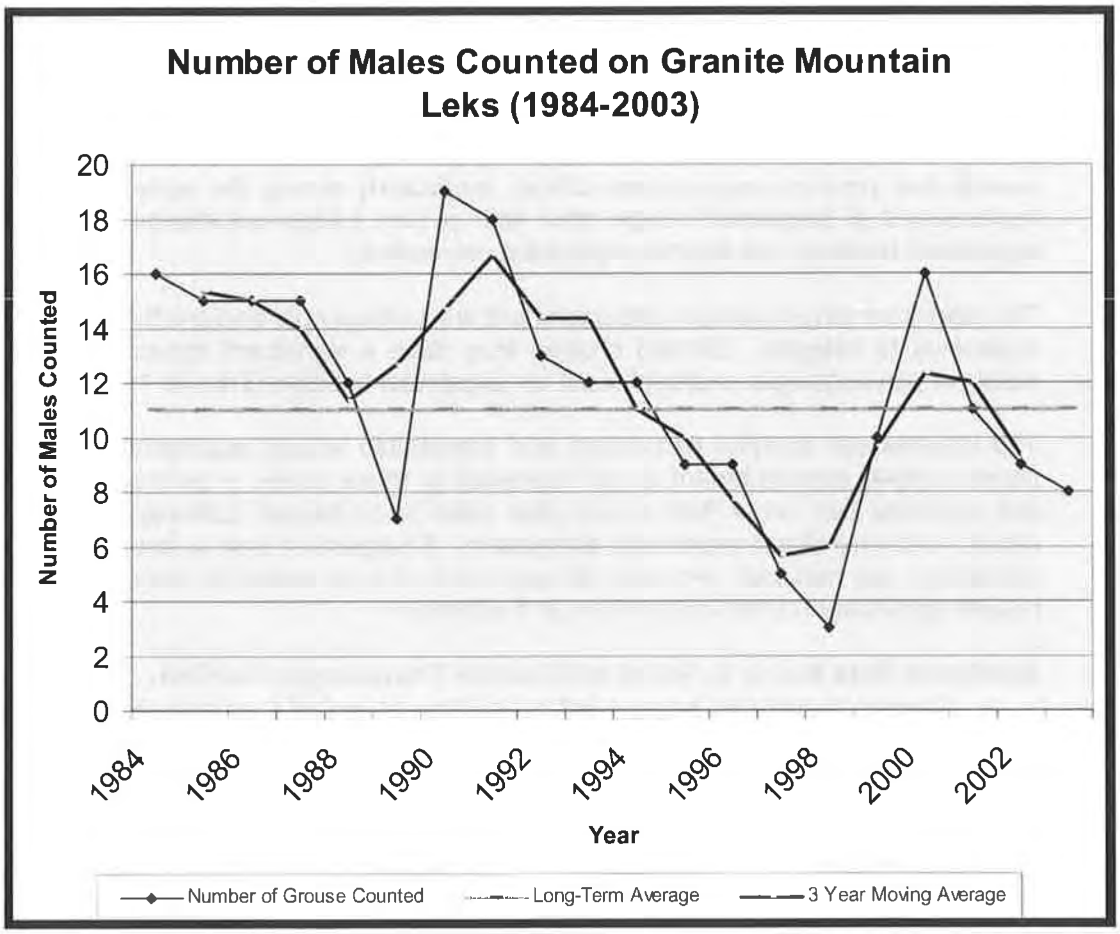


The long term trend in breeding population for Long Valley was evaluated from 1973 to the present for the 6 cores leks using a three year moving average, where each year is an average of that year and the year before and after. This trend was marked by several distinct changes in spring population, which appear related to changes associated with fall sage-grouse hunting regulations in Mono County (Figure 8.6). From 1973-1983, three year averages for the number of males counted on core leks ranged from 43 percent to 67 percent of the long term average (Figure 8.6). This low trend in population coincided with a period from 1970-1982 when licensed sage-grouse hunting occurred annually in Mono County.

Granite Mountain Population Trend. Only two active leks, Gaspipe and Adobe, are known within the Granite Mountain area. Although Granite Mountain is within the boundaries of the South Mono hunt zone, hunting pressure is thought to be relatively light due to the area's remote location and small population size. Survey data from Adobe Lek have been collected continuously since 1984, while data from Gaspipe Lek have been collected since 1990. The high peak male count for both leks combined was 19 grouse in 1990, while the low was just 3 grouse in 1998 (Figure 8.7). The long-term average for the 20 years of existing data was 11 males. The long-term average might be higher if pre-1990 data were known for Gaspipe Lek, as high counts for Adobe Lek were in the mid 1980s.

The long term trend in breeding population for Granite Mountain was evaluated for the period from 1984-2003. From 1984-1993, the 3 year trend in population ranged from 130 percent to 150 percent of the 20 year average (Figure 8.7). This trend declined from 1994-1999, when 3-year averages ranged from 50%-100% of the long-term average. The current trend in population has declined to approximately 20% below the long-term average (Figure 8-8).

Figure 8-8. Number of Males Counted on Granite Mountain Leks (1984-2003).



Parker Population Trend. Although CDFG has known about the presence of the Parker breeding complex since 1953, lek data are only available from 2002 and 2003 when formal surveys were first initiated. The peak single day male count at Parker was 17 grouse in both of these years.

8.4 South Mono PMU Risk Assessment and Conservation Actions

Existing and potential risks for the South Mono PMU include grazing management, recreation, hunting, poaching, landfill, predation, wild horses, fences and transmission lines, fire/fire suppression/controlled burns, pinyon-juniper encroachment, water management, urbanization/changing land use, mining/geothermal development, succession – habitat degradation, cheatgrass / invasive exotic plants, road kill hazards, scientific study, herbicides, and lack of information. Some of the most critical risk factors are discussed in detail below.

8.4.1 Pinyon-Juniper Encroachment

Pinyon-juniper (PJ) encroachment is occurring in portions of the PMU. PJ habitats run primarily from the Northern part of the PMU along the Nevada/California border from the eastern part of the Mono Valley through the Inyo National Forest from Deep Wells to the Adobe Hills. The PJ habitats skirts around Adobe Valley and runs south along the Benton Range. There are also smaller pockets of PJ in the northern part of Long Valley. Pinyon-juniper can provide additional nesting and perching habitat for predatory birds such as ravens that prey on sage-grouse chicks, particularly during the early brood stage. The replacement of sagebrush range sites with pinyon juniper-woodlands is fragmenting the sagebrush habitats and diminishing habitat connectivity.

The risks from pinyon-juniper encroachment are manageable and predictable, but potentially expensive to mitigate. Climate change may have a significant impact on the speed and extent of pinyon/juniper encroachment on sagebrush habitats (Trimble 1989).

The impacts can become permanent and irreversible without appropriate management. If pinyon-juniper encroachment is not managed in these areas, a permanent change of the site potential can occur that would alter plant successional pathways and preclude the natural recovery of the sagebrush ecosystem. If sagebrush and its associated herbaceous understory are replaced, recovery of sagebrush sites to desirable sage-grouse habitat will require significant human intervention and expense.

Additional Data Needs to Verify and Further Characterize the Risk:

- On-site inventories are needed to rank the "stage" of encroachment and identify sites with the highest potential for recovery if trees are removed.
- Monitoring bird movements with radio telemetry is needed to verify population distribution patterns in relation to habitat connectivity.
- Identify critical habitat areas with pinyon-juniper encroachment for potential treatment.

Initial Conservation Strategy:

Identify quality sagebrush habitats adjacent to sage-grouse use areas where young PJ trees are becoming established for the initial PJ control projects. The PJ density should be low (10%) to maximize success. Photo points should be established for long term monitoring.

Review the WAFWA Guidelines and consult with local range ecologists to determine the criteria for site selection and the appropriate size of the treatment area.

Conservation Action: Pinyon Juniper Reduction

Risk: Loss of sagebrush habitat in the South Mono PMU due to encroachment of pinyon-juniper.

Objective: Remove pinyon-juniper overstory where it is encroaching into sagebrush habitat adjacent to sage-grouse seasonal use areas.

Action: Remove pinyon-juniper overstory by organizing and directing Christmas tree and firewood cutting in areas identified by PMU working group.

Rationale: Areas to be identified by the PMU working group will have the greatest potential to return to good quality sage-grouse habitat once pinyon and juniper are removed.

Legal Authority: Projects addressing this risk are within the management responsibility of the Inyo National Forest and the BLM.

Procedural Requirements: Projects addressing this risk are within the management responsibility of the Inyo National Forest and the BLM.

Level of Partnership Commitment: Both USFS and BLM plan to continue to work closely with local groups to allow Christmas tree cutting in areas identified as key PJ thinning areas.

Funding Source: Quail Unlimited is a proposed partner in this project. The National Forest and BLM will use volunteers to oversee the project.

Implementation Process:

1. Project Planning: Forest Service and BLM (2004):
    a. Identify action locations.
    b. Enter into budget planning.
    c. Identify Proposed Action for treatment
    d. Schedule Heritage and Biological surveys
    e. Complete Environmental Analysis.
2. Project Implementation Forest Service and BLM (2005):
    a. Budget for project
    b. Budget for Partners
3. Project Monitoring: Forest Service and BLM (2005-2006):
    a. Forest Service and BLM monitor implementation for consistency with the proposed action. Monitor change in percent canopy cover of pinyon-juniper before treatment and one year after treatment. Complete additional treatment required to accomplish the project proposal.
    b. California Department of Fish and Game along with BLM, USFS, and USGS continue monitoring sage-grouse populations through lek counts for changes in numbers of males visiting leks and through radio telemetry monitoring of sage-grouse.
    c. Report accomplishment to USFWS, Reno Office.

8.4.2 Urbanization/Changing Land Use

Although private lands comprise only a small amount of this PMU, the impacts from these lands can be far reaching. In addition, expansion of existing infrastructure within the PMU such as the proposed Mammoth Airport expansion could increase potential conflicts between urbanization and sage-grouse habitats within the PMU.

Additional Data Needs to Verify and Further Characterize the Risk:

- Identify current zoning ordinances on private lands within the PMU.
- Develop a map of private lands areas with critical habitat concerns.

Initial Conservation Strategy:

- Establish partnerships with private landowners and determine their interest in conservation planning and federal conservation incentive programs for private lands.
- Provide habitat assessments on private land to identify management opportunities for sage-grouse.
- Support zoning that will maintain, enhance, or preserve critical sage-grouse habitat.
- Identify, propose, and initiate land acquisition and conservation easement opportunities for important seasonal sage-grouse habitats under current/future threat of development.

8.4.3 Fences/Transmission Lines

Construction of transmission lines, roads, airstrips, and fences are risks to sage-grouse in the South Mono PMU that affect habitat quantity and populations on a yearlong basis. Breeding habitats, brood habitats, and migratory habitat can be impacted. Transmission lines provide perches for predatory birds. Sage-grouse mortality caused by direct impacts to fences has been documented in the South Mono PMU. Lek numbers 13, 7, and 14 are in close proximity to transmission lines. A transmission line from Little Antelope area to the Glass Mountains goes through a lek area, brooding, nesting, and wintering habitats. A sage-grouse use area on the south side of Highway 395 is being impacted by a transmission line. A local transmission line on Benton Crossing Road is potentially impacting sage-grouse in the area. Future geothermal development near Mammoth may expand transmission line corridors.

New developments that pose this type risk are being managed on federal lands in conjunction with the National Environmental Policy Act (NEPA) process, and on private lands in California in accordance with the California Environmental Quality Act (CEQA). This risk has the potential to affect breeding, nesting, and roosting habitats. This risk could also affect the connectivity of the habitat for sage-grouse movements.

Factors that modify the risk include snow cover, brush height, design of both fence and transmission line structures, location of structures, habitat type, land ownership, competing land uses, bird behavior, and adjacent land uses. Fences are a valuable rangeland management tool. Mitigation of potential impacts to sage-grouse caused by fences includes their design (such as let down fences) and placement.

Raptor perch inhibitors are being used on some transmission line poles within the PMU. However, these perch inhibitors are only on the insulators and not on the center of the poles.

Additional Data Needs to Verify and Further Characterize the Risk:

- Research current and future planning/project documents in regard to new fencing or transmission lines.
- Map the current extent of fences and transmission lines within the South Mono PMU and identify the type of fence and power line/pole construction.
- Conduct radio telemetry monitoring of sage-grouse to determine seasonal movements and to facilitate identifying the causes of mortality to telemetered birds. Use this information to identify potential conflict areas such as specific transmission lines that are being used as perch/hunt areas by raptors, and to fences that bisect sage-grouse movement corridors and are causing direct mortality of sage-grouse. This risk is manageable and predictable and can be either inexpensive or expensive to mitigate.
- Determine the seasonal peaks of raptor predation.

Initial Conservation Strategy:

- Work with land management agencies and land owners to mark new fences, install let down fences or relocate fence construction away from critical habitat areas.
- Maintain existing corridors for power lines and transportation routes. Locate new utility corridors away from critical sage-grouse habitat.
- Modify aerial structures to prevent avian predator perching or nesting. Work with transmission line companies to modify or add raptor perch inhibitors in critical areas.
- The let down fence adjacent to lek 2 is working. Extend a portion of that fence line to further reduce mortalities.

8.4.4 Recreational Activities

Risks to sage-grouse populations in the South Mono PMU from recreational activities are affecting multiple birds on multiple sites year round, but especially during the breeding and nesting seasons. Some critical sage-grouse habitats in the South Mono PMU are accessible for public recreation year round. This risk potentially affects sage-grouse habitat quality and quantity as well as the population. The timing of the recreational activities coincides with the July 4th trout fishing opener, deer season (fall season), and during the month of May when the Mammoth motocross event occurs. The motocross event requires a USFS permit. This risk is manageable but sufficient effort is required to mitigate potential impacts via policy, permit recommendations, and enforcement.

Factors that may modify the risk include the likelihood of increased urbanization and visitation to the area, the increase in special events, and any significant changes in timing of events. Other factors that may modify this risk are weather, habitat quality, sage-grouse population levels, and wild horse population levels. Managers will have to be alert to the possibility of increases in public use in some areas following restricted public use in other areas.

This risk of 'recreational activities' has been documented by the observation of all night activities, observations of angler and hunter camping adjacent to key sage-grouse habitats during sensitive periods in sage-grouse life history, strutting sage-grouse observed flushing when approached by large groups of people, and the direct observation of dog training activities within the PMU. Also, the PMU group members have in general observed an increase in human presence in the Crowley Lake and Long Valley area over time.

Additional Data Needs to Verify and Further Characterize the Risk:

- Identify seasonal use areas by sage-grouse in the South Mono PMU by radio telemetry and use this information to evaluate potential recreational impacts to sage-grouse and their habitat. Using radio telemetry monitoring, evaluate the relationship between nest abandonment incidents and recreational activities; between snowmobile use and winter sage-grouse use areas; and between fishing activities and sage-grouse use areas.

- Obtain and deploy trail counters, and evaluate data obtained by them.

- Evaluate recreational activities that may modify habitat, such as hot tub users modifying channels, and OHV off-trail riding.

Initial Conservation Strategy:

- Limit public access to lek sites during the breeding season.

- Establish wildlife-viewing points for the public at safe distances from the leks and develop educational programs and materials to inform people about the problems caused by human disturbance. Coordinate educational activities through Bird Chautauqua, Audubon, and other conservation groups.

- Limit the use of snowmobiles and discourage other winter recreation activity within critical winter habitats.

- Deploy trail counters, analyze data and adjust trail use (closures, reroutes) as needed to minimize disturbance to sage-grouse if activities are determined to be impacting sage-grouse population stability.

- CDFG coordinate with local land management agency biologists when evaluating special use permits (motocross, special hunts, dog training) to ensure that best available information is used when developing special conditions for the permits.

- Request increased law enforcement activities at specific times/events to insure regulations/permit requirements are followed.

- Close redundant roads.

- Establish a threshold of recreational disturbance that will trigger specific emergency actions.

8.4.5 Predation

Predation on sage-grouse is a threat to the population that is affected by many conditions including availability of other prey species, habitat condition, and climate. The range and size of predator populations can be expanded by human activities such as road and fence construction, landfills, and housing development. Predator densities can also increase with the number and availability of prey species. However, predation pressure may vary unpredictably with predator density. Management of predatory species is possible and has been performed in the past. Active predator control should be considered a last resort conservation strategy and performed by Wildlife Services of the Animal, Plant and Health Inspection Service within the Department of Agriculture. Free-roaming domestic animals (e.g. cats or dogs) represent an additional predation risk. Enforcement of leash laws is under the jurisdiction of Mono County. Facilitation of predation by raptors through the presence of utility poles and transmission lines is another predatory risk and addressed separately.

Additional Data Needs to Verify and Further Characterize the Risk:

- Through radio telemetry monitoring, evaluate sage-grouse mortality rates and causes.
- Evaluate raven and gull populations associated with local landfills or refuse exchange centers.
- Evaluate the effects of active predator control on population dynamics of sage-grouse.

Initial Conservation Strategy:

- Educate private landowners to reduce predation by domestic pets.
- Provide optimal habitat of sage-grouse for all seasons to minimize predation.
- Reduce raven and gull populations associated with local landfills or refuse exchange centers via prudent refuse management practices or propose to move refuse site.
- Avoid routing overhead transmission lines through critical habitat (e.g. leks, brood rearing areas).

8.4.6 Sport Hunting

Sport hunting is the physical act of removing individual birds from the population during a regulated season and by regulated methods of take (shotgun, archery, falconry). However, hunting seasons are only scheduled when specific population criteria are met. Sport hunting of sage-grouse occurs within the South Mono PMU within a designated hunting zone called the South Mono/Inyo Hunt Zone. This zone is illustrated in the genetic sampling area map in Chapter 2. This hunt zone includes portions of Mono and Inyo counties. A portion of the hunt zone is closed to hunting in order to reduce take of adult hens that often use the meadow area adjacent to lek #2 during the late summer and early fall season. The hunting season for sage-grouse in the South Mono PMU is a two day permit only hunt. Permit numbers are based upon population levels and are adjusted annually as necessary.

From 1984-1987, the Department of Fish and Game closed all licensed sage-grouse hunting in Mono County. During this same period, the trend in population increased, reaching peak

3-year levels of 186 percent and 190 percent of long term average in 1986 and 1987, respectively (Figure 8.6). Therefore, it appears that in the decade prior to the 1984-1987 season closure, the sage-grouse population in Long Valley was approximately one-quarter of its peak unhunted density. Licensed sage-grouse hunting in Mono County was again reopened in 1987, but this time under a limited permit system. Permits were issued each season through a statewide drawing for two specific hunt areas, North Mono and South Mono. From 1987-1990, a total of 250 single bird permits were issued annually for the South Mono hunt area, which included both the Long Valley and Granite Mountain areas (Table 8-4). During this same period, the trend in breeding males steadily declined to about even with the long-term average, or about half of the unhunted density observed from 1984-1987 (Figure 8.6).

Table 8-4. Permit Numbers Authorized for the North and South Mono Hunt Areas, Inyo-Mono Counties, California, 1987-2002.

YEAR	NUMBER OF PERMITS		BAG LIMIT (PER SEASON)	SEASON DATES
	SOUTH MONO	NORTH MONO		
1987	250	300	1/1	Oct. 10-11
1988	250	300	1/1	Oct. 8-9
1989	250	300	1/1	Oct. 14-15
1990	250	300	1/1	Oct. 13-14
1991	125	450	1/1	Oct. 5-6
1992	125	450	1/1	Oct. 3-4
1993	125	300	1/1	Oct. 2-3 (falcon Oct 9-Dec 7)
1994	125	300	1/1	Oct 1-2 (falcon Oct 8-Dec 6)
1995	100	150	1/1	
1996	50	150	1/1	
1997	50	100	1/1	
1998	20	20	1/1	
1999	20	20	1/1	
2000	25	25	1/1	
2001	25	25	1/1	
2002	25	25	1/1	Sep 14-15 (falcon Oct 1- Dec 2)

From 1991-1994, the quota in the South Mono hunt zone was reduced to 125 single bird permits (Table 8.4). During this same period, the trend in population continued to hover around the long-term average (Figure 8.6). From 1996 and 1997, despite another quota reduction to 50 single bird permits (Table 8-4), the trend in population remained about even with the long-term average. Since 1998, the trend in population has stabilized at between 123 percent and 129 percent of the long-term average (Figure 8.6). This trend coincided with yet another quota reduction to 25 single bird permits in the South Mono hunt zone (Table 8-4).

CDFG's current limited-quota permit system is effective because it eliminates the potential for excessive over harvest due to weather and other influences. Additionally, the current system employs a mail-in hunter reporting system that provides wing data necessary for evaluating harvest and production trends.

Initial Conservation Strategy:

- Continue routine population monitoring to assess trends in breeding populations and annual production.

- Permit and schedule hunting seasons only when specific population criteria indicate that the population will not suffer from loss of individuals.

Conservation Action: Licensed Hunting Management

Risk: Direct mortality of sage-grouse from licensed hunting in the PMU.

Objective(s): Ensure that licensed hunting does not adversely affect sage-grouse populations in the South Mono PMU. Maintain the current conservative approach to managing sage-grouse harvest levels in the South Mono PMU.

Actions:

1. Develop and implement a comprehensive strategy for the management of licensed sage-grouse hunting in the South Mono PMU.
2. Maintain a conservative approach to managing harvest levels through the current limited-quota permit system.
3. Identify population thresholds for season closures.
4. Incorporate population trend data into permit allocation decisions.
5. Modify hunt area boundaries to more accurately reflect breeding populations or to protect sub-populations at risk.
6. Adjust season dates as necessary to moderate disproportional harvest of females and broods on water sources.
7. Improve hunter feedback requirements to facilitate data collection opportunities.
8. Coordinate and standardize harvest management strategies with NDOW to ensure that similar limited-quota harvest methods are adopted and employed within the Bi-State area.
9. Re-evaluate this Hunting Action Plan annually.

Rationale: It is important that the CDFG develop a comprehensive harvest management strategy for sage-grouse in the South Mono PMU, with criteria for making harvest management decisions based on population trend, annual hunter success, and weather influences. Additionally, the plan should specify hunter reporting requirements and how these data will be used to evaluate harvest and production trends. Most importantly, the plan should be coordinated with NDOW to ensure that similar limited-quota harvest strategies are adopted and employed throughout the Bi-State area. Finally, the plan should be reviewed an updated annually using an adaptive management approach.

Legal Authority: All actions addressing this risk are under the management authority of the California Department of Fish and Game.

Procedural Requirements: The California Department of Fish and Game will develop a formal harvest management plan for sage-grouse in the South Mono PMU.

Level of Partnership Commitment: The CDFG is committed to improving all aspects of harvest management within the South Mono PMU. The South Mono PMU Planning Group members have expressed a clear desire to improve upon existing hunting management where possible.

Funding Source(s): The Sage-grouse Harvest Management Plan for the South Mono PMU will be developed by the California Department of Fish and Game.

Implementation Process:

1. Review existing harvest management actions and population trend information within the South Mono PMU.
2. Develop a Harvest Management Plan for the South Mono PMU.
3. Implement the Harvest Management Plan.
4. Annually review and, if necessary, update the Harvest Management Plan based on the most current population trend and hunter harvest information.

8.4.7 Poaching

Local California Department of Fish and Game Wardens and other local law enforcement offices are aware of the sage-grouse hunting season and any suspicious activity is investigated. There are no recent accounts of sage-grouse poaching within the PMU. The effectiveness of law enforcement is influenced by budgetary constraints and increased urbanization.

Additional Data Needs to Verify and Further Characterize the Risk:

- Obtain reports from Game Wardens, other patrol officers, and citation records from local courts.

Initial Conservation Strategy:

- Contact all law enforcement offices within the South Mono PMU prior to the hunting season each year and provide them with the updated regulations. Ask them to report any poaching activity to the PMU leader. Adjust strategy as needed based upon the feedback from law enforcement offices.

- Increase public awareness regarding sage-grouse conservation efforts and hunting regulations.

- Provide sage-grouse hunting regulations with X Zone deer tag packets.

- Increase penalties and limit road access.

8.4.8 Livestock Grazing

Livestock grazing occurs throughout the South Mono PMU under the authority, permitting, and management of the US Forest Service Inyo Ranger District, and the Bureau of Land Management Bishop Field Office.

Fences are an essential part of livestock grazing operations; however, the type and position of fences used in livestock operations may result in grouse mortality (See Fence/Transmission Line Risk 8.4.3).

Factors influencing the risk of livestock operations include environmental (e.g. drought, late or heavy snowfall), water use, invasive or exotic plants and adjacent land use/allotment decisions.

Additional Data Needs to Verify and Further Characterize the Risk:

- Monitor utilization or stubble height at known nesting sites prior to the nesting season.
- Monitor utilization or stubble height on late brooding habitat.
- Monitor birds movements with radio telemetry to identify nesting, early brood, and late brood habitats.
- Identify habitat used during late fall and winter, particularly during heavy snow years.
- Identify roosting sites using radio telemetry.
- Determine the site potential of nesting habitat to produce optimal habitat conditions for nesting.
- Monitor vegetation trends to determine the status of current conditions in comparison to the potential natural community (PNC).
- Inventory and conduct Proper Functioning Condition (PFC) evaluations on meadows and riparian habitats used or potentially used by sage-grouse.
- Identify irrigation patterns (when and where) and determine the process for making irrigation decisions.

Initial Conservation Strategy:

- Maintain current grazing management practices on National Forest allotments where current utilization levels are consistent with maintaining or enhancing nesting and brood habitats.
- Distribute livestock by using supplements, water distribution and fencing (preferably let-down fences) when potential habitat degradation is indicated.
- Use an adaptive management approach during drought periods to modify grazing if cover requirements for nesting are not met.
- Conduct educational workshops for livestock operators on grazing strategies and methods for maintaining or improving sage-grouse habitat.
- Coordinate management activities and communication among agencies, ranchers and researchers for clarification of problems and a more effective adaptive management approach.
- Construct exclosures on selected meadows if it is determined that complete rest from grazing would benefit sage-grouse habitat conditions.

- Maintain sage-grouse use on all currently used meadows.

- When possible, modify water sources to restore wet meadow and riparian habitats.

8.4.9 Overall Sagebrush Habitat Condition

The South Mono PMU has an impressive mosaic of sagebrush communities. Much of the habitat is in fairly good condition, with no major areas of invasive plant species. Some PJ encroachment is evident throughout the PMU but further investigation of the effect of this encroachment on sage-grouse populations is warranted before PJ management is enacted. Sagebrush is old and decadent in some areas with little desirable understory. Other factors that affect the quality of sagebrush habitats include wildfire, drought, insects, and range improvement budgets for federal land management agencies.

Additional Data Needs to Verify and Further Characterize the Risk:

- Quantify and map vegetation types to document the age and structural character of sagebrush in key areas.

- Review National Forest Management Guidelines for approved land management techniques.

- Monitor condition and trend of key sagebrush habitats in terms of sage-grouse habitat requirements.

- Conduct rangeland health assessments on key sagebrush habitats.

Initial Conservation Strategy:

- Emphasize monitoring, analysis, and management of sagebrush range sites for sage-grouse on public lands.

- Integrate specific objectives for sage-grouse habitat into land management plans.

- Conduct workshops for livestock operators and private landowners on management techniques that can be used to maintain or enhance sagebrush habitats.

- Increase fire suppression priorities in critical sagebrush habitats, particularly areas prone to cheatgrass invasion.

8.4.10 Wild Horses

Local risks to sage-grouse exist from wild horse populations primarily in the Granite Mountain area. Preferred foraging areas for wild horses are the meadows, riparian and spring-influenced areas (such as River Springs in Adobe Valley) also used by grouse during nesting and brood rearing stages, potentially resulting in habitat degradation and population disturbance. Environmental factors, such as drought or wildfire, may influence the degree of risk posed by wild horses. Mountain lion predation may influence wild horse numbers or location within the PMU.

No Herd Management Area (HMA) or related goals, or Appropriate Management Level (AML) exist for wild horses in the South Mono PMU. Wild horse management is performed under the authority of the BLM and Forest Service.

Additional Data Needs to Verify and Further Characterize the Risk:

- Evaluate wild horse population size and areas of use in relation to grouse use areas.
- Evaluate and document the impact of wild horses on nesting and brood rearing habitats of grouse.

Initial Conservation Strategy:

- The BLM and Forest Service should complete an HMA Plan with an established AML.
- Emergency plans should be adopted to gather wild horses moving out of the HMA or if population numbers increase above AML.

8.4.11 Mining/Geothermal/Energy Development

The South Mono PMU has numerous existing and potential sites for resource extraction, including but not limited to sand and gravel, hard rock mining, wind energy, and geothermal resources. The majority of these activities occur on public lands (BLM, FS, County/LADWP lands) as most of the lands (~97%) within the PMU are public lands. Risks from these activities to sage-grouse may affect habitat quality, habitat quantity and the population directly. The effects from these risks can occur at any time throughout the year, including the nesting, brood rearing, and winter season. Potential effects on habitat can occur at multiple scales and multiple sites depending on the scope and nature of the development. The effects of these types of activities on existing sage-grouse populations within this PMU could be on individual or multiple birds with the potential for cumulative effects on all birds in the PMU.

The risk to sage-grouse from mining/geothermal/energy development can occur at any time throughout the year. These types of operations have taken place in the past in varying degrees, and are now occurring at multiple sites within the PMU (geothermal energy plant, sand and gravel operations, hard rock mining, etc). These types of developments are predicted to increase in the future although there are no current hard rock, geothermal or sand and gravel applications for new development on file at this time. Some of the operations already proposed or in place are described below.

1. Basalt Canyon Exploration Project Description (approved, one well already drilled)

This geothermal exploration well project, termed the Basalt Canyon Exploration Project (Project), is located west of U.S. Highway 395 (US 395) and north of California Highway 203 (Highway 203), entirely on Inyo National Forest (INF) lands within the Mono-Long Valley Known Geothermal Resource Area (KGRA) (sites are on Federal Geothermal Leases CA-11667 and CA-14408, within Section 31, Township 3 South, Range 28 East (T3S, R28E), and Section 36, T3S, R27E, Mount Diablo Baseline and Meridian (MDB&M)). Mammoth Pacific, L.P. (MPLP) proposes the following activities as part of the Project: construction of two well sites (out of seven possible locations) including drilling pads and a reserved pit for the storage of waste drilling mud; the improvement or construction, as necessary, of required access roads to the two constructed well sites; the drilling (and redrilling, as may be necessary) of up to two geothermal resource exploration wells; the flow-testing of each drilled well into portable storage tanks; the flow-testing of each drilled well into the other exploration well drilled as part of this Project via a temporary pipeline laid along the access road(s); and the continued monitoring of well pressure and other data in each well. MPLP commenced operations in the fall of 2001 and eventually completed the first of the two permitted exploration wells.

2. Basalt Canyon Pipeline Project Description (proposed and being evaluated)

The purpose of the project is to develop and produce geothermal fluid from Federal Geothermal Lease CA-14408 and deliver this fluid to the existing MPLP power plants located on private lands east of U.S. Highway 395 at Casa Diablo. These fluids are needed because the existing project wells are producing less and cooler geothermal fluid to the power plants than was the case during the first years of their operations (an expected outcome of any type of geothermal development). As a result, these two power plants currently produce less electrical energy than they were designed and permitted to produce. New replacement or "make-up" wells are needed to supply additional, hotter geothermal fluid to these power plants to increase their electrical output back up to the original design and operating capacity. The Basalt Canyon Geothermal Pipeline Project is designed to interconnect with, and supply this additional, hotter geothermal fluid to these power plants.

Five drill holes have been previously approved for the Basalt Canyon Geothermal exploration program (81-36, 12-31, 23-31, 35-31, 55-31). Two of these five drill holes will be constructed as geothermal wells. Exploration well 12-31 has been completed and a production well is planned for this site (the pipeline would extend at least as far as this site). The other production well be constructed depending on the results from exploration at the other four sites. The pipeline would connect the two production wells with the geothermal power plants located on private lands at Casa Diablo. The Project would consist of the construction and operation of up to 1.8 miles (terminating at site 81-36) of nominal 16-inch diameter insulated, welded-steel pipe, which would be constructed above ground on low piers and underground where necessary to cross under existing roads.

The precise alignment of the pipeline could vary slightly depending on final engineering and actual conditions encountered in the field. The pipeline is routed to pass by each of the five previously approved potential well sites that could supply geothermal fluid, although the pipeline would only be constructed from the western-most well to actually be connected to the pipeline. A maximum of 9,500 feet of production pipeline would be required to reach from the westernmost well site (81-36) to the interconnection point with the existing power plant production pipelines.

From the west, the pipeline route first parallels Sawmill Road on the north side, the side of the road on which four of the five potential wells are located, so that only if well 35-31 were connected to the pipeline would a short spur pipeline be needed to cross under Sawmill Road. The pipeline would be placed about 10 to 15 feet off of the edge of Sawmill Road so that the existing vegetation between the road and the pipeline would help screen the view of the pipeline from the road.

Southeast of well site 35-31 the pipeline turns east, away from Sawmill Road and towards well site 55-31. In this area the route has been selected to avoid encroaching on any of the ephemeral riparian conservation areas delineated by Inyo National Forest consistent with the direction of the Sierra Nevada Framework Plan. The route here also crosses under the existing Southern California Edison (SCE) transmission line in a manner and location that maintains SCE's existing access to the transmission line for any required maintenance.

Further east, in the vicinity of well site 55-31, the pipeline is routed through an area of vegetation mapped as Jeffrey Pine Forest where the pipeline would be hidden from view by the trees. To the extent possible, the pipeline alignment through this area will avoid existing trees. However, in those few instances were trees must be cleared, marketable logs will be disposed of according to specific instructions from the Inyo National Forest.

At the western edge of the Caltrans right-of-way (ROW) for U.S. Highway 395 the pipeline route turns southeast (between the ROW and the existing snow fence) so that the pipeline can cross under U.S. Highway 395 at right angles to the roadbed and remain on federal lands. The pipeline route in this location is well below the level of the roadbed of U.S. Highway 395 and the southbound exit ramp to California Route 203 and, thus, is hidden from the view of vehicles traveling on these roads. On the east side of the highway the pipeline route crosses under Antelope Springs Road, then parallels the east side of Antelope Springs Road southeast to Casa Diablo Cutoff Road, where it turns northeast and parallels Casa Diablo Cutoff Road to interconnect with the production well pipelines entering the power plants. All but approximately the last 400 feet of this pipeline route is located on public lands within the Inyo National Forest.

3. Upper Basalt Canyon Exploration Project Description (proposed and being evaluated)

MPLP proposes to conduct the Upper Basalt Geothermal Exploration Project (Project), consisting of two geothermal resource exploration drilling programs, on portions of Federal Geothermal Leases CA-11667, CA-11672 and CA-14407. The area to be explored, termed the Upper Basalt Geothermal Exploration Area (Project area), consists of Section 25 and portions of Section 26, Township 3 South, Range 27 East (T3S, R27E) and portions of Sections 30 and 31, T3S, R28E, Mount Diablo Baseline and Meridian. All of the lands are located within the Inyo National Forest (see Figure 3). The purpose of the proposed Project is to locate, sample, drill, test and monitor potential geothermal resource development target zones on these geothermal leases.

Nine drill sites have been proposed, with each drill site designed to explore a specific geophysical or geologic target. For the Slim Hole Exploration Program portion of the Project, MPLP proposes the construction of up to nine slim hole drill pads, each with a reserve pit for the storage of waste drilling mud, and the improvement or construction, as necessary, of required access roads; the drilling (and redrilling, as necessary) of up to nine slim holes, one each from each of the nine proposed drill sites, each to a total depth of approximately 1,500 feet (into the geothermal zone); measuring the temperature profile of each hole; bailing or flowing enough fluid from each hole to obtain a sample for water chemistry; and monitoring reservoir pressure in each hole after completion. MPLP anticipates drilling of the first slim hole to commence in the fall of 2002, or as soon as the required permits are obtained.

MPLP proposes the following activities as part of the Geothermal Well Exploration Program portion of the Project: construction of up to four well drilling pads, each with a reserve pit for the storage of waste drilling mud, on up to four of the nine proposed drill sites; the improvement or construction, as necessary, of required access roads to each of the four constructed well drilling pads; the drilling (and redrilling, as may be necessary) of up to four geothermal resource exploration wells, each to a total depth of approximately 1,500 feet (into the geothermal zone) from one of the constructed well drilling pads; the flow-testing of each drilled well into portable storage tanks; the flow-testing of each drilled well into another drilled exploration well via a temporary pipeline laid along the access road(s); and the continued monitoring of well pressure and other data in each well.

4. Rhyolite Plateau Exploration Project Description

The proposed project is located in the Rhyolite Plateau geothermal exploration area, within existing geothermal leases, in T3S R27E, Sections 14, 15, 16, 22, and 28. In general, the area is west of U.S. Highway 395 and north of California Highway 203, north of the Town of Mammoth Lakes. The purpose of the project is to locate, sample, drill, test, and monitor potential commercial geothermal resource development target zones. The proposed activities include the construction of up to eleven slim hole drill pads approximately 120 X 120 feet, construction of up to eleven exploration well drilling pads approximately 200 X 300 feet in size, and the construction of approximately 1800 feet of temporary access roads. In addition, roads used to access the exploration well sites will require the creation and/or maintenance of an all-weather surface with a minimum road bed width of ten feet, a maximum grade of ten percent, and a turning radius of no less than 50 feet. Temporary pipelines may be used between exploration wells to conduct geothermal fluid during long-term tests associated with the exploration wells. Pipelines will be laid on the surface on the disturbed shoulders of the access roads. Fugitive dust generated during construction and travel over access roads and well sites will be minimized by watering and by limiting of vehicle speeds, as necessary.

This risk is manageable through various means although some types of operations are more manageable than others. Sand and gravel operations and geothermal resources are under greater regulation by public agencies than hard rock mining activities under current management policies. The Forest Service and BLM both have management plans in effect that consider effects of proposed mining and geothermal development on sage-grouse although the level of protection may vary between agencies. The BLM considers the sage-grouse a sensitive species in California. This designation ensures potential effects on sage-grouse populations are considered in the permitting process with respect to BLM lands. The LADWP also has a policy in place that takes into consideration the potential biological effects of proposed actions on their lands. Any action taken on their lands must comply with county ordinances as well.

Market forces are probably the most important factor which will modify this risk in the future. The price of precious minerals (gold) and the need for energy and natural resources in this region will likely have a major impact on future development of these resources. In addition, urban development may increase demand for energy or resource extraction (sand and gravel for roads, etc.) and there is a potential for increased recreational activity such as OHV use if new roads are created with any future geothermal, mining, energy developments. The current philosophy of Mono County and the city of Mammoth can modify the existing risk as well. Both groups have fairly strict regulations on any new mining activities and tend to promote very strong environmental and recreation oriented policies. A summary of the review process is given below.

Evaluation Process for Geothermal and Locatable Minerals Proposals

The analysis of the majority of geothermal or locatable mineral proposals follows the highly summarized evaluation process described below. Some prospecting or exploration proposals are limited enough not to need a lengthy project description and meet the requirements for a shorter evaluation process.

1. The proponent prepares a detailed project description and submits it to the Forest Service (or to BLM for a geothermal project on a federal lease; the Forest Service works with the BLM for geothermal projects on Forest Service administered land). The project description covers all of the activities that will occur during the life of the project, including the reclamation activities that will occur once the project operation is terminated.

2. The agency reviews the proposal for completeness and if it is incomplete asks for additional information. (The back and forth dialogue between the proponent and agency can go on for some time). This part of the process involves internal review of the project by Forest Service resource specialists. Forest Service personnel can also involve resource specialists from other agencies where appropriate. This review can also result in the Forest Service working with the proponent to reconfigure or relocate proposed operations or facilities where there are obvious and avoidable conflicts with other resources.

3. Once the Forest Service (or BLM) determines the project description is complete they work through the environmental review process, including:

    a. Public notification and receipt of comments on the proposed project.

    b. Analysis of potential impacts and documentation of the analysis in an Environmental Assessment (EA) or Environmental Impact Statement (EIS) per federal National Environmental Policy Act (NEPA) requirements.

    c. Public comment on the analysis and receipt and review of comments (which may result in additional analysis or rewriting the document).

    d. Completion of a decision on the environmental analysis, which generally includes selection of the project alternative or of a modified project alternative generated during the environmental analysis.

    e. Address appeals, if any.

4. Upon completion of the environmental review, the project as described in the selected alternative is approved.

5. The Forest Service (or the BLM for a geothermal project on a Federal lease) then oversees project operations to make sure the project is implemented as approved, including completion of reclamation activities at the end of the project life.

    The first three steps in the process can take months or years to compete depending on the project complexity, location, and resources potentially impacted, and can involve consultation with numerous individuals and agencies.

Additional Data Needs to Verify and Further Characterize the Risk:

- Develop GIS layers which identify past, present, and proposed geothermal, hard rock mining, sand and gravel mining, and other energy development within the PMU.

- Initiate a study which examines the effects of current geothermal/mining/energy developments on greater sage-grouse populations within the PMU or the Bi-State region.

- Continue to gather biological data on greater sage-grouse within the PMU in order to assess potential impacts of proposed actions on current populations.

Initial Conservation Strategy:

- Incorporate conservation strategies into the respective agency management plans to ensure sage-grouse are considered when issuing land use permits, if they are not already considered.

- Examine the level of protection and consideration given to sage-grouse via the County Panning Process and work to incorporate into future guidelines.

8.4.12 Development Of Needed Data Layers To Improve Decision Making

Sage-grouse conservation must be founded on sound information and a reasonable hope that an action will have the desired impacts. Many of the risk factors identified in the South Mono PMU identify data layers that are essential for understanding and mitigating potential risks to local sage-grouse populations. Currently there are no contiguous data layers for the South Mono PMU which contain detailed landscape information for the entire PMU. Information does exist for some of the lands within the PMU but this information varies by landowner and jurisdiction. The level of information available for a variety of topics is limited to smaller parcels within the PMU, and not at the PMU scale.

Conservation Action: Development of Data Layers

Risk: This action item addresses information needs listed in several of the risk sections including PJ encroachment, geothermal risks, and urbanization.

Objective: Develop data layers which document vegetation communities, hydrologic features, geothermal areas, soil types, zoning classifications, mining and energy developments and infrastructure, and fences, roadways and power lines.

Action: Compile existing data layers for this PMU and collect new data where necessary to fill in information gaps. A project leader (a contractor or existing team member willing to fill in this role) will work with various landowners to complete each of the data layers.

Rationale: Developing the data layers would help to quantify the amount of available habitats within the PMU for seasonal use by sage-grouse. This could help to identify areas that are limited by particular habitat characteristics or areas where specific management actions could be most effective. Ongoing research into bird movements and habitat use could be combined with any or all of these data layers to aid in future decision-making processes.

Legal Authority: Many of these data layers can be compiled from existing information under the jurisdiction of the principal landowners primarily the US Forest Service, the BLM, and

LADWP. On the ground data gathering on private land would require the permission of the landowner.

Procedural Requirements: The data gathering and integration into data layers should require minimal procedural requirements. Any sensitive information incorporated into the data layers should be reviewed by the appropriate land manager.

Funding Source: Potential funding for the development of these data layers would likely come from the major land owners/managers in the area including USFS, BLM, and LADWP. Application has already been made for USGS funds to augment the ongoing sage-grouse research by helping to create some of these data layers.

Implementation Process: This projected could be implemented as soon as funds become available to do so.

Project Area: The South Mono PMU

8.4.13 Stakeholder Involvement

Private land and grazing allotments within the PMU provide some of the most productive habitats for brood rearing sage-grouse. These areas also include many heavily used leks, and important wintering areas. Land use decisions for these areas may have disproportionate effects on sage-grouse. Public support of management and policy decisions within the PMU is necessary for effective and continued implementation of management strategies and research efforts.

Conservation Action: Stakeholder Involvement Workshop

Risk: Multiple risks can be addressed including grazing, recreational activities, urbanization/changing land use, fences/transmission lines, and poaching. All risks directly or indirectly affect habitat quality or affect survival of individual birds.

Objective: Conduct a public meeting/workshop to facilitate information sharing with private landowners and provide an update of the current status of sage-grouse knowledge and research/management activities.

Action: Active involvement of private citizens will be encouraged through public announcements and contacting those individuals that showed previous interest in sage-grouse conservation activities. An initial meeting will be held in Mono County and include personnel from agencies responsible for management or research of sage-grouse or sage-grouse habitat. Periodic meetings will be held to ensure dissemination of relevant information, and keep interested parties informed of the current state of knowledge.

Rationale: Well-informed stakeholders can continue to work with agency personnel to develop viable conservation actions. Public education activities can foster involvement and a sense of ownership in management goals.

Legal Authority: Not applicable.

Procedural Requirements:

1. Public notice of meeting will be announced in popular media and interested parties will be contacted at least two weeks prior to scheduled workshop.
2. Prior distribution of findings and activity schedules among agencies is suggested to facilitate a comprehensive discussion.

Funding Source: Funding requirements of this action item are relatively modest. Funding is being sought by USGS personnel to facilitate additional meetings in the South Mono PMU. Funds from this grant should be available for a public information workshop. Agencies will be expected to provide travel arrangements for personnel attending the workshop.

Implementation Process:
1. Identification of issues/subjects of specific concern, interagency information dissemination (June 2004)
2. Workshop/Meeting announcement (July 2004)
3. Meeting Date (August 2004)
4. Identify future topics of discussion and plan additional meetings to satisfy public interest and/or resolve issues of contention.

Project Area Locations: Location to be determined on consensus and ability to address local needs in regions with active management or research or specific concerns.

9.0 Conservation Goals, Objectives, and Priorities

To be completed.
The following general concepts have not been finalized by the Bi-State Planning Group, and only represent some of the initial concepts that have been discussed. Further work on the Conservation Goals and Objectives is in progress.

Conservation Goals address the threats and guide the management actions at the local planning level. Conservation Objectives are specific, quantifiable objectives for each goal to measure progress toward the goal or make future changes to the goal in an adaptive management strategy.

9.1 Ensure No Net-Loss of Sage-grouse Breeding Populations within the Bi-State Planning Area.

Objective 1-1 Continue aerial surveys of leks.

Objective 1-2 Initiate aerial surveys in Inyo and Mono Counties.

9.2 Maintain and Restore (Improve) Sagebrush and Associated Habitats Critical to the Long-Term Viability of Sage-grouse Populations within the Bi-State Planning Area.

Objective 2-1 Map and identify key existing sagebrush habitats within each PMU that are not rated R0.

Objective 2-2 Based on sage-grouse use and distribution as indicated by telemetry, identify areas to treat on all seasonal ranges where habitat evaluation indicates pinyon juniper encroachment, or decadent or excessive sagebrush canopy may adversely affect sage-grouse habitat use.

Objective 2-3 Minimize the threat of catastrophic wildfire in sagebrush habitats.

Objective 2-4 After all affected interests agree that sufficient distribution data showing key seasonal sage-grouse habitats have been gathered, identify key areas for treatment to increase habitat quality and quantity within occupied sage-grouse habitats.

Objective 2-5 Review management activities that may contribute to the spread of noxious species to determine if additional management measures are necessary to minimize weed infestations and spread rate.

Objective 2-6 Compare historical pinyon juniper distribution with current pinyon juniper distribution to determine the amount of encroachment that has occurred.

9.3 Identify and Eliminate or Substantially Reduce Threats to Sage-grouse Populations and Habitats within the Bi-State Planning Area.

Objective 3-1 By 2005, determine if any fences near known occupied or potential sage-grouse habitat contribute to sage-grouse mortality directly or by providing perch sites for avian predators.

Objective 3-2 Evaluate whether or not pesticides/herbicides known to be harmful to sage-grouse are being used in or near occupied habitat.

Objective 3-3 Increase law enforcement presence in the area.

Objective 3-4 Evaluate areas for seasonal closures to known sage-grouse use areas during strutting and nesting seasons between February and May.

9.4 Identify and Implement Scientifically and Economically Sound Management Strategies Applicable to the Management of Sage-grouse Populations and Habitats within the Bi-State Planning Area.

Objective 4-1 - Increase law enforcement presence in the area.

Objective 4-2 Manage habitat in accordance with site potentials to optimize habitat characteristics as described by Connelly (2002) or locally approved standards.

Objective 4-3 Evaluate possibility of installing artificial wildlife water developments (guzzlers) in areas with limited and/or unreliable natural water sources where water is a limiting factor.

Objective 4-4 Evaluate all existing spring developments occurring in potential or occupied sage-grouse habitat. Repair or modify as necessary, in order to maintain water and riparian vegetation at the source.

9.5 Identify Important Data Gaps and Implement (Scientific) Data Collection Efforts Specific to Sage-grouse Populations and Habitats within the Bi-State Planning Area.

Objective 5-1 Investigate new potential lek sites through planned field activities.

Objective 5-2 Place radio collars on adult sage-grouse in each PMU by 2005.

Objective 5-3 Continue to identify and verify seasonal and critical sage-grouse habitats

Objective 5-4 Maintain wild horse populations at appropriate management levels in existing herd management areas.

9.6 Develop Active, Well Informed, Local Planning Groups Committed to the Development and Implementation of Sage-grouse Conservation Actions within the Bi-State Planning Area.

Objective 6-1	Continue the ongoing work of the Bi-State Local Planning Group.
Objective 6-2	Create working partnerships with non-governmental organizations, such as Deep Springs College, to assist with data collection.
Objective 6-3	Expand grant application efforts to obtain additional funding for specific conservation projects.
Objective 6-4	Create an "Adopt-a-Lek" program where an interested party or group can donate money to support sage-grouse conservation efforts.

10.0 Monitoring

To be completed.
The Bi-State Planning Group recognizes the importance of monitoring to identify successful conservation actions and measure conservation success. The Bi-State Planning Group is aware of efforts at the State level and between land management agencies to develop uniform monitoring protocols that will yield consistent, comparable results between various locations in the Nevada-California plan area. The Bi-State Planning Group anticipates completing the Monitoring section of this plan prior to the 2005 field season.

11.0 Adaptive Management

To be completed.
The Bi-State Planning Group is committed to the adaptive management approach for sage-grouse conservation. The following general approach is given as an initial step that identifies the primary concepts for adaptive management.

An Adaptive Conservation Strategy is a mechanism for sharing information and influencing policy across sites and ecosystems. Adaptive management practices are specific actions designed to reach conservation goals and evaluate policies (Elliot et al. 2003). The following information is summarized from the Adaptive Conservation Strategy Guide written by Elliot et al. in 2003 and published by the Point Reyes Bird Observatory on their website (http://www.prbo.org/cms/docs/consplans/ACSGUIDEweb.pdf).

Adaptive management practices are designed to reach specific management goals, test and evaluate management or policy actions. Results from monitoring and experimental studies are used to refine and augment Adaptive Conservation Plan management and policy recommendations. Adaptive Conservation Plans utilize existing information and desired outcomes to recommend management and policy actions. These two complimentary cycles are necessary to provide direction toward specific goals and measure progress from past to intended conditions.

Adaptive Conservation Plans will be designed to provide recommendations (if necessary) to habitat management, restoration, protection, monitoring, research design, policy and land use decisions, and education activities. Included should be a means to evaluate both financial effectiveness and ecological response to management efforts.

Both Passive (observational) and active (experimental) adaptive management practices will be employed. Passive practices, such as monitoring and observational research, provide useful foundations to suggest management activities. Active practices will allow comparisons between regions and conservation policies. The procurement of funding for long-term monitoring studies has historically been overlooked in many “adaptive management” scenarios. Long-term datasets are critical to evaluate the impacts of policies and management activities; especially for sage-grouse, whose populations have been identified as cyclic and/or highly variant (Crawford et al. 2004).

Adaptive Conservation Strategies require collaboration among all stakeholders, teamwork, keeping data current, shared information, effective communication, flexibility among partners and funding sources, and a result-oriented commitment to monitoring, research and management. The goals of an ACS are far-reaching, but can only be achieved through local projects. Cooperation, understanding and flexibility combined with standardized methodologies, and sound research design provides the foundation for an effective ACS. The Bi-State Conservation Plan allows for many of the key elements for adaptive conservation strategies to be built into the plan. The PMU groups form the local partnership necessary to implement local projects, promote communication and are committed to monitoring, research and management.

The Two Components of an Adaptive Conservation Strategy.

- Adaptive Management:

  - Identify management and policy recommendations, assumptions and set specific management goals for site-specific adaptive management plans.
  - Implement management actions
  - Monitor and analyze response to management actions.
  - Revise, Repeat and Reevaluate management actions or monitoring scheme.

- Adaptive Conservation Plans:
  - Synthesize findings from multiple adaptive management projects, as well as peer-reviewed, and gray literature to advance resource management recommendations and policy decisions.
  - Disseminate ACP recommendations via hard copy and on-line resources to partnering audiences and through outreach activities.
  - Evaluate and reassess specific management activities and ACPs
  - Repeat at appropriate timetables.

The Bi-State Planning Committee recognizes the value and benefit generated from cooperative information sharing and results-driven monitoring and research. As a consortium of interested parties and agencies, we will cooperatively participate in both recommending management and policy actions and in designing and implementing monitoring projects and research studies to address data gaps. This interactive and evolving effort will incorporate standardized survey methodologies, sound research design, and focus on addressing identified goals and information needs.

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To be completed.

Guidelines to manage sage grouse populations and their habitats

John W. Connelly, Michael A. Schroeder, Alan R. Sands, and Clait E. Braun

Abstract The status of sage grouse populations and habitats has been a concern to sportsmen and biologists for >80 years. Despite management and research efforts that date to the 1930s, breeding populations of this species have declined throughout much of its range. In May 1999, the western sage grouse (C. urophasianus phaios) in Washington was petitioned for listing under the Endangered Species Act because of population and habitat declines (C. Warren, United States Fish and Wildlife Service, personal communication). Sage grouse populations are allied closely with sagebrush (Artemisia spp.). Despite the well-known importance of this habitat to sage grouse and other sagebrush obligates, the quality and quantity of sagebrush habitats have declined for at least the last 50 years. Braun et al. (1977) provided guidelines for maintenance of sage grouse habitats. Since publication of those guidelines, much more information has been obtained on sage grouse. Because of continued concern about sage grouse and their habitats and a significant amount of new information, the Western States Sage and Columbian Sharp-tailed Grouse Technical Committee, under the direction of the Western Association of Fish and Wildlife Agencies, requested a revision and expansion of the guidelines originally published by Braun et al. (1977). This paper summarizes the current knowledge of the ecology of sage grouse and, based on this information, provides guidelines to manage sage grouse populations and their habitats.

Key words Artemisia, Centrocercus urophasianus, guidelines, habitat, management, populations, sage grouse, sagebrush

The status of sage grouse populations and habitats has been a concern to sportsmen and biologists for >80 years (Hornaday 1916, Patterson 1952, Autenrieth 1981). Despite management and research efforts that date to the 1930s (Girard 1937), breeding populations of this species have declined by at least 17–47% throughout much of its range (Connelly and Braun 1997). In May 1999, the western sage grouse (*C. urophasianus phaios*) in Washington was petitioned for listing under the Endangered Species Act because of population and habitat declines (C. Warren, United States Fish and Wildlife Service, personal communication).

Sage grouse populations are allied closely with sagebrush (*Artemisia* spp.) habitats (Patterson 1952, Braun et al. 1977, Braun 1987). The dependence of sage grouse on sagebrush for winter habitat has been well documented (Eng and Schladweiler 1972, Beck 1975, Beck 1977, Robertson 1991). Similarly, the relationship between sagebrush

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Sage grouse on a nest with good shrub and herbaceous cover. The nest was successful.

habitats and sage grouse nest success has been described thoroughly (Klebenow 1969, Wallestad and Pyrah 1974, Wakkinen 1990, Connelly et al. 1991, Gregg et al. 1994). Despite the well-known importance of this habitat to sage grouse and other sagebrush obligates (Braun et al. 1976, Saab and Rich 1997), the quality and quantity of sagebrush habitats have declined for at least the last 50 years (Braun et al. 1976, Braun 1987, Swenson et al. 1987, Connelly and Braun 1997).

Braun et al. (1977) provided guidelines for maintenance of sage grouse habitats. Since publication of those guidelines, much more information has been obtained on relative size of sagebrush habitats used by these grouse (Connelly 1982, Connelly et al. 1988, Wakkinen et al. 1992), seasonal use of sagebrush habitats (Benson et al. 1991, Connelly et al. 1991), effects of insecticides on sage grouse (Blus et al. 1989), importance of herbaceous cover in breeding habitat (Wakkinen 1990, Connelly et al. 1991, Gregg 1991, Barnett and Crawford 1994, Drut et al. 1994*a*, Gregg et al. 1994), and effects of fire on their habitat (Hulet 1983; Benson et al. 1991; Robertson 1991; Fischer 1994; Fischer et al. 1996*a*, 1997; Pyle and Crawford 1996; Connelly et al. 2000*b*). Because of continued concern about sage grouse and their habitats and a significant amount of new information, the Western States Sage and Columbian Sharp-tailed Grouse Technical Committee, under the direction of the Western Association of Fish and Wildlife Agencies, requested a revision and expansion of the guidelines originally published by Braun et al. (1977). This paper summarizes the current knowledge of the ecology of sage grouse and, based on this information, provides guidelines to manage sage grouse populations and their habitats.

Population biology

Seasonal movements and home range

Sage grouse display a variety of annual migratory patterns (Beck 1975, Wallestad 1975, Hulet 1983, Berry and Eng 1985, Connelly et al. 1988, Wakkinen 1990, Fischer 1994). Populations may have: 1) distinct winter, breeding, and summer areas; 2) distinct summer areas and integrated winter and breeding areas; 3) distinct winter areas and integrated breeding and summer areas; or 4) well-integrated seasonal habitats (nonmigratory populations). Seasonal movements between distinct seasonal ranges may exceed 75 km (Dalke et al. 1963, Connelly et al. 1988), which complicates attempts to define populations. Thus, Connelly et al. (1988) suggested that sage grouse populations be defined on a temporal and geographic basis. Because of differences in seasonal movements among populations (Dalke et al. 1963, Wallestad 1975, Connelly et al. 1988, Wakkinen 1990), 3 types of sage grouse populations can

Sage grouse on a nest with poor shrub and herbaceous cover. This nest was unsuccessful. Photo by Jena Hickey.

Sage grouse on winter range. Note the relatively sparse cover; without snow, the canopy cover of sagebrush in this area exceeds 20%.

be defined: 1) nonmigratory, grouse do not make long-distance movements (i.e., >10 km one way) between or among seasonal ranges; 2) one-stage migratory, grouse move between 2 distinct seasonal ranges; and 3) 2-stage migratory, grouse move among 3 distinct seasonal ranges. Within a given geographic area, especially summer range, there may be birds that belong to more than one of these types of populations.

On an annual basis, migratory sage grouse populations may occupy areas that exceed 2,700 km^2 (Hulet 1983, Leonard et al. 2000). During winter, Robertson (1991) reported that migratory sage grouse in southeastern Idaho made mean daily movements of 752 m and occupied an area $\geq$140 km^2. For a nonmigratory population in Montana, Wallestad (1975) reported that winter home range size ranged from 11 to 31 km^2. During summer, migratory sage grouse in Idaho occupied home ranges of 3 to 7 km^2 (Connelly and Markham 1983, Gates 1983).

Despite large annual movements, sage grouse have high fidelity to seasonal ranges (Keister and Willis 1986, Fischer et al. 1993). Females return to the same area to nest each year (Fischer et al. 1993) and may nest within 200 m of their previous year's nest (Gates 1983, Lyon 2000).

Survival

Wallestad (1975) reported that annual survival rates for yearling and adult female sage grouse were 35 and 40%, respectively, for poncho-tagged birds. However, Zablan (1993) reported that survival rates for banded yearling and adult females in Colorado were similar and averaged 55%; survival rates for yearling and adult males differed, averaging 52 and 38%, respectively. In Idaho, annual survival of male sage grouse ranged from 46 to 54% and female survival from 68 to 85% (Connelly et al. 1994). Lower survival rates for males may be related to physiological demands because of sexual dimorphism and greater predation rates (Swenson 1986).

Reproduction

Bergerud (1988) suggested that most female tetraonids nest as yearlings. Although essentially all female sage grouse nested in Washington (Schroeder 1997), Connelly et al. (1993) reported that in Idaho up to 45% of yearling and 22% of adult female sage grouse do not nest each year. Gregg (1991) indicated that, of 119 females monitored through the breeding season in eastern Oregon, 26 (22%) did not nest. However, Coggins (1998) reported a 99% nest initiation rate for 3 years for the same population in Oregon. The differences may be related to improved range condition that resulted in better nutritional status of pre-laying hens (Barnett and Crawford 1994).

Estimates of sage grouse nest success throughout the species' range vary from 12 to 86% (Trueblood 1954, Gregg 1991, Schroeder et al. 1999). Nest success also may vary on an annual basis (Schroeder 1997, Sveum et al. 1998*a*). Wallestad and Pyrah (1974) observed greater nest success by adults than yearlings. However, significant differences in nest success between age groups have not been reported in other studies (Connelly et al. 1993, Schroeder 1997).

Clutch size of sage grouse is extremely variable and relatively low compared to other species of gamebirds (Edminster 1954, Schroeder 1997). Average clutch size for first nests varies from 6.0 to

Sage grouse nest. Photo by Jena Hickey.

9.5 throughout the species' range (Sveum 1995, Schroeder 1997). Greatest and least average clutch sizes have been reported in Washington (Sveum 1995, Schroeder 1997).

Renesting by sage grouse varies regionally from <20% (Patterson 1952, Eng 1963, Hulet 1983, Connelly et al. 1993) to >80% (Schroeder 1997). Despite regional variation, differences in renesting rates due to age have not been documented (Connelly et al. 1993, Schroeder 1997). Because of variation in nest initiation, success, and renesting rates, the proportion of females successfully hatching a brood varies between 15 and 70% (Wallestad and Pyrah 1974, Gregg et al. 1994). Despite this variation, sage grouse generally have low reproductive rates and high annual survival compared to most gallinaceous species (Zablan 1993, Connelly et al. 1994, Connelly and Braun 1997, Schroeder 1997, Schroeder et al. 1999).

Little information has been published on mortality of juvenile sage grouse or the level of production necessary to maintain a stable population. Among western states, long-term ratios have varied from 1.40 to 2.96 juveniles/hen in the fall; since 1985 these ratios have ranged from 1.21 to 2.19 (Connelly and Braun 1997). Available data suggest that a ratio ≥2.25 juveniles/hen in the fall should result in stable to increasing sage grouse populations (Connelly and Braun 1997, Edelmann et al. 1998).

Habitat requirements

Breeding habitats

Leks, or breeding display sites, typically occur in open areas surrounded by sagebrush (Patterson 1952, Gill 1965); these sites include, but are not limited to, landing strips, old lakebeds, low sagebrush flats and ridge tops, roads, cropland, and burned areas (Connelly et al. 1981, Gates 1985). Sage grouse males appear to form leks opportunistically at sites within or adjacent to potential nesting habitat. Although the lek may be an approximate center of annual ranges for nonmigratory populations (Eng and Schladweiler 1972, Wallestad and Pyrah 1974, Wallestad and Schladweiler 1974), this may not be the case for migratory populations (Connelly et al. 1988, Wakkinen et al. 1992). Average distances between nests and nearest leks vary from 1.1 to 6.2 km, but distance from lek of female capture to nest may be >20 km (Autenrieth 1981, Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994, Lyon 2000). Nests are placed independent of lek location (Bradbury et al. 1989, Wakkinen et al. 1992).

Habitats used by pre-laying hens also are part of the breeding habitat. These areas should provide a diversity of forbs high in calcium, phosphorus, and protein; the condition of these areas may greatly affect nest initiation rate, clutch size, and subsequent reproductive success (Barnett and Crawford 1994, Coggins 1998).

Most sage grouse nests occur under sagebrush (Patterson 1952, Gill 1965, Gray 1967, Wallestad and Pyrah 1974), but sage grouse will nest under other plant species (Klebenow 1969, Connelly et al. 1991, Gregg 1991, Sveum et al. 1998*a*). However, grouse nesting under sagebrush experience greater nest success (53%) than those nesting under other plant species (22%, Connelly et al. 1991).

Table 1. Habitat characteristics associated with sage grouse nest sites.

	Sagebrush		Grass		
State	Height[a](cm)	Coverage (%)[b]	Height(cm)	Coverage(%)[c]	Reference
Colo.	52				Petersen 1980
Id.		15		4	Klebenow 1969
Id.	58–79	23–38			Autenrieth 1981
Id.	71	22	18	3–10	Wakkinen 1990
Id.			19–23	7–9	Connelly et al. 1991
Id.	61		22	30	Fischer 1994
Id.		15–32	15–30		Klott et al. 1993
Id.	69	19	34	15	Apa 1998
Mont.	40	27			Wallestad 1975
Oreg.	80	20			Keister and Willis 1986
Oreg.		24	14	9–32	Gregg 1991
Wash.		20		51	Schroeder 1995
Wash.		19		32	Sveum et al. 1998a
Wyo.	36				Patterson 1952
Wyo.	29	24	15	9	Heath et al. 1997
Wyo.	31	25	18	5	Holloran 1999
Wyo.	33	26	21	11	Lyon 2000

[a] Mean height of nest bush.
[b] Mean canopy coverage of the sagebrush surrounding the nest.
[c] Some coverage estimates may include both grasses and forbs.

Mean height of sagebrush most commonly used by nesting grouse ranges from 29 to 80 cm (Table 1), and nests tend to be under the tallest sagebrush within a stand (Keister and Willis 1986, Wakkinen 1990, Apa 1998). In general, sage grouse nests are placed under shrubs having larger canopies and more ground and lateral cover as well as in stands with more shrub canopy cover than at random sites (Wakkinen 1990, Fischer 1994, Heath et al. 1997, Sveum et al. 1998*a*, Holloran 1999). Sagebrush cover near the nest site was greater around successful nests than unsuccessful nests in Montana (Wallestad and Pyrah 1974) and Oregon (Gregg 1991). Wallestad and Pyrah (1974) also indicated that successful nests were in sagebrush stands with greater average canopy coverage (27%) than those of unsuccessful nests (20%). Gregg (1991) reported that sage grouse nest success varied by cover type. The greatest nest success occurred in a mountain big sagebrush (*A. t. tridentata vaseyana*) cover type where shrubs 40–80 cm in height had greater canopy cover at the site of successful nests than at unsuccessful nests (Gregg 1991). These observations were consistent with the results of an artificial nest study showing greater coverage of medium-height shrubs improved success of artificial nests (DeLong 1993, DeLong et al. 1995).

Grass height and cover also are important components of sage grouse nest sites (Table 1). Grass associated with nest sites and with the stand of vegetation containing the nest was taller and denser than grass at random sites (Wakkinen 1990, Gregg 1991, Sveum et al. 1998*a*). Grass height at nests under non-sagebrush plants was greater ($P<0.01$) than that associated with nests under sagebrush, further suggesting that grass height is an important habitat component for nesting sage grouse (Connelly et al. 1991). Moreover, in Oregon, grass cover was greater at successful nests than at unsuccessful nests (Gregg 1991). Grass >18 cm in height occurring in stands of sagebrush 40–80 cm tall resulted in lesser nest predation rates than in stands with lesser grass heights (Gregg et al. 1994). Herbaceous cover associated with nest sites may provide scent, visual, and physical barriers to potential predators (DeLong et al. 1995).

Early brood-rearing areas occur in upland sagebrush habitats relatively close to nest sites, but movements of individual broods may vary (Connelly 1982, Gates 1983). Within 2 days of hatching, one brood moved 3.1 km (Gates 1983). Early brood-rearing habitats may be relatively open

Radiotelemetry and a pointing dog are used to capture sage grouse chicks for a research project in southeastern Idaho.

(about 14% canopy cover) stands of sagebrush (Martin 1970, Wallestad 1971) with ≥15% canopy cover of grasses and forbs (Sveum et al. 1998*b*, Lyon 2000). Great plant species richness with abundant forbs and insects characterize brood areas (Dunn and Braun 1986, Klott and Lindzey 1990, Drut et al. 1994*a*, Apa 1998). In Oregon, diets of sage grouse chicks included 34 genera of forbs and 41 families of invertebrates (Drut et al. 1994*b*). Insects, especially ants (Hymenoptera) and beetles (Coleoptera), are an important component of early brood-rearing habitat (Drut et al. 1994*b*, Fischer et al. 1996*a*). Ants and beetles occurred more frequently ($P=0.02$) at brood-activity centers compared to nonbrood sites (Fischer et al. 1996*a*).

Summer–late brood-rearing habitats

As sagebrush habitats desiccate, grouse usually move to more mesic sites during June and July (Gill 1965, Klebenow 1969, Savage 1969, Connelly and Markham 1983, Gates 1983, Connelly et al. 1988, Fischer et al. 1996*b*). Sage grouse broods occupy a variety of habitats during summer, including sagebrush (Martin 1970), relatively small burned areas within sagebrush (Pyle and Crawford 1996), wet meadows (Savage 1969), farmland, and other irrigated areas adjacent to sagebrush habitats (Connelly and Markham 1983, Gates 1983, Connelly et al. 1988). Apa (1998) reported that sites used by grouse broods had twice as much forb cover as independent sites.

Fall habitats

Sage grouse use a variety of habitats during fall. Patterson (1952) reported that grouse move from summer to winter range in October, but during mild weather in late fall, some birds may still use summer range. Similarly, Connelly and Markham (1983) observed that most sage grouse had abandoned summering areas by the first week of October. Fall movements to winter range are slow and meandering and occur from late August to December (Connelly et al. 1988). Wallestad (1975) documented a shift in feeding habits from September, when grouse were consuming a large amount of forbs, to December, when birds were feeding only on sagebrush.

Winter habitats

Characteristics of sage grouse winter habitats are relatively similar throughout most of the species' range (Table 2). Eng and Schladweiler (1972) and Wallestad (1975) indicated that most observations of radiomarked sage grouse during winter in Montana occurred in sagebrush habitats with >20% canopy cover. However, Robertson (1991) indicated that sage grouse used sagebrush habitats that had average canopy coverage of 15% and average height of 46 cm during 3 winters in southeastern Idaho. In Idaho, sage grouse selected areas with greater canopy cover of Wyoming big sagebrush (*A. t. wyomingensis*) in stands containing taller shrubs when compared to random sites (Robertson 1991).

Table 2. Characteristics of sagebrush at sage grouse winter-use sites.

State	Canopy Coverage[a] (%)	Canopy Height[a] (cm)	Reference
Colo.		24–36[bd]	Beck 1977
Colo.		20–30[cd]	Beck 1977
Colo.	43[b]	34[b]	Schoenberg 1982
Colo.	37[c]	26[c]	Schoenberg 1982
Colo.	30–38[de]	41–54[de]	Hupp 1987
Id.	38[e]	56[e]	Autenrieth 1981
Id.	26[b]	29[b]	Connelly 1982
Id.	25[c]	26[c]	Connelly 1982
Id.	15	46	Robertson 1991
Mont.	27	25	Eng and Schladweiler 1972
Mont.	>20		Wallestad 1975
Oreg.	12–17[d]		Hanf et al. 1994

[a] Mean canopy coverage or height of sagebrush above snow.
[b] Males
[c] Females
[d] Ranges are given when data were provided for more than one year or area.
[e] No snow present when measurements were made or total height of plant was measured.

In Colorado, sage grouse may be restricted to <10% of the sagebrush habitat because of variation in topography and snow depth (Beck 1977, Hupp and Braun 1989). Such restricted areas of use may not occur throughout the species' range because in southeastern Idaho, severe winter weather did not result in the grouse population greatly reducing its seasonal range (Robertson 1991).

During winter, sage grouse feed almost exclusively on leaves of sagebrush (Patterson 1952, Wallestad et al. 1975). Although big sagebrush dominates the diet in most portions of the range (Patterson 1952; Wallested et al. 1975; Remington and Braun 1985; Welch et al. 1988, 1991), low sagebrush (*A. arbuscula*), black sagebrush (*A. nova*, Dalke et al. 1963, Beck 1977), fringed sagebrush (*A. frigida*, Wallestad et al. 1975), and silver sagebrush (*A. cana*, Aldridge 1998) are consumed in many areas depending on availability. Sage grouse in some areas apparently prefer Wyoming big sagebrush (Remington and Braun 1985, Myers 1992) and in other areas mountain big sagebrush (Welch et al. 1988, 1991). Some of the differences in selection may be due to preferences for greater levels of protein and the amount of volatile oils (Remington and Braun 1985, Welch et al. 1988).

Effects of habitat alteration

Range management treatments

Breeding habitat. Until the early 1980s, herbicide treatment (primarily with 2,4-D) was the most common method to reduce sagebrush on large tracts of rangeland (Braun 1987). Klebenow (1970) reported cessation of nesting in newly sprayed areas with <5% live sagebrush canopy cover. Nesting also was nearly nonexistent in older sprayed areas containing about 5% live sagebrush cover (Klebenow 1970). In virtually all documented cases, herbicide application to blocks of sagebrush rangeland resulted in major declines in sage grouse breeding populations (Enyeart 1956, Higby 1969, Peterson 1970, Wallestad 1975). Effects of this treatment on sage grouse populations seemed more severe if the treated area was subsequently seeded to crested wheatgrass (*Agropyron cristatum*, Enyeart 1956).

Using fire to reduce sagebrush has become more common since most uses of 2,4-D on public lands were prohibited (Braun 1987). Klebenow (1972) and Sime (1991) suggested that fire may benefit sage grouse populations. Neither Gates (1983),

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Martin (1990), nor Bensen et al. (1991) reported adverse effects of fire on breeding populations of sage grouse. In contrast, following a 9-year study, Connelly et al. (1994, 2000*b*) indicated that prescribed burning of Wyoming big sagebrush during a drought period resulted in a large decline (>80%) of a sage grouse breeding population in southeastern Idaho. Additionally, Hulet (1983) documented loss of leks from fire and Nelle et al. (2000) reported that burning mountain big sagebrush stands had long-term negative impacts on sage grouse nesting and brood-rearing habitats. Canopy cover in mountain big sagebrush did not provide appropriate nesting habitat 14 years after burning (Nelle et al. 2000). The impact of fire on sage grouse populations using habitats dominated by silver sagebrush (which may resprout following fire) is unknown.

Cheatgrass (*Bromus tectrorum*) will often occupy sites following disturbance, especially burning (Valentine 1989). Repeated burning or burning in late summer favors cheatgrass invasion and may be a major cause of the expansion of this species (Vallentine 1989). The ultimate result may be a loss of the sage grouse population because of long-term conversion of sagebrush habitat to rangeland dominated by an annual exotic grass. However, this situation largely appears confined to the western portion of the species' range and does not commonly occur in Wyoming (J. Lawson, Wyoming Department of Game and Fish, personal communication).

Mechanical methods of sagebrush control have often been applied to smaller areas than those treated by herbicides or fire, especially to convert rangeland to cropland. However, adverse effects of this type of treatment on sage grouse breeding populations also have been documented. In Montana, Swenson et al. (1987) indicated that the number of breeding males declined by 73% after 16% of their study area was plowed.

Brood-rearing habitats. Martin (1970) reported that sage grouse seldom used areas treated with herbicides to remove sagebrush in southwestern Montana. In Colorado, Rogers (1964) indicated that an entire population of sage grouse appeared to emigrate from an area that was subjected to several years of herbicide application to remove sagebrush. Similarly, Klebenow (1970) reported that herbicide spraying reduced the brood-carrying capacity of an area in southeastern Idaho. However, application of herbicides in early spring to reduce sagebrush cover may enhance some brood-rearing habitats by increasing the amount of herbaceous plants used for food (Autenrieth 1981).

Fire may improve sage grouse brood-rearing habitat (Klebenow 1972, Gates 1983, Sime 1991), but until recently, experimental evidence was not available to support or refute these contentions (Braun 1987). Pyle and Crawford (1996) suggested that fire may enhance brood-rearing habitat in montane settings but cautioned that its usefulness requires further investigation. A 9-year study of the effects of fire on sage grouse did not support that prescribed fire, conducted during late summer in a Wyoming big sagebrush habitat, improved brood-rearing habitat for sage grouse (Connelly et al. 1994, Fischer et al. 1996*a*). Prescribed burning of sage grouse habitat did not increase amount of forbs in burned areas compared to unburned areas (Fischer et al. 1996*a*, Nelle et al. 2000) and resulted in decreased insect populations in the treated area compared to the unburned area. Thus, fire may negatively affect sage grouse brood-rearing habitat rather than improve it in Wyoming big sagebrush habitats (Connelly and Braun 1997), but its effect on grouse habitats in mountain big sagebrush communities requires further investigation (Pyle and Crawford 1996, Nelle et al. 2000).

Sage grouse often use agricultural areas for brood-rearing habitat (Patterson 1952, Wallestad 1975, Gates 1983, Connelly et al. 1988, Blus et al. 1989). Grouse use of these areas may result in mortality because of exposure to insecticides. Blus et al. (1989) reported die-offs of sage grouse that were exposed to methamidiphos used in potato fields and dimethoate used in alfalfa fields. Dimethoate is used commonly for alfalfa, and 20 of 31 radio-marked grouse (65%) died following direct exposure to this insecticide (Blus et al. 1989).

Winter habitat. Reduction in sage grouse use of an area treated by herbicide was proportional to the severity (i.e., amount of damage to sagebrush) of the treatment (Pyrah 1972). In sage grouse winter range, strip partial kill, block partial kill, and total kill of sagebrush were increasingly detrimental to sage grouse in Montana (Pyrah 1972) and Wyoming (Higby 1969).

In Idaho, Robertson (1991) reported that a 2,000-ha prescribed burn that removed 57% of the sagebrush cover in sage grouse winter habitat minimally impacted the sage grouse population. Although sage grouse use of the burned area declined following the fire, grouse adapted to this disturbance by moving 1 to 10 km outside of the burn to areas with greater sagebrush cover (Robertson 1991) than was available in the burned area.

Land use

Mining-energy development. Effects of mining, oil, and gas developments on sage grouse populations are not well known (Braun 1998). These activities negatively impact grouse habitat and populations over the short term (Braun 1998), but research suggests some recovery of populations following initial development and subsequent reclamation of the affected sites (Eng et al. 1979, Tate et al. 1979, Braun 1986). In Colorado, sage grouse were displaced by oil development and coal-mining activities, but numbers returned to pre-disturbance levels once the activities ceased (Braun 1987, Remington and Braun 1991). At least 6 leks in Alberta were disturbed by energy development and 4 were abandoned (Aldridge 1998). In Wyoming, female sage grouse captured on leks disturbed by natural gas development had lower nest-initiation rates, longer movements to nest sites, and different nesting habitats than hens captured on undisturbed leks (Lyon 2000). Sage grouse may repopulate an area following energy development but may not attain population levels that occurred prior to development (Braun 1998). Thus, short-term and long-term habitat loss appears to result from energy development and mining (Braun 1998).

Grazing. Domestic livestock have grazed over most areas used by sage grouse and this use is generally repetitive with annual or biennial grazing periods of varying timing and length (Braun 1998). Grazing patterns and use of habitats are often dependent on weather conditions (Valentine 1990). Historic and scientific evidence indicates that livestock grazing did not increase the distribution of sagebrush (Peterson 1995) but markedly reduced the herbaceous understory over relatively large areas and increased sagebrush density in some areas (Vale 1975, Tisdale and Hironaka 1981). Within the intermountain region, some vegetation changes from livestock grazing likely occurred because sagebrush steppe in this area did not evolve with intensive grazing by wild herbivores, as did the grassland prairies of central North America (Mack and Thompson 1982). Grazing by wild ungulates may reduce sagebrush cover (McArthur et al. 1988, Peterson 1995), and livestock grazing may result in high trampling mortality of sagebrush seedlings (Owens and Norton 1992). In Wyoming big sagebrush habitats, resting areas from livestock grazing may improve understory production as well as decrease sagebrush cover (Wambolt and Payne 1986).

There is little direct experimental evidence linking grazing practices to sage grouse population levels (Braun 1987, Connelly and Braun 1997). However, grass height and cover affect sage grouse nest site selection and success (Wakkinen 1990, Gregg 1991, Gregg et al. 1994, Delong et al. 1995, Sveum et al. 1998*a*). Thus, indirect evidence suggests grazing by livestock or wild herbivores that significantly reduces the herbaceous understory in breeding habitat may have negative impacts on sage grouse populations (Braun 1987, Dobkin 1995).

Miscellaneous activities. Construction of roads, powerlines, fences, reservoirs, ranches, farms, and housing developments has resulted in sage grouse habitat loss and fragmentation (Braun 1998). Between 1962 and 1997, >51,000 km of fence were constructed on land administered by the Bureau of Land Management in states supporting sage grouse populations (T. D. Rich, United States Bureau of Land Management, personal communication). Structures such as powerlines and fences pose hazards to sage grouse because they provide additional perch sites for raptors and because sage grouse may be injured or killed when they fly into these structures (Call and Maser 1985).

Weather

Prolonged drought during the 1930s and mid-1980s to early 1990s coincided with declining sage grouse populations throughout much of the species' range (Patterson 1952, Fischer 1994, Hanf et al. 1994). Drought may affect sage grouse populations by reducing herbaceous cover at nests and the quantity and quality of food available for hens and chicks during spring (Hanf et al. 1994, Fischer et al. 1996*a*).

Spring weather may influence sage grouse production. Relatively wet springs may result in increased production (Wallestad 1975, Autenrieth 1981). However, heavy rainfall during egg-laying or unseasonably cold temperatures with precipitation during hatching may decrease production (Wallestad 1975).

There is no evidence that severe winter weather affects sage grouse populations unless sagebrush cover has been greatly reduced or eliminated (Wallestad 1975, Beck 1977, Robertson 1991).

Predation

Over the last 25 years, numerous studies have used radiotelemetry to address sage grouse survival and nest success (Wallestad 1975; Hulet 1983; Gregg 1991; Robertson 1991; Connelly et al. 1993, 1994; Gregg et al. 1994; Schroeder 1997). Only Gregg (1991) and Gregg et al. (1994) indicated that predation was limiting sage grouse numbers, and their research suggested that low nest success from predation was related to poor nesting habitat. Most reported nest-success rates are >40%, suggesting that nest predation is not a widespread problem. Similarly, high survival rates of adult (Connelly et al. 1993, Zablan 1993) and older (>10 weeks of age) juvenile sage grouse indicate that population declines are not generally related to high levels of predation. Thus, except for an early study in Oregon (Batterson and Morse 1948), predation has not been identified as a major limiting factor for sage grouse (Connelly and Braun 1997).

Constructing ranches, farms, and housing developments has resulted in the addition of nonnative predators to sage grouse habitats, including dogs, cats, and red foxes (*Vulpes vulpes*; J. W. Connelly, Idaho Department of Fish and Game, unpublished data; B. L. Welch, United States Forest Service, personal communication) and may be responsible for increases in abundance of the common raven (*Corvus corax*, Sauer et al. 1997). Relatively high raven populations may decrease sage grouse nest success (Batterson and Morse 1948, Autenrieth 1981), but rigorous field studies using radiotelemetry do not support this hypothesis. Current work in Strawberry Valley, Utah, suggests that red foxes are taking a relatively high proportion of the population (Flinders 1999). This may become a greater problem if red foxes become well established throughout sage grouse breeding habitat.

Recommended guidelines

Sage grouse populations occupy relatively large areas on a year-round basis (Berry and Eng 1985, Connelly et al. 1988, Wakkinen 1990, Leonard et al. 2000), invariably involving a mix of ownership and jurisdictions. Thus, state and federal natural resource agencies and private landowners must coordinate efforts over at least an entire seasonal range to successfully implement these guidelines. Based on current knowledge of sage grouse population and habitat trends, these guidelines have been developed to help agencies and landowners effectively assess and manage populations, protect and manage remaining habitats, and restore damaged habitat. Because of gaps in our knowledge and regional variation in habitat characteristics (Tisdale and Hironaka 1981), the judgment of local biologists and quantitative data from population and habitat monitoring are necessary to implement the guidelines correctly. Further, we urge agencies to use an adaptive management approach (Macnab 1983, Gratson et al. 1993), using monitoring and evaluation to assess the success of implementing these guidelines to manage sage grouse populations.

Activities responsible for the loss or degradation of sagebrush habitats also may be used to restore these habitats. These activities include prescribed fire, grazing, herbicides, and mechanical treatments. Decisions on land treatments using these tools should be based on quantitative knowledge of vegetative conditions over an entire population's seasonal range. Generally, the treatment selected should be that which is least disruptive to the vegetation community and has the most rapid recovery time. This selection should not be based solely on economic cost.

Definitions

For the purpose of these guidelines, we define an occupied lek as a traditional display area in or adjacent to sagebrush-dominated habitats that has been attended by ≥2 male sage grouse in ≥2 of the previous 5 years. We define a breeding population as a group of birds associated with 1 or more occupied leks in the same geographic area separated from other leks by >20 km. This definition is somewhat arbitrary but generally based on maximum distances females move to nest.

Population management

1) Before making management decisions, agencies should cooperate to first identify lek locations and determine whether a population is migratory or nonmigratory. In the case of migratory populations, migration routes and seasonal habitats must be identified to allow for meaningful and correct management decisions.

2) Breeding populations should be assessed by either lek counts (census number of males attending leks) or lek surveys (classify known leks as active or inactive) each year (Autenrieth et al. 1982). Depending on number of counts each spring (Jenni and Hartzler 1978, Emmons and Braun

1984) and weather conditions when the counts were made, lek counts may not provide an accurate assessment of sage grouse populations (Beck and Braun 1980) and the data should be viewed with caution. Despite these shortcomings, lek counts provide the best index to breeding population levels and many long-term data sets are available for trend analysis (Connelly and Braun 1997).

3) Production or recruitment should be monitored by brood counts or wing surveys (Autenrieth et al. 1982). Brood counts are labor-intensive and usually result in inadequate sample size. Where adequate samples of wings can be obtained, we recommend using wing surveys to obtain estimates of sage grouse nesting success and juvenile:adult hen (including yearlings) ratios.

4) Routine population monitoring should be used to assess trends and identify problems for all hunted and nonhunted populations. Check stations, wing collections, and questionnaires can be used to obtain harvest information. Breeding population and production data (above) can be used to monitor nonhunted populations.

5) The genetic variation of relatively small, isolated populations should be documented to better understand threats to these populations and implement appropriate management actions (Young 1994, Oyler-McCance et al. 1999).

6) Hunting seasons for sage grouse should be based on careful assessments of population size and trends. Harvest should not be based on the observations of Allen (1954:43), who stated, "Our populations of small animals operate under a 1-year plan of decimation and replacement; and Nature habitually maintains a wide margin of overproduction. She kills off a huge surplus of animals whether we take our harvest or not." To the contrary, sage grouse tend to have relatively long lives with low annual turnover (Zablan 1993, Connelly et al. 1994) and a low reproductive rate (Gregg 1991, Connelly et al. 1993). Consequently, hunting may be additive to other causes of mortality for sage grouse (Johnson and Braun 1999, Connelly et al. 2000*a*). However, most populations appear able to sustain hunting if managed carefully (Connelly et al. 2000*a*).

7) If populations occur over relatively large geographic areas and are stable to increasing, seasons and bag limits can be relatively liberal (2- to 4-bird daily bag limit and a 2- to 5-week season) for hunting seasons allowing firearms (Braun and Beck 1985).

8) If populations are declining (for 3 or more consecutive years) or trends are unknown, seasons and bag limits should be generally conservative (1- or 2-bird daily bag limit and a 1-to 4-week season) for hunting seasons allowing firearms, or suspended (for all types of hunting, including falconry and Native American subsistence hunting) because of this species' population characteristics (Braun 1998, Connelly et al. 2000*a*).

9) Where populations are hunted, harvest rates should be 10% or less of the estimated fall population to minimize negative effects on the subsequent year's breeding population (Connelly et al. 2000*a*).

10) Populations should not be hunted where ≤300 birds comprise the breeding population (i.e., ≤100 males are counted on leks [C. E. Braun, Colorado Division of Wildlife, unpublished report]).

11) Spring hunting of sage grouse on leks should be discouraged or, if unavoidable, confined to males only during the early portion of the breeding season. Spring hunting is considered an important tradition for some Native American tribes. However, in Idaho, 80% of the leks hunted during spring in the early 1990s (n=5) had become inactive by 1994 (Connelly et al. 1994).

12) Viewing sage grouse on leks (and censusing leks) should be conducted so that disturbance to birds is minimized or preferably eliminated (Call and Maser 1986). Agencies should generally not provide all lek locations to individuals simply interested in viewing birds. Instead, 1 to 3 lek locations should be identified as public viewing leks, and if demand is great enough, agencies should consider erecting 2–3 seasonal blinds at these leks for public use. Camping in the center of or on active leks should be vigorously discouraged.

13) Discourage establishment of red fox and other nonnative predator populations in sage grouse habitats.

14) For small, isolated populations and declining populations, assess the impact of predation on survival and production. Predator control programs are expensive and often ineffective. In some cases, these programs may provide temporary help while habitat is recovering. Predator management programs also could be considered in areas where seasonal habitats are in good condition but their extent has been reduced greatly. However, predator management should be implemented only if the available data (e.g., nest success <25%, annual survival of adult hens <45%) support the action.

Table 3. Characteristics of sagebrush rangeland needed for productive sage grouse habitat.

	Breeding		Brood-rearing		Winter[e]	
	Height (cm)	Canopy (%)	Height (cm)	Canopy (%)	Height (cm)	Canopy (%)
Mesic sites[a]						
Sagebrush	40–80	15–25	40–80	10–25	25–35	10–30
Grass–forb	>18[c]	≥25[d]	variable	>15	N/A	N/A
Arid sites[a]						
Sagebrush	30–80	15–25	40–80	10–25	25–35	10–30
Grass/forb	>18[c]	≥15	variable	>15	N/A	N/A
Area[b]	>80		>40		>80	

[a] Mesic and arid sites should be defined on a local basis; annual precipitation, herbaceous understory, and soils should be considered (Tisdale and Hironaka 1981, Hironaka et al. 1983).
[b] Percentage of seasonal habitat needed with indicated conditions.
[c] Measured as "droop height"; the highest naturally growing portion of the plant.
[d] Coverage should exceed 15% for perennial grasses and 10% for forbs; values should be substantially greater if most sagebrush has a growth form that provides little lateral cover (Schroeder 1995)
[e] Values for height and canopy coverage are for shrubs exposed above snow.1

General habitat management

The following guidelines pertain to all seasonal habitats used by sage grouse:

1) Monitor habitat conditions and propose treatments only if warranted by range condition (i.e., the area no longer supports habitat conditions described in the following guidelines under habitat protection). Do not base land treatments on schedules, targets, or quotas.

2) Use appropriate vegetation treatment techniques (e.g., mechanical methods, fire) to remove junipers and other conifers that have invaded sage grouse habitat (Commons et al. 1999). Whenever possible, use vegetation control techniques that are least disruptive to the stand of sagebrush, if this stand meets the needs of sage grouse (Table 3).

3) Increase the visibility of fences and other structures occurring within 1 km of seasonal ranges by flagging or similar means if these structures appear hazardous to flying grouse (e.g., birds have been observed hitting or narrowly missing these structures or grouse remains have been found next to these structures).

4) Avoid building powerlines and other tall structures that provide perch sites for raptors within 3 km of seasonal habitats. If these structures must be built, or presently exist, the lines should be buried or poles modified to prevent their use as raptor perch sites.

Breeding habitat management

For migratory and nonmigratory populations, lek attendance, nesting, and early brood rearing occur in breeding habitats. These habitats are sagebrush-dominated rangelands with a healthy herbaceous understory and are critical for survival of sage grouse populations. Mechanical disturbance, prescribed fire, and herbicides can be used to restore sage grouse habitats to those conditions identified as appropriate in the following sections on habitat protection. Local biologists and range ecologists should select the appropriate technique on a case-by-case basis. Generally, fire should not be used in breeding habitats dominated by Wyoming big sagebrush if these areas support sage grouse. Fire can be difficult to control and tends to burn the best remaining nesting and early brood-rearing habitats (i.e., those areas with the best remaining understory), while leaving areas with poor understory. Further, we recommend against using fire in habitats dominated by xeric mountain big sagebrush (*A. t. xericensis*) because annual grasses commonly invade these habitats and much of the original habitat has been altered by fire (Bunting et al. 1987).

Although mining and energy development are common activities throughout the range of sage grouse, quantitative data on the long-term effects of these activities on sage grouse are limited. However, some negative impacts have been documented (Braun 1998, Lyon 2000). Thus, these activities should be discouraged in breeding habitats, but when they are unavoidable, restoration efforts should follow procedures outlined in these guidelines.

Habitat protection

1) Manage breeding habitats to support 15-25% canopy cover of sagebrush, perennial herbaceous cover averaging ≥18 cm in height with ≥15% canopy cover for grasses and ≥10% for forbs and a diversity of forbs (Barnett and Crawford 1994, Drut et al. 1994*a*, Apa 1998) during spring (Table 3). Habitats meeting these conditions should have a high priority for wildfire suppression and should

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not be considered for sagebrush control programs. Sagebrush and herbaceous cover should provide overhead and lateral concealment from predators. If average sagebrush height is >75 cm, herbaceous cover may need to be substantially greater than 18 cm to provide this protection. There is much variability among sagebrush-dominated habitats (Tisdale and Hironaka 1981, Hironaka et al. 1983), and some Wyoming sagebrush and low sagebrush breeding habitats may not support 25% herbaceous cover. In these areas, total herbaceous cover should be ≥15 % (Table 3). Further, the herbaceous height requirement may not be possible in habitats dominated by grasses that are relatively short when mature. In all of these cases, local biologists and range ecologists should develop height and cover requirements that are reasonable and ecologically defensible. Leks tend to be relatively open, thus cover on leks should not meet these requirements.

2) For nonmigratory grouse occupying habitats that are distributed uniformly (i.e., habitats have the characteristics described in guideline 1 and are generally distributed around the leks), protect (i.e., do not manipulate) sagebrush and herbaceous understory within 3.2 km of all occupied leks. For nonmigratory populations, consider leks the center of year-round activity and use them as focal points for management efforts (Braun et al. 1977).

3) For nonmigratory populations where sagebrush is not distributed uniformly (i.e., habitats have the characteristics described in guideline 1 but distributed irregularly with respect to leks), protect suitable habitats for ≤5 km from all occupied leks. Use radiotelemetry, repeated surveys for grouse use, or habitat mapping to identify nesting and early brood-rearing habitats.

4) For migratory populations, identify and protect breeding habitats within 18 km of leks in a manner similar to that described for nonmigratory sage grouse. For migratory sage grouse, leks generally are associated with nesting habitats but migratory birds may move >18 km from leks to nest sites. Thus, protection of habitat within 3.2 km of leks may not protect most of the important nesting areas (Wakkinen et al. 1992, Lyon 2000).

5) In areas of large-scale habitat loss (≥40% of original breeding habitat), protect all remaining habitats from additional loss or degradation. If remaining habitats are degraded, follow guidelines for habitat restoration listed below.

6) During drought periods (≥2 consecutive years), reduce stocking rates or change management practices for livestock, wild horses, and wild ungulates if cover requirements during the nesting and brood-rearing periods are not met. Grazing pressure from domestic livestock and wild ungulates should be managed in a manner that at all times addresses the possibility of drought.

Sage grouse just leaving a nest in good-condition breeding habitat in southwestern Idaho. Note the height of grass and herbaceous cover.

7) Suppress wildfires in all breeding habitats. In the event of multiple fires, land management agencies should have all breeding habitats identified and prioritized for suppression, giving the greatest priority to those that have become fragmented or reduced by >40% in the last 30 years.

8) Adjust timing of energy exploration, development, and construction activity to minimize disturbance of sage grouse breeding activities. Energy-related facilities should be located >3.2 km from active leks whenever possible. Human activities within view of or <0.5 km from leks should be minimized during the early morning and late evening when birds are near or on leks.

Habitat restoration

1) Before initiating vegetation treatments, quantitatively evaluate the area proposed for treatment to ensure that it does not have sagebrush and herbaceous cover suitable for breeding habitat (Table 3). Treatments should not be undertaken within sage grouse habitats until the limiting vegetation factor(s) has been identified, the proposed treatment is known to provide the desired vegetation response, and land-use activities can be managed after treatment to ensure that vegetation objectives are met.

2) Restore degraded rangelands to a condition that again provides suitable breeding habitat for sage grouse by including sagebrush, native forbs

(especially legumes), and native grasses in reseeding efforts (Apa 1998). If native forbs and grasses are unavailable, use species that are functional equivalents and provide habitat characteristics similar to those of native species.

3) Where the sagebrush overstory is intact but the understory has been degraded severely and quality of nesting habitat has declined (Table 3), use appropriate techniques (e.g., brush beating in strips or patches and interseed with native grasses and forbs) that retain some sagebrush but open shrub canopy to encourage forb and grass growth.

4) Do not use fire in sage grouse habitats prone to invasion by cheatgrass and other invasive weed species unless adequate measures are included in restoration plans to replace the cheatgrass understory with perennial species using approved reseeding strategies. These strategies could include, but are not limited to, use of pre-emergent herbicides (e.g., Oust®, Plateau®) to retard cheatgrass germination until perennial herbaceous species become established.

5) When restoring habitats dominated by Wyoming big sagebrush, regardless of the techniques used (e.g., prescribed fire, herbicides), do not treat >20% of the breeding habitat (including areas burned by wildfire) within a 30-year period (Bunting et al. 1987). The 30-year period represents the approximate recovery time for a stand of Wyoming big sagebrush. Additional treatments should be deferred until the previously treated area again provides suitable breeding habitat (Table 3). In some cases, this may take <30 years and in other cases >30 years. If 2,4-D or similar herbicides are used, they should be applied in strips such that their effect on forbs is minimized. Because fire generally burns the best remaining sage grouse habitats

Nest habitat is measured in Owyhee County, southwestern Idaho.

This breeding habitat is in poor condition because of a lack of understory.

(i.e., those with the best understory) and leaves areas with sparse understory, use fire for habitat restoration only when it can be convincingly demonstrated to be in the best interest of sage grouse.

6) When restoring habitats dominated by mountain big sagebrush, regardless of the techniques used (e.g., fire, herbicides), treat ≤20% of the breeding habitat (including areas burned by wildfire) within a 20-year period (Bunting et al. 1987). The 20-year period represents the approximate recovery time for a stand of mountain big sagebrush. Additional treatments should be deferred until the previously treated area again provides suitable breeding habitat (Table 3). In some cases, this may take <20 years and in other cases >20 years. If 2,4-D or similar herbicides are used, they should be applied in strips such that their effect on forbs is minimized.

7) All wildfires and prescribed burns should be evaluated as soon as possible to determine whether reseeding is necessary to achieve habitat management objectives. If needed, reseed with sagebrush, native bunchgrasses, and forbs whenever possible.

8) Until research unequivocally demonstrates that using tebuthiuron and similar-acting herbicides to control sagebrush has no long-lasting negative impacts on sage grouse habitat, use these herbicides only on an experimental basis and over a sufficiently small area that any long-term negative impacts are negligible. Because these herbicides have the potential of reducing but not eliminating sagebrush cover within grouse breeding habitats, thus stimulating herbaceous development, their use as sage grouse habitat management tools should be examined closely.

John Crawford explains Oregon's sage grouse research program to field-trip attendees during a meeting of the Western States Sage and Columbian sharp-tailed Grouse Technical Committee.

Summer–late brood-rearing habitat management

Sage grouse may use a variety of habitats, including meadows, farmland, dry lakebeds, sagebrush, and riparian zones from late June to early November (Patterson 1952, Wallestad 1975, Connelly 1982, Hanf et al. 1994). Generally, these habitats are characterized by relatively moist conditions and many succulent forbs in or adjacent to sagebrush cover.

Habitat protection

1) Avoid land-use practices that reduce soil moisture effectiveness, increase erosion, cause invasion of exotic plants, and reduce abundance and diversity of forbs.

2) Avoid removing sagebrush within 300 m of sage grouse foraging areas along riparian zones, meadows, lakebeds, and farmland, unless such removal is necessary to achieve habitat management objectives (e.g., meadow restoration, treatment of conifer encroachment).

3) Discourage use of very toxic organophosphorus and carbamate insecticides in sage grouse brood-rearing habitats. Sage grouse using agricultural areas may be adversely affected by pesticide applications (Blus et al. 1989). Less toxic agrichemicals or biological control may provide suitable alternatives in these areas.

4) Avoid developing springs for livestock water, but if water from a spring will be used in a pipeline or trough, design the project to maintain free water and wet meadows at the spring. Capturing water from springs using pipelines and troughs may adversely affect wet meadows used by grouse for foraging.

Habitat restoration

1) Use brush beating or other mechanical treatments in strips 4–8 m wide in areas with relatively high shrub-canopy cover (≥35% total shrub cover) to improve late brood-rearing habitats. Brush beating can be used to effectively create different age classes of sagebrush in large areas with little age diversity.

2) If brush beating is impractical, use fire or herbicides to create a mosaic of openings in mountain big sagebrush and mixed-shrub communities used as late brood-rearing habitats where total shrub cover is ≥35%. Generally, 10–20% canopy cover of sagebrush and ≤25% total shrub cover will provide adequate habitat for sage grouse during summer.

3) Construct water developments for sage grouse only in or adjacent to known summer-use areas and provide escape ramps suitable for all avian species and other small animals. Water developments and "guzzlers" may improve sage grouse summer habitats (Autenrieth et al. 1982, Hanf et al. 1994). However, sage grouse used these developments infrequently in southeastern Idaho because most were constructed in sage grouse winter and breeding habitat rather than summer range (Connelly and Doughty 1989).

4) Whenever possible, modify developed springs and other water sources to restore natural free-flowing water and wet meadow habitats.

Winter habitat management

Sagebrush is the essential component of winter habitat. Sage grouse select winter-use sites based on snow depth and topography, and snowfall can affect the amount and height of sagebrush available to grouse (Connelly 1982, Hupp and Braun 1989, Robertson 1991). Thus, on a landscape scale, sage grouse winter habitats should allow grouse access to sagebrush under all snow conditions (Table 3).

Habitat protection

1) Maintain sagebrush communities on a landscape scale, allowing sage grouse access to sagebrush stands with canopy cover of 10–30% and heights of at least 25–35 cm regardless of snow cover. These areas should be high priority for wildfire suppression and sagebrush control should be avoided.

2) Protect patches of sagebrush within burned areas from disturbance and manipulation. These areas may provide the only winter habitat for sage grouse and their loss could result in the extirpation of the grouse population. They also are important

seed sources for sagebrush re-establishment in the burned areas. During fire-suppression activities do not remove or burn any remaining patches of sagebrush within the fire perimeter.

3) In areas of large-scale habitat loss (≥40% of original winter habitat), protect all remaining sagebrush habitats.

Habitat restoration

1) Reseed former winter range with the appropriate subspecies of sagebrush and herbaceous species unless the species are recolonizing the area in a density that would allow recovery (Table 3) within 15 years.

2) Discourage prescribed burns >50 ha, and do not burn >20% of an area used by sage grouse during winter within any 20–30-year interval (depending on estimated recovery time for the sagebrush habitat).

Conservation strategies

We recommend that each state and province develop and implement conservation plans for sage grouse. These plans should use local working groups comprised of representatives of all interested agencies, organizations, and individuals to identify and solve regional issues (Anonymous 1997). Within the context of these plans, natural resource agencies should cooperate to document the amount and condition of sagebrush rangeland remaining in the state or province. Local and regional plans should summarize common problems to conserve sage grouse and general conditions (Table 3) needed to maintain healthy sage grouse populations. Local differences in conditions that affect sage grouse populations may occur and should be considered in conservation plans. Natural resource agencies should identify remaining breeding and winter ranges in Wyoming big sagebrush habitats and establish these areas as high priority for wildfire suppression. Prescribed burning in habitats that are in good ecological condition should be avoided. Protection and restoration of sage grouse habitats also will likely benefit many other sagebrush obligate species (Saab and Rich 1997) and enhance efforts to conserve and restore sagebrush steppe.

Although translocating sage grouse to historical range has been done on numerous occasions, few attempts have been successful (Musil et al. 1993, Reese and Connelly 1997). Thus, we agree with Reese and Connelly (1997) that translocation efforts should be viewed as only experimental at this time and not as a viable management strategy.

More information is needed on characteristics of healthy sagebrush ecosystems and the relationship of grazing to sage grouse production. Field experiments should be implemented to evaluate the relationship of grazing pressure (i.e., disturbance and removal of herbaceous cover) to sage grouse nest success and juvenile survival (Connelly and Braun 1997). The overall quality of existing sage grouse habitat will become increasingly important as quantity of these habitats decrease. Sage grouse populations appear relatively secure in some portions of their range and at risk in other portions. However, populations that have thus far survived extensive habitat loss may still face extinction because of a time lag between habitat loss and ultimate population collapse (Cowlishaw 1999).

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California Wildlife Habitat Relationships System
California Department of Fish and Game
California Interagency Wildlife Task Group

AMERICAN MARTEN *Martes americana*
Family: MUSTELIDAE Order: CARNIVORA Class: MAMMALIA
M154

Written by: G. Ahlborn
Reviewed by: M. White
Edited by: M. White

DISTRIBUTION, ABUNDANCE, AND SEASONALITY

Uncommon to common, permanent resident of North Coast regions and Sierra Nevada, Klamath, and Cascades Mts. Optimal habitats are various mixed evergreen forests with more than 40% crown closure, with large trees and snags. Important habitats include red fir, lodgepole pine, subalpine conifer, mixed conifer, Jeffrey pine, and eastside pine (Grinnell et al. 1937, Schemof and White 1977, Clark et al. 1987).

SPECIFIC HABITAT REQUIREMENTS

Feeding: American martens are mostly carnivorous, taking primarily small mammals: tree squirrels, chipmunks, mice, shrews, rabbits, hares, and pikas. Spring through autumn, often eat birds, insects, and fruits. Eat fish, and will forage along edge of water (Haley 1975). Forage on ground, and in trees, snags, logs, and rock areas. May tunnel under snow. Search and pounce on, or chase prey. Use forepaws to remove birds from tree cavities. Individuals may travel up to 24 km (15 mi) hunting in 1 night.

Cover: Use cavities in large trees, snags, stumps, logs, or burrows, caves, and crevices in rocky areas for denning cover. Less commonly will den in woodpiles, cabins, and other human artifacts. Also may den under snow near logs, stumps, or other objects.

Reproduction: Nests are located in cavities, as described above, lined with leaves, grass, mosses, or other vegetation.

Water: No information found.

Pattern: Habitat with limited human use is important. Martens require a variety of different-aged stands, particularly old-growth conifers and snags, which provide abundant cavities for denning and nesting. Tend to travel along ridgetops, and rarely move across large areas devoid of canopy cover. Small clearings, meadows, and riparian areas provide foraging habitats, particularly during snow-free periods. Little information available on the interspersion of habitats required by this species.

SPECIES LIFE HISTORY

Activity Patterns: Active yearlong. Mostly nocturnal and crepuscular, some diurnal activity.

Seasonal Movements/Migration: Non-migratory, although may move to lower elevations in winter.

Home Range: In Montana, home ranges of males averaged 238 ha (589 ac), and varied from 88-262 ha (218-646 ac). Home ranges of females averaged 70 ha (173 ac), and varied from 8-52 ha (19-128 ac) (Hawley and Newby 1957). Home ranges often coincide with topographical or vegetation features, such as timber stands, ridges, streams, meadows, or burns.

Territory: Territory may equal home range; antisocial behavior between males observed within a male's home range. In contrast, males and females tolerant of each other, and adults tolerant of juveniles, in other observations.

Reproduction: Breed in summer; have a gestation of 220-290 days, including delayed implantation (Maser et al. 1981). Embryos usually implanted in uterus during February, having an active growing period of about 27 days prior to birth. Most litters born in March and April, some as late as June. One litter/yr of an average 3.5 young, ranging from 1-5. Young stay with female until autumn, and then begin solitary life. Males are mature sexually at 1 yr, females at 2 yr.

Niche: Occasionally prey of fishers, bobcats, great horned owls, and eagles (deVos 1952). Agile climbers, and mostly arboreal. Population levels appear to follow primary prey abundance. Sensitive to human disturbance, and trapped easily. Large clearcuts, extensive even-aged forest management, and destruction of mature stands are detrimental to these mustelids. Potentially compete with other carnivorous forest-dwelling mammals and birds, such as fishers, bobcats, spotted owls, great horned owls, and accipiters. Competition for den sites may occur with other cavity using species.

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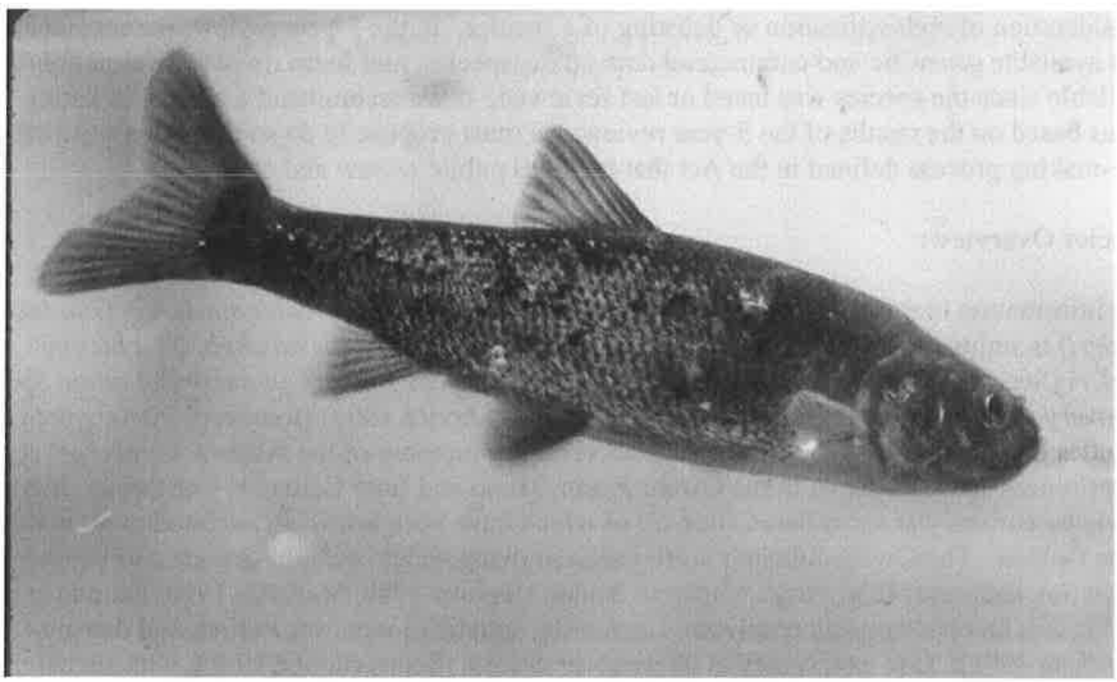
Owens Tui Chub
(Siphateles bicolor snyderi = Gila bicolor snyderi)

5-Year Review: Summary and Evaluation



(Photograph courtesy of Steve Parmenter, California Department of Fish and Game, Bishop, California)

U.S. Fish and Wildlife Service
Venture Fish and Wildlife Office
Ventura, California

May 19, 2009

5-YEAR REVIEW

Owens tui chub (*Siphateles bicolor snyderi = Gila bicolor snyderi*)

I. GENERAL INFORMATION

Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

Species Overview:

The information in this section on the Owens tui chub (*Siphateles bicolor snyderi = Gila bicolor snyderi*) is summarized from the *Draft Recovery Plan for the Owens tui chub, Gila bicolor snyderi* (Service 1990) (Draft Recovery Plan) and the *Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties, California* (Service 1998) (Recovery Plan), which includes the Owens tui chub. The Owens tui chub is a member of the minnow family (Cyprinidae) and is endemic to the Owens Basin, Mono and Inyo Counties, California. It is restricted currently to six isolated sites, all of which have been artificially created or altered in some fashion. The Owens tui chub prefers slow-moving water, with the presence of submerged vegetation and cover (e.g., rocks, undercut banks) (Jenkins 1990, McEwan 1990, Leunda et al. 2005). It is an opportunistic omnivore, consuming aquatic insects, vegetation, and detritus (McEwan 1991). Life expectancy is likely several years (Scoppettonne 1988), with sexual maturity reached by age 2 (McEwan 1990). Spawning occurs from late winter to early summer, usually over gravel substrate or aquatic vegetation. Females can produce large numbers of eggs (McEwan 1989), and there are multiple spawning bouts. Recent genetic analysis of several Owens tui chub populations revealed that there are two distinct lineages within the Owens tui chub, an Owens lineage and a Toikona lineage (Chen et al. 2007). Threats to the Owens tui chub include: habitat loss and alteration, predation, disease, competition, inbreeding depression, genetic drift, hybridization, population loss from stochastic events, and climate change.

Methodology Used to Complete This Review:

The Ventura Fish and Wildlife Office (VFWO) prepared this review, following the Region 8 guidance issued in March 2008. We used information from the Draft Recovery Plan and the Recovery Plan, published journal articles on the species, reports from experts who have been monitoring various populations of this species, dissertations and theses from universities, and the California Natural Diversity Database (CNDDB) maintained by the California Department of Fish and Game (CDFG). We received no information from the public in response to our *Federal Register* notice initiating this 5-year review (73 FR 11945). This 5-year review contains updated information on the species' biology and threats, and an assessment of that information compared to that known at the time of listing. We focus on current threats to the species that are attributable to the Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provides an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions be completed or initiated within the next 5 years.

Contact Information:

Lead Field Office: Judy Hohman, Senior Biologist, (805) 644-1766, ext. 304, and Michael McCrary, Listing and Recovery Coordinator, (805) 644-1766, ext. 372, Ventura Fish and Wildlife Office, Ventura, California.

Federal Register (FR) Notice Citation Announcing Initiation of This Review: A notice announcing initiation of the 5-year review of this taxon and the opening of a 60-day period to receive information from the public was published in the *Federal Register* on March 5, 2008 (73 FR 11945). We received no information from the public in response to this notice.

Listing History:

Original Listing
FR Notice: *Federal Register* Volume 50, Number 150, pp. 31592-31597
Date of Final Listing Rule: August 5, 1985
Entity Listed: *Gila bicolor snyderi*, a fish subspecies. The genus was changed to *Siphateles* in 1998, with the publication of genetic data for the family Cyprinidae in the western United States by Simons and Mayden (1998).
Classification: Endangered

State Listing: The Owens tui chub, *Gila bicolor snyderi*, was listed by the State of California as endangered on January 10, 1974.

Associated Rulemakings: The Service designated critical habitat for the Owens tui chub in 1985 in the *Federal Register* Volume 50, Number 150, pp. 31592-31597.

Review History: Although this is the first 5-year status review for the Owens tui chub since it was listed in 1985, updated information on status and threats was included in the 1998 Recovery Plan.

Species' Recovery Priority Number at Start of 5-Year Review: The recovery priority number for *Siphateles bicolor snyderi* is 9 according to the 2008 Recovery Data Call for the Ventura Fish and Wildlife Office, based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). This number indicates that the taxon is a subspecies that faces a moderate degree of threat and has a high potential for recovery. Based on the information obtained during the preparation of this 5-year review, we believe the recovery priority number should be changed to 3. Please see the "New Recovery Priority Number and Brief Rationale" section below for our reason for making this change.

Recovery Plan or Outline

> **Name of Plan or Outline:** *Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties, California*
> **Date Issued:** September 30, 1998
> **Dates of Previous Revisions, if applicable:** There have been no revisions to this recovery plan.

II. REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) Policy

The Endangered Species Act defines "species" as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listing as distinct population segments to species of vertebrate fish or wildlife. The 1996 Policy Regarding the Recognition of Distinct Vertebrate Population Segments under the Endangered Species Act (61 FR 4722, February 7, 1996) clarifies the interpretation of the phrase "distinct population segment" for the purposes of listing, delisting, and reclassifying species under the Act.

The Owens tui chub was listed as a subspecies with no mention of a DPS. Recent genetic analyses of this subspecies and various populations suggest that the Owens tui chub could be considered a separate species. Within this possible species designation there are there are two distinct genetic lineages, the Owens lineage and the Toikona lineage. Researchers have not proposed a formal taxonomic split of these lineages until more information on meristic (counting quantitative features of fish, such as the number of fins or scales) and osteological characters are available. Each of these lineages could potentially be classified as a DPS. However, we do not believe it is crucial to the recovery of the Owens tui chub to conduct a formal DPS analysis at the present time. The Service and the CDFG are developing and implementing a management plan to ensure that both lineages are managed for and maintained.

Information on the Species and its Status

Species Biology and Life History

The Owens tui chub evolved in the Owens River watershed with only three other smaller species of fishes, Owens pupfish (*Cyprinodon radiosus*), Owens speckled dace (*Rhinichthys osculus* ssp.), and Owens sucker (*Catostomus fumeiventris).* These species are not predators of other fish species. Thus, the Owens tui chub evolved in an environment with no aquatic predators.

Little is known about the life history of the Owens tui chub. It likely has similar requirements as other subspecies of tui chubs to which it is closely related (Service 1990). As with other tui chubs, the Owens tui chub prefers water with low velocities such as portions of the Owens River, associated tributaries, springs, sloughs, drainage ditches, and irrigation canals (Service 1990), with dense aquatic vegetation for cover and habitat for insect food items (McEwan 1990).

The Owens tui chub is an opportunistic omnivore, consuming aquatic insects, vegetation, and detritus (Cooper 1978; McEwan 1990, 1991). Owens tui chubs feed mainly by gleaning and grazing among submerged vegetation. Its diet varies seasonally (McEwan 1990); the dominant items in its diet are chironomid larvae and algae in spring, chironomid larvae in summer, hydroptilid caddisflies in fall, and chironomid larvae in winter (McEwan 1990, Geologica 2003).

Life expectancy is likely several years. At Hot Creek Headwaters (see Figure 2), the age of the oldest fish captured was estimated to be at least 7 years (McEwan 1989, 1990). However, age determination for fish that occupy spring habitats with constant water temperatures is difficult because growth is relatively constant year-round, and annular marks on otoliths, scales, or bones used to determine age are either absent or unreliable (McEwan 1990).

For Owens tui chubs in springs with constant water temperature, sexual maturity is reached at 2 years of age for females and 1 year of age for males (McEwan 1989, 1990). At other sites with varied temperatures, both male and female Owens tui chubs likely become sexually mature at age 2 (McEwan 1990). Spawning occurs from late winter to early summer at spring habitats (McEwan 1990), with spawning likely triggered by day length. In riverine and lacustrine or lake-like habitats where water temperatures fluctuate seasonally, the Owens tui chub spawns in spring and early summer (McEwan 1989), with spawning triggered by warming water temperatures. Spawning usually occurs over gravel substrate or aquatic vegetation, with the eggs adhering to these features. There are multiple spawning bouts during the breeding season (Moyle 1976), and each female produces large numbers of eggs at each bout (McEwan 1989). Similar species of tui chubs produce 4,000 to 5,000 eggs per season (Service 1984). Hatching time is likely influenced by water temperature, with eggs hatching earlier in warmer water (Cooper 1978). Fry congregate in areas with cover (Moyle 1976). Growth during the first summer is rapid, with yearling fish ranging in size from 22 to 42 millimeters (mm) (0.9 to 1.8 inches (in)) (Moyle 1976).

Taxonomy and Morphology

The Owens tui chub is a member of the minnow family (Cyprinidae). Individuals range from 15 mm (0.6 in) to 180 mm (7 in) in length (Miller 1973). This fish is dusky-olive in color from above with a gold-colored head. The sides of the body are blue and gold. The fins are olive-brown to reddish-brown. The Owens tui chub is distinguished from other tui chubs by the presence of lateral radii on the scales with a rounded or shield-shaped scale base (Miller 1973, Madoz et al. 2005). It is similar morphologically to the Mohave tui chub (*Siphateles bicolor mohavensis*), which occurs to the south of the Owens tui chub in the Mojave Desert, and the Lahontan tui chub (*Siphateles bicolor obesa*), which occurs to the north in the Walker River. The similarity of these three subspecies plus hydrographic evidence suggest that the drainages where these species currently occur were once connected, although not contemporaneously.

Distribution and Abundance

The Owens tui chub is endemic to the Owens Basin (Owens Valley, Round Valley, and Long Valley) of Inyo and Mono Counties, California (Service 1998) (see Figure 1). Historically, the Owens tui chub occurred in large numbers in suitable habitat throughout the Owens Basin, including the Owens River and associated tributaries, springs, drainage ditches, and irrigation canals. Capture efforts by researchers in the late 19th and early-to-mid 20th centuries suggest that the Owens tui chub was common in the Owens Valley floor (Gilbert 1893, Snyder 1917, Miller 1973). However, when Miller published the official scientific description of the subspecies in 1973, the population size and range of the Owens tui chub had been drastically reduced.

When listed in 1985, only two populations of Owens tui chub were believed to exist (50 FR 31592, Chen et al. 2007). One is the Hot Creek Headwaters population, which is located at the headwaters of Hot Creek above the Hot Creek Fish Hatchery (Figure 2). The site consists of two springs, AB Spring and CD Spring. The second population is in the Upper Owens Gorge located below Long Valley Dam and above the town of Bishop (Figure 2).

Subsequent to listing, a third population at Cabin Bar Ranch (owned by the Anheuser Busch Company) was discovered in 1987 (Miller 1997). The Cabin Bar Ranch population consisted of fish occupying irrigation ditches fed by a spring on the southwest shore of Owens Dry Lake (Chen 2006). Predation from introduced largemouth bass (*Micropterus salmoides*) and sunfish (*Lepomis macrochirus*) and failure to maintain adequate water quality and quantity extirpated the Cabin Bar Ranch population of Owens tui chub in 2003.

Prior to 2003, individuals from the Hot Creek Headwaters, Upper Owens Gorge, and Cabin Bar Ranch populations were translocated to establish additional populations of Owens tui chubs. Currently, the Owens tui chub is limited to six isolated sites (Figure 2): Hot Creek Headwaters (AB Spring and CD Spring), Little Hot Creek Pond, Upper Owens Gorge, Mule Spring, White Mountain Research Station (operated by the University of California), and Sotcher Lake, the last of which is outside the historical range of the species in Madera County. The populations at these six sites are genetically pure Owens tui chubs (see Genetics section). The current populations of the Owens tui chub and the origins of the fish stock from relict populations are listed in Table 1 (Conservation Management Institute 1996, Service 1998, Potter 2004, Chen et al. 2007, and Parmenter *in litt.* 2007).

The population that may have expanded its range is the Upper Owens Gorge population. Individuals thought to be Owens tui chubs were observed in the Lower Owens Gorge in 1995

Figure 1. Historical Distribution of Owens Tui Chub Populations

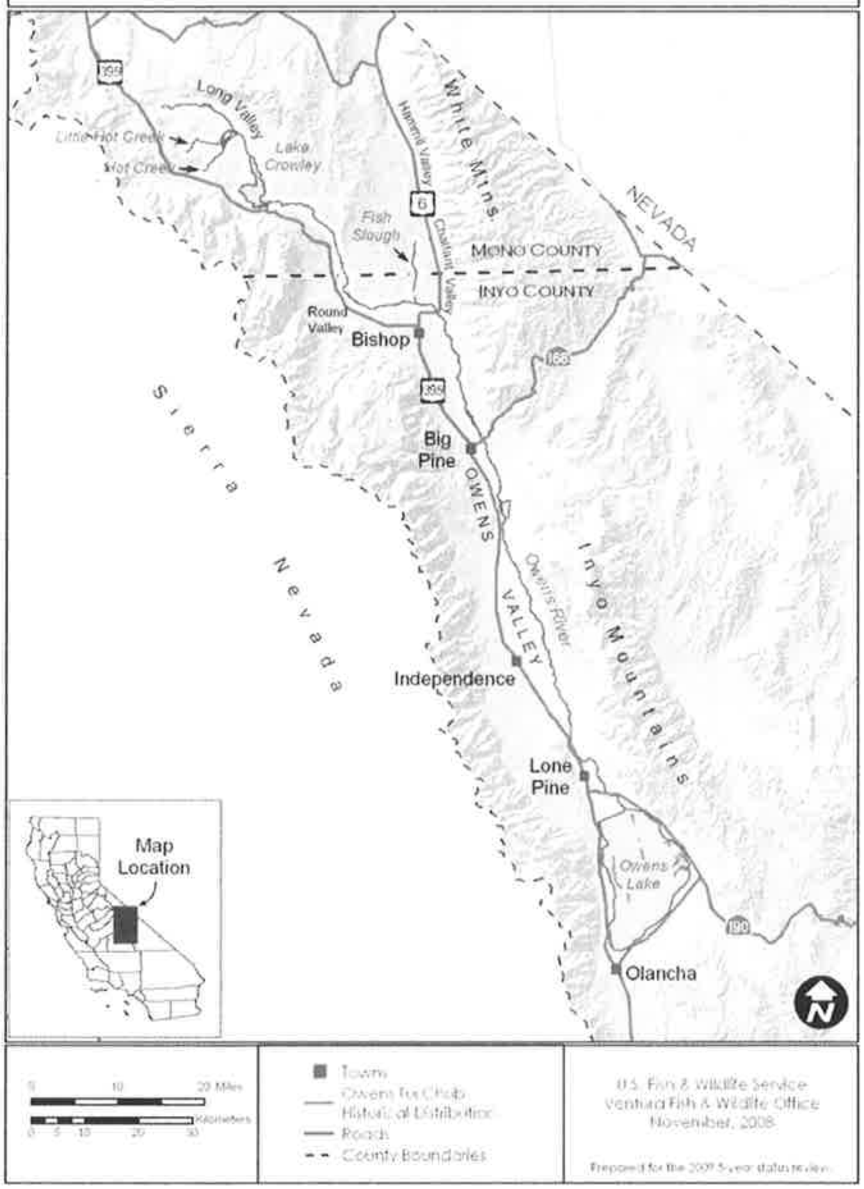


Figure 2. Current Distribution of Owens Tui Chub Populations.

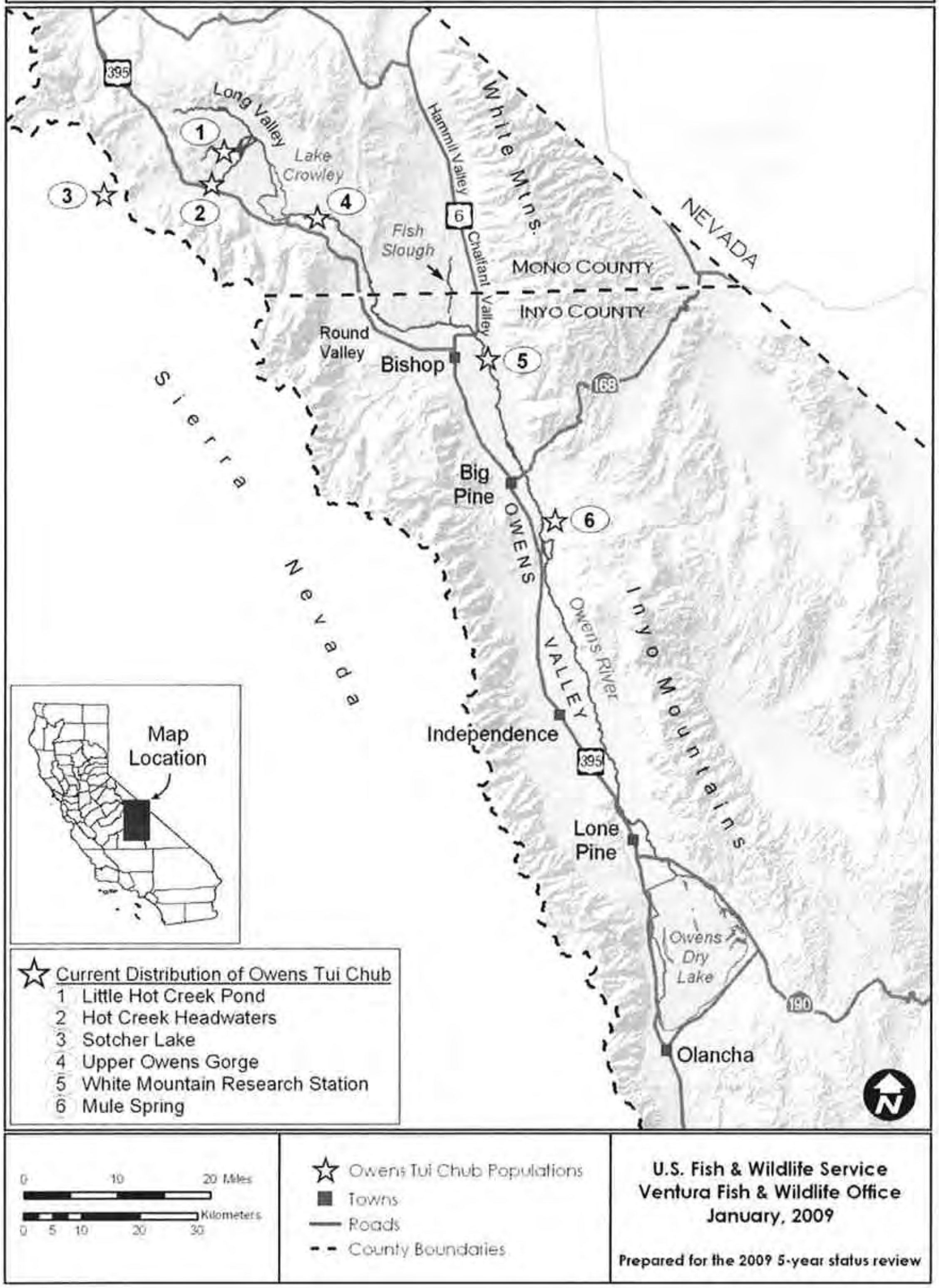


Table 1. Owens tui chub (*Siphateles bicolor snyderi*) populations at the time of listing in 1985, current populations, land ownership, and estimated population size.

Populations at the Time of Listing	Current Populations	Land Ownership	Initial Population Count and Date	Most Recent Population Count and Date
Owens Tui Chub Lineage				
Hot Creek Headwaters AB Spring CD Spring	Hot Creek Headwaters AB Spring CD Spring	LADWP[1]	 334 ± 105 (1988) 523 ± 146 (1988)	 180-245 (1999) None observed in 1998-99
	Little Hot Creek Pond	Inyo National Forest	811 transplanted (1988)	No count
Upper Owens Gorge	Upper Owens Gorge	LADWP	2818 (1989)	28 observed (1999)
	White Mountain Research Station (3 ponds)	LADWP	40 transplanted (1999)	No count
	Sotcher Lake	Inyo National Forest	No count	No count
Toikona Tui Chub Lineage				
Cabin Bar Ranch		Anheuser Busch Co.	No count	Extirpated
	Mule Spring	BLM[2]	59 transplanted (1991)	250-338 (2007) 214-305 (2008)
	White Mountain Research Station (1 pond)	LADWP	24 transplanted (1987)	No count

[1] LADWP = Los Angeles Department of Water and Power
[2] BLM = Bureau of Land Management

and 2008 in a portion of the Owens Gorge re-watered since 1992 (Fransz 1997, Hill *in litt*. 2008). However, no Owens tui chubs were captured in the Lower Owens Gorge in 1998 despite extensive trapping and electrofishing efforts (Malengo 1998). We need to conduct a genetic analysis of these fish to determine whether they are pure Owens tui chubs or hybrids.

The Hot Creek Headwaters (AB and CD Springs), Upper Owens Gorge, and White Mountain Research Station populations of the Owens tui chub are on lands owned by the Los Angeles

Department of Water and Power (LADWP). The Sotcher Lake and Little Hot Creek Pond populations are on lands managed by the Inyo National Forest, and the Mule Spring population is on land managed by the Bureau of Land Management (Chen and May 2003).

Information on Owens tui chub abundance or changes in population size is limited or unknown for these populations (Table 1), and when counts have been made, the methodologies used to estimate population size have varied (Malengo 1999, Geologica 2003, Eckland and McKee 2007, and Holmes et al. 2008). While we know that these populations currently exist, we are unable to determine whether they are increasing, decreasing, or stable. No information is available on population age structure, sex ratio, or mortality.

Habitat or Ecosystem

Much of the aquatic habitat in the Owens Valley has been eliminated or modified since the early 1900s. Water has been dammed, diverted, and transported to Los Angeles for human consumption, or is used locally for agriculture and human consumption. Of the remaining perennial aquatic habitat in the Owens Valley, much of it contains the abiotic features (e.g., water velocity, water quality, cover) needed by the Owens tui chub but not the biotic features (e.g., absence of non-native aquatic species that prey on or hybridize with Owens tui chubs) (see Five Factor Analysis, C: Disease or Predation section).

The Owens tui chub occurs in low-velocity waters with well-developed beds of aquatic vegetation, rocks, and undercut banks (Leunda et al. 2005). Jenkins (1990) observed Owens tui chubs only in the lacustrine habitats of a weir pool and beaver pond in the upper portion of the Owens Gorge. These areas had mud bottoms and aquatic vegetation. Riffle and run habitats of the Owens River in the Gorge were devoid of chubs. Vegetation is likely important to Owens tui chubs for predator avoidance, reproduction, food, and reduced water velocity (McEwan 1990, 1991, Conservation Management Institute 1996, Geologica 2003). Aquatic vegetation is especially important as it provides plant food and habitat for aquatic invertebrates, the main food item of the Owens tui chub (McEwan 1990, 1991). Water temperature is usually fairly constant at spring sites (e.g., 59 degrees Fahrenheit (°F) (15 degrees Centigrade [°C])) at Hot Creek Headwaters, but can fluctuate from 36 to 78 °F (2 to 25 °C) in a river (e.g., Owens Gorge) (Geologica 2003). The pH ranges from 6.6 to 8.9 (McEwan 1989, Geologica 2003), dissolved oxygen varies from 5 to 9.3 milligrams/liter (mg/l or parts per million (ppm)) (Malengo 1999, Geologica 2003), and alkalinity varies from 68.0 to 88.4 parts per million (McEwan 1989).

In 1997, a Memorandum of Understanding (MOU) among the litigants (LADWP and Inyo County) and interveners required LADWP to release a permanent base flow of 40 cubic feet per second in the lower Owens River. This action was accepted, and stipulated by the Superior Court of the State of California, County of Inyo. The LADWP initiated this release and in 2007, the court determined that LADWP had complied with the permanent base flow release requirement in the MOU. This release increased the availability of runs, riffles, and pools in the lower Owens River, much of which was historical habitat for the Owens tui chub. However, this increase in habitat has not benefited the Owens tui chub; rather, it has benefited the non-native largemouth bass and other non-native aquatic species (Hill *in litt*. 2008), which prey on or compete with the Owens tui chub (see Factor C: Disease or Predation and Factor E: Other

Natural or Manmade Factors Affecting Its Continued Existence sections).

We provide a description of the habitat at each of the extant populations below.

Hot Creek Headwaters (AB and CD Springs): Both springs are the headwaters for Hot Creek, a tributary of the Owens River. The habitat for the AB Spring subpopulation has four spring discharge locations among its 123-meter (m) (400-foot (ft)) long, flowing channel (McEwan 1991). The habitat for the CD Spring population has five spring discharge locations and is about 178 m (600 ft) long (McEwan 1990, 1991). Both springs are similar in width, 6.3 m (20.5 ft), and depth, 0.15 to 0.77 m (0.5 to 2.5 ft) (McEwan 1990, 1991). Both springs have a profuse growth of emergent and submergent vegetation (McEwan 1990). Rainbow trout (*Oncorhynchus mykiss*), a competitor with the Owens tui chub for food and a predator of its eggs and fry, are present.

Little Hot Creek Pond: This population occupies a man-made pond constructed by the U.S. Forest Service in 1986 to enhance waterfowl habitat. The stream channel was impounded about 0.4 kilometer (km) (0.25 mi) downstream from the thermal headsprings of Little Hot Creek (Moskowitz 1989). The pond is shallow; covered with muskgrass (*Chara* sp.), an invasive alga which provides cover for the chubs; and cattail (*Typha* sp.) is abundant. Mosquitofish (*Gambusia affinis*) are also present. Mosquitofish prey on the eggs and fry of Owens tui chubs and compete for aquatic insects.

Owens Gorge: This portion of the Owens River, which supports the Upper Owens Gorge population, is located below Crowley Lake and Long Valley Dam. The water source for the upper gorge is seepage through the Long Valley Dam. Owens tui chubs are located downstream of the dam and upstream of a weir (a low dam built across a stream to raise water level or divert water), which is 1,610 m (5232 ft) below the dam. The dam and weir function as barriers to movement of non-native fish species from Crowley Lake above the dam and the Owens River below the weir.

The aquatic habitat in the Upper Owens Gorge consists of narrow, heavily silted channels (Bogan et al. 2002). Lacustrine habitat for the chub is confined to a long pond created by a beaver dam. The banks of the pond and channel are heavily vegetated with willow (*Salix* sp.), cattail, grasses, stinging nettle (*Urtica* sp.), and wild rose (*Rosa californica*). Pondweed (*Potamogeton* sp.) is abundant along the banks (Bogan et al. 2002). Non-native fish present in the Owens Gorge include brown trout (*Salmo trutta*), which prey on Owens tui chubs, and Lahontan tui chub, which hybridize with Owens tui chubs (Malengo 1998).

White Mountain Research Station: This population is at the University of California's White Mountain Research Station, a facility leased from the LADWP near the Owens River and the town of Bishop, California. The facility includes three 18.5 by 18.5 m (60 by 60 ft) lined, square, man-made ponds and one small, unlined, rectangular, man-made pond (Parmenter *in litt.* 2007). The small ponds are fed by ground water. The square ponds have submerged tires to provide cover for fish and the rectangular pond is bordered with cottonwood trees that provide cover. Each pond has a drain at the bottom center to allow water to flow through the ponds (Bogan et al. 2002). Non-native fish are not present.

Mule Spring: This population occupies a small, 9 by 13 m (30 by 42 ft) man-made pond (Bogan et al. 2002). The spring that feeds the pond flows from a nearby old mine site. A dense stand of cattail dominates most of the pond, leaving about 30 percent open water. Muskgrass grows around the pond edge and willows grow in the channel below the pond. Non-native fish are not present, but non-native bullfrogs (*Rana catesbeiana*) are present (Bogan et al. 2002).

Sotcher Lake: This is a 26-hectare (ha) (64-acre (ac)) alpine lake located in the Upper San Joaquin River watershed of the western Sierra Nevada. The lake elevation is 2,332 m (7,651 ft). Non-native rainbow and brown trout are present. There is no additional information available about the habitat at Sotcher Lake.

<u>Genetics</u>

Since the time of listing and approval of the Recovery Plan, research has been conducted on the genetics of the Owens tui chub. The Owens tui chub is the most distinct of the tui chubs based on both allozymes and amplified fragment length polymorphisms (AFLP) data and could probably be considered a separate species (May 1999).

One reason the Owens tui chub was extirpated throughout most of its range was from introgression (i.e., hybridization) with the introduced Lahontan tui chub (50 FR 31594) (Chen et al. 2007). Introgression is the movement of a gene from one species into the gene pool of another species. Recent genetic analyses of various populations of presumed pure (i.e., non-introgressed) Owens tui chubs revealed that some populations were introgressed (Chen 2006). These include June Lake, Mammoth Creek, Hot Creek below the fish hatchery, Twin Lakes-Mammoth, Owens River Upper Gorge Tailbay (the area downstream of a dam where water is released into the river after passing through the turbines of a generating station), A1 Drain, C2 Ditch, and McNally Canal. Chen (2006) determined that the following populations, which were sampled in 2002, were non-introgressed Owens tui chubs:

Hot Creek Headwaters - AB Spring and CD Spring subpopulations
Little Hot Creek Pond
Owens Gorge – Upper Owens Gorge
White Mountain Research Station
Mule Spring
Sotcher Lake
Cabin Bar Ranch (extirpated after sampling)

These remaining non-introgressed populations of Owens tui chubs persist in a small number of fragmented habitats. Chen et al. (2007) compared populations of introgressed and non-introgressed Owens tui chubs based on microsatellite DNA loci (Meredith and May 2002) and genomic screening (Chen 2006). Using factorial correspondence (a statistical analysis of data), Chen et al. (2007) discovered that the differences between the Cabin Bar Ranch population and other populations of Owens tui chubs are much greater than between the recognized subspecies of *S. bicolor snyderi* and *S. bicolor obesa*. Thus, the Owens tui chubs and Cabin Bar Ranch tui chubs (translocated to Mule Spring and one pond at the White Mountains Research Station prior to the Cabin Bar Ranch extirpation) represent distinct, independent lines of evolution in the Owens Basin (Chen 2006).

Changes in Taxonomic Classification or Nomenclature

Nomenclature: The most recent peer-reviewed paper to address the classification of the North American genera of Cyprinidae is Simons and Mayden (1998). Using mitochondrial and ribosomal RNA sequences, they recognized *Gila* as a monophyletic genus of primarily Colorado River fishes, and restored *Siphateles* from a subgenus to a full genus. The Owens tui chub was previously classified in the subgenus *Siphateles*. This usage was subsequently adopted by Smith et al. (2002), Moyle (2002), Baerwald and May (2004), Leunda et al. (2005), Chen et al. (2007), Chen et al. (2008), and others. Additional non-peer-reviewed work by Hughson and Woo (2004), Scharpf (2005), and Garron (2006) also follow this usage. Based on this recent information, we suggest a nomenclature change from *Gila bicolor snyderi*, the scientific name used in the final rule and the Recovery Plan, to *Siphateles bicolor snyderi*.

Taxonomy: Based on his genetic research (see Genetics section), Chen (2006) proposed that the Cabin Bar Ranch population is a separate lineage, the Toikona tui chub lineage, from the Owens tui chub lineage. Fish from the Cabin Bar Ranch population have been translocated and populations established at Mule Spring and the White Mountain Research Station; the Cabin Bar Ranch population has subsequently been extirpated (Parmenter *in litt.* 2008). Chen does not propose making a formal taxonomic split from the Owens tui chub until more information on meristic and osteological characters becomes available. However, this information cannot be collected at this time because, in their present small pond locations (Mule Spring and White Mountains Research Station), Toikona tui chubs do not attain sufficient body size at maturity for the indicative characters to develop fully (Miranda and Escala 2000).

Five-Factor Analysis

The following five-factor analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

The listing rule identified extensive habitat destruction and modification as threatening the Owens tui chub (50 FR 31594). These continue to be threats. Currently, most streams and rivers in the Owens Basin have been diverted and some impounded. The Owens tui chub, which used to occur throughout the Owens River and its tributaries in the Owens Basin, is restricted to six isolated populations, five of which are within the historical range of the species. Of these five populations, three (Hot Creek Headwaters, Little Hot Creek Pond, and Upper Owens Gorge) are located in small, isolated, man-altered portions of these waterways. The other two populations (Mule Spring and White Mountain Research Station) exist in man-made ponds at upland sites with water supplied by artificial methods. The occupied habitat at Hot Creek Headwaters, Little Hot Creek Pond, White Mountain Research Station, and Mule Spring is 0.8 ha (2 ac) or smaller at each site. The habitats for these five populations are threatened by water diversions, failure of infrastructures that deliver water to these habitats, and/or emergent vegetation.

Most of the water rights in the Owens Basin are owned by the city of Los Angeles. Currently, the demand for water from the Owens Basin is high and growing as Los Angeles continues to grow. The LADWP operates and maintains dams, diversion structures, groundwater pumps, and canals to capture and convey much of the water from the Owens Basin to Los Angeles. The remaining ground water, which provides water to isolated springs and springs that are the headwaters of streams in the Owens Basin, and surface water are used extensively for agriculture and municipal purposes in the Owens Basin. These man-made changes to aquatic habitat in the Owens Basin dramatically reduced suitable aquatic habitat for the Owens tui chub. They reduced the occurrence of the Owens tui chub from a common, wide-ranging species in the Owens Basin to a rare species occurring at a few sites, representing less than 1 percent of the fish's historical range (50 FR 31594).

In addition to the increasing water demands for the greater Los Angeles area, areas adjacent to the Owens Valley (e.g., Round, Chalfant, and Hammil Valleys) are growing, and the demand for water is growing. This increased demand has resulted in an increased withdrawal of ground and surface water from the Owens Valley Groundwater Basin (see Factor D: Inadequacy of Existing Regulatory Mechanisms), which affects springs and other surface waters in the Owens Basin (Pinter and Keller 1991).

As mentioned above, two of the populations (White Mountain Research Station and Mule Spring) are confined to small, man-made ponds with artificial water sources. The survival of these two populations is dependent upon the continual maintenance of the artificial water supply and ensuring adequate water quality. When water flow is not maintained, aquatic habitat and/or water quality will likely degrade rapidly because the ponds are so small. This loss of habitat or degradation of water quality could result in the loss of a population of Owens tui chubs. This scenario almost occurred at Mule Spring when the pipe supplying water from Mule Spring to the Owens tui chub pond was plugged by calcic deposits. Fortunately, the plugged line was quickly discovered and the deposits were removed (Bogan et al. 2002). Currently, there is no routine maintenance program for this population of the Owens tui chub and its habitat.

In the upper portion of the Owens Gorge, the water gradient is mostly riffle and run habitat and is not suitable for Owens tui chubs. Water is supplied by leakage through Long Valley Dam, an earthen structure. This dam does not have outlet gates to control the release of water into the upper gorge. The only occupied or suitable habitat in the upper gorge is at a pool created by a beaver dam. The limited habitat created by the beaver dam is eroding resulting in a reduction of lacustrine habitat for Owens tui chubs (Jenkins 1990).

Habitat requirements for the Owens tui chub include aquatic submerged vegetation but not large amounts of emergent vegetation. At the spring sites (Hot Creek Headwaters, Little Hot Creek Pond, and Mule Spring), invasive emergent plants (e.g. cattail) have altered the aquatic habitat. Cattail proliferation results in deposition of large amounts of organic biomass, eventually converting aquatic habitat to upland habitat (Potter 2004). This conversion results in a loss of habitat for the Owens tui chub. In addition, dense emergent vegetation provides cover for non-native predators of Owens tui chubs, such as bullfrogs and crayfish (*Procambarus* sp.), which enables non-native predators to thrive at these sites (see Factor C: Disease or Predation). CDFG has installed a device in the waterway between the Hot Creek Hatchery and Hot Creek Headwaters to help remove emergent vegetation. This device requires routine, manual cleaning. No structures to remove emergent vegetation occur at the other population sites. These sites rely on routine, manual clearing of emergent vegetation. At Mule Spring, cattail has been removed by hand from littoral zone or nearshore aquatic areas. Currently, there is no formal program or management plan to conduct this activity by the land management agencies.

Of the five populations within the historical range of the Owens tui chub, two (Mule Spring and White Mountain Research Station) require routine management of water quantity and water quality and three (Mule Spring, Hot Creek Headwaters, and Little Hot Creek) require routine removal of emergent vegetation. One (Upper Owens Gorge) has been severely altered by the construction of a dam, with no mechanism to manage adequate releases of water downstream of the dam; thus, there is no way to manage water quantity, water quality, and water velocity in the Upper Gorge. Given the dependency of these populations of the Owens tui chub to the routine maintenance of their habitats, the continued existence of these restricted habitats and the associated populations of Owens tui chubs are tenuous.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization for commercial, recreational, scientific, or educational purposes was not identified as a factor in the 1985 final listing rule (50 FR 31594). Since listing, only five individuals/entities, including the Service and the CDFG, have received recovery permits to take the Owens tui chub for scientific purposes (Marquez *in litt.* 2008). The permits authorized capture and release; no mortality was permitted. Thus, there has been limited use of the Owens tui chub for scientific purposes but no evidence that overutilization is a threat to the species.

There is no information in the literature that suggests that the Owens tui chub is or has been used for commercial, recreational, or educational purposes since listing in 1985. Therefore, overutilization for commercial, recreational, scientific, or educational purposes is not known to be a threat at this time or expected to be a threat in the future.

FACTOR C: Disease or Predation

<u>Disease</u>

The final rule listing the Owens tui chub as endangered did not identify disease as a factor (50 CFR 31594). Since listing, evidence of disease has been observed in some populations of the Owens tui chub. One Owens tui chub from Cabin Bar Ranch had 183 Asian tapeworms (*Bothriocephalus acheilognathi*) (Bogan et al. 2002). However, Bogan et al. (2002) did not find any evidence of parasites in 15 Owens tui chubs from Hot Creek Headwaters (seven from AB Spring and eight from CD Spring). Bogan et al. (2002) did find evidence of infection in six of the seven Owens tui chubs from AB Spring that were collected for genetic analysis. Five of the six had intraperitoneal fluid and hypertrophied livers, four had lesions around the anal opening, one had red eyes, and one had a curved spinal cord. Most of these symptoms are characteristic of either bacterial or viral infections or water pollution (Bogan et al. 2002). Since disease has been identified in Owens tui chubs, it is considered a threat. However, the magnitude of this threat is unknown.

Predation

The final listing rule (50 FR 31594) identified predation by introduced non-native fish, specifically brown trout, as a major threat to the Owens tui chub. Chen and May (2003) identified predation by non-native largemouth bass and brown trout as eliminating Owens tui chubs from much of their historical range in the Owens River. These species (Table 2) are abundant in the Owens River system (Chen and May 2003). The presence of non-native aquatic predators in the Owens Basin has greatly limited the locations in which the Owens tui chub can survive and persist. Subsequent to the listing of the Owens tui chub as endangered in 1985, a new population of Owens tui chubs was established at Fish Slough (Figure 2). This population was lost within a short time due to introduction of and predation by largemouth bass (Parmenter *in litt.* 2009). The Cabin Bar Ranch population of the Owens tui chub was lost shortly after the discovery of largemouth bass and sunfish in this population (see Distribution and Abundance section).

Table 2. Occurrence of aquatic predators of the Owens tui chub at current and historical locations.

	Hot Creek Head-waters	Little Hot Creek Pond	Upper Owens Gorge	White Mtn Research Station	Mule Spring	Sotcher Lake	Cabin Bar Ranch	Histor-ical Range
Brown trout	X		X			X		X
Rainbow trout	X		X			X		X
Largemouth bass			X				X	X
Bluegill sunfish							X	X
Sacramento perch			X					X
Mosquito-fish		X						X
Bullfrog					X			X
Crayfish								X

Much of the recreation-based economy of the Owens Basin depends on recreational fishing, primarily for trout and largemouth bass. Because of the miles of riverine habitat and the historical and current practice of angling in the Owens Basin, it is unlikely that curtailing stocking these species would eliminate them from the Basin. Consequently, restoring the Owens tui chub to most of the Owens River or its connected tributaries is unlikely to occur.

At the Hot Creek Headwaters, predation by rainbow trout, which escape from the Hot Creek Fish Hatchery, does not seem to be a threat (McEwan 1990, 1991). Although rainbow trout eat Owens tui chub eggs, an examination of stomach contents of 109 rainbow trout in CD Spring revealed no Owens tui chub. McEwan (1990, 1991) hypothesized that this absence of evidence of predation on hatched Owens tui chubs may be due to the less piscivorous (fish-eating) nature of rainbow trout and/or the small size of the hatchery trout.

Mosquitofish are abundant at Little Hot Creek Pond. Data are not available regarding their interaction with the Owens tui chub (Moskowitz 1990). However, we do know that mosquitofish will prey on small individuals of Mohave tui chub (Archdeacon 2007).

Brown trout occur in both the upper and lower portions of the Owens Gorge (Bogan et al. 2002). In 1989, Jenkins sampled the fish population in the first 9 km (5.6 mi) of the upper portion of the Gorge downstream from Crowley Dam. Population estimates were 2,818 for the Owens tui chub, 5,961 for the Owens sucker, and 50,000 for brown trout (Jenkins 1990). The Upper Owens Gorge population receives protection from the movement of introduced brown trout upstream from the Lower Owens Gorge by a landslide and concrete weir making upstream movement unlikely (Fransz 1997). During a survey of the Lower Owens Gorge in 1998, 19 brown trout ranging in length from 65 to 120 mm (2.5 to 4.7 in) (forklength) were captured (Malengo 1998). Bogan et al. (2002) believed that the Owens tui chub did not occur in the Lower Owens Gorge; however, individuals thought to be Owens tui chubs were observed there in 2008 (Hill *in litt.* 2008). Sacramento perch (*Archoplites interruptus*), another non-native predatory species, also occur in the lower portion of the Owens Gorge.

At Mule Spring, bullfrogs are present and probably prey on Owens tui chubs. Although there is no report in the literature of direct observations of bullfrog preying on Owens tui chubs, bullfrogs prey on many species of fish, including other subspecies of tui chubs (Parmenter *in litt.* 2009).

Although avian predation on Owens tui chubs has not been observed, McEwan (1990) hypothesized that birds occasionally prey on them at Hot Creek Headwaters. Predation by black-crowned night herons (*Nycticorax nycticorax*) and great blue herons (*Ardea herodias*) on rainbow trout at the Hot Creek Fish Hatchery immediately downstream from Hot Creek Headwaters has been documented.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

The inadequacy of existing regulatory mechanisms was identified as a threat to the Owens tui chub at the time of listing in 1985 and, in the absence of the protections afforded by the Act, would continue to be a threat. The final rule noted that as a State-listed endangered species, the California Endangered Species Act (CESA) and California Fish and Game Code 2080 protected the Owens tui chub from take. Take is defines in section 86 of the California Fish and Game Code as "hunt, pursue, catch, capture, or kill; or attempt to hunt, pursue, catch, capture, or kill." If the take is incidental, CDFG requires that the permit applicant fully mitigate for it. If the take is intentional or purposeful (e.g., for research purposes), the researcher must first obtain a Memorandum of Understanding (MOU) with the CDFG. However, CESA does not protect the species' habitat, and habitat destruction and alteration were identified as factors threatening the Owens tui chub (see Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range).

The Endangered Species Act (Act) is the primary Federal law providing protection for this species. Since its listing, the Service has analyzed the potential effects of Federal projects under section 7(a)(2), which requires Federal agencies to consult with the Service prior to authorizing, funding, or carrying out activities that may affect listed species. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its reproduction, numbers, or distribution (50 C.F.R. § 402.02). A non-jeopardy opinion may include reasonable and prudent measures that minimize the amount or extent of incidental take of listed species associated with a project. Incidental take refers to taking of listed species that results from, but is not the purpose of, carrying out an otherwise lawful activity by a Federal agency or applicant (50 C.F.R. § 402.02). In cases where some incidental take is unavoidable, the Service works with the agency to include additional conservation measures to minimize negative impacts. For projects without a Federal nexus that may take a listed species, the Service may issue incidental take permits pursuant to section 10(a)(1)(B). To qualify for an incidental take permit, applicants must develop, fund, and implement a Service-approved habitat conservation plan (HCP) that details measures to minimize and mitigate the project's adverse impacts to listed species. Regional HCPs in some areas now provide an additional layer of regulatory protection for covered species, and these HCPs are coordinated with the related Natural Communities Conservation Program, a State program.

The Recovery Plan did not identify inadequacy of existing regulatory mechanisms as a threat to the Owens tui chub; therefore, it did not identify any recovery tasks that would mitigate this factor. There is no information in the literature that suggests this factor is a direct threat to the Owens tui chub, but there is a concern about indirect effects to the Owens tui chub and its habitat from actions that are not regulated. The unregulated actions are those that may result in the overdrafting of the aquifer in the Owens Valley Groundwater Basin area, which underlies the Benton, Hammil, and Chalfant Valleys in Mono County and Round and Owens Valleys in Inyo County. Groundwater withdrawal is an activity under state jurisdiction. However, in California, groundwater withdrawal is controlled and monitored only in those areas that have been adjudicated (settled by judicial procedure). The aquifer in the Owens Basin has not been adjudicated; therefore, its use is not regulated. Without regulated groundwater use, groundwater pumping could result in reduced or no water flow to existing isolated springs and headwater springs of streams in the Owens Basin. This change would result in a reduction or loss of aquatic habitat for the Owens tui chub. For example, from the early 1900s to the 1960s, there was a 40 percent decrease in water flow from the springs at Fish Slough near Bishop (Pinter and Keller 1991). The reduction was greater than could be explained by natural, aboveground processes, such as evaporation and transpiration losses from phreatophytes (deep-rooted plants that obtain water from a permanent ground supply or from the water table). The decrease in water flow at Fish Slough may have been related to increased groundwater pumping in the Owens Valley Groundwater Basin (Pinter and Keller 1991, MHA 2001).

The Recovery Plan identified protecting spring discharge as a recovery task for the spring-fed Conservation Areas (see Strategy of Recovery – Conservation Areas section). Springs are supplied by ground water, and the State of California is responsible for regulating ground water. However, California has not issued groundwater regulations for the Owen Valley Groundwater Basin. The Recovery Plan noted that the City of Los Angeles and Inyo County had recently agreed to manage groundwater resources to minimize the effects of groundwater pumping on Owens Valley vegetation (EIP Associates 1991). This agreement covers only the Owens Valley. It does not include areas outside the Owens Valley but within the Owens Valley Groundwater Basin, such as the Long, Chalfant, and Hammil Valleys. Long Valley was identified as a Conservation Area for downlisting and delisting the Owens tui chub. Recently, the amount of groundwater pumping in the Chalfant and Hammil Valleys for agricultural use exceeded the amount of water that was recharged by precipitation and snowmelt (MHA 2001). Ground water in the Long, Chalfant, and Hammil Valleys provides water to Owens tui chub Conservation Areas. Any reduction in flow from springs in the Owens Basin would result in further reductions of habitat quality and quantity for the Owens tui chub at springs and tributaries of the Owens River. Therefore, inadequacy of existing regulatory mechanisms is a threat at this time.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

The final listing rule identified introduction of the Lahontan tui chub and subsequent hybridization and competition as major threats to the Owens tui chub. Hybridization and competition continue to be threats; although not discussed in the listing rule, stochasticity (i.e., random events), catastrophic events, and climate change are also potential threats.

Hybridization

Until recently, the Owens tui chub and the closely related Lahontan tui chub were isolated from each other. Lahontan tui chubs were introduced as baitfish into many of the streams in the Owens Basin. This was first observed at Crowley Lake in 1973, where fishermen illegally introduced the Lahontan tui chub (Miller 1973). Since that time, hybridization between the Owens tui chub and Lahontan tui chub has been documented for populations in Mono County at Hot Creek (downstream from the hatchery), Mammoth Creek, Twin Lakes-Mammoth, June Lake, and Owens River Upper Gorge Tailbay, and in Inyo County at A1 Drain, C2 Ditch, and McNally Canal (Madoz et al. 2005, Chen 2006). At the time of listing, only three populations of genetically pure Owens tui chubs existed, while at the present time, there are six genetically pure populations (see Spatial Distribution section).

Using Lahontan tui chubs in the Owens Basin as baitfish is not allowed under fishing regulations. However, Lahontan tui chubs and hybrids are present in the Owens Basin including Crowley Lake, Hot Creek and tributaries, including Little Hot Creek, and the lower portion of the Owens Gorge (Malengo 1998, Chen 2006). If man-made barriers isolating the Owens tui chub populations at these sites are degraded or removed, this degradation/removal could result in the loss of the pure populations of Owens tui chubs at Hot Creek Headwaters, Little Hot Creek

Pond, and the Upper Owens Gorge. In addition, the opportunities to establish new populations of Owens tui chubs in the Owens Basin is limited by the presence of hybrids in the Owens River and tributaries, the historical habitat for the Owens tui chub. Currently, the only viable locations for establishing the Owens tui chub are isolated springs or the headwaters of streams with downstream barriers to upstream movement of Lahontan tui chubs or hybrids.

Competition

The final listing rule identified competition with non-native fish species as a threat to the Owens tui chub. However, little specific information on the impact of competition on the Owens tui chub is available in the literature.

Non-native insectivorous fish occur at Hot Creek Headwaters (rainbow trout) and Little Hot Creek Pond (mosquitofish) (McEwan 1989). A major part of the diets for these non-native species is the same aquatic insects consumed by Owens tui chubs. Although information is not available for rainbow trout, mosquitofish are known to affect some southwestern native fishes through competition and predation (Deacon et al. 1964, Courtenay and Meffe 1989).

Stochasticity

The creation and maintenance of small, often intensively managed, populations have prevented extinction of the Owens tui chub. Only six populations of the Owens tui chub exist, and they are isolated from each other. Species consisting of small populations, such as the Owens tui chub, are recognized as being vulnerable to extinction from stochastic (i.e., random) threats, such as demographic, genetic, and environmental stochasticity and catastrophic events (Shaffer 1981).

Demographic stochasticity refers to random variability in survival and/or reproduction among individuals within a population (Shaffer 1981). Random variability in survival or reproduction can have a significant impact on population viability for populations that are small, have low fecundity, and are short-lived. In small populations, reduced reproduction or die-offs of a certain age-class will have a significant effect on the whole population. Individuals vary naturally in their ability to produce viable offspring; for example, a particular male may be sterile or a female may produce fewer eggs than average. Although of only minor consequence to large populations, this randomly occurring variation in individuals becomes an important issue for small populations.

Currently Owens tui chub populations are small, between 100 and 10,000 individuals; therefore, random events that may cause high mortality, or decreased reproduction may have a significant effect on the viability of Owens tui chub populations. Furthermore, because the number of populations is small (six) and each is vulnerable to this threat, the risk of extinction is exacerbated.

Genetic stochasticity results from the changes in gene frequencies caused by founder effect, random fixation, or inbreeding bottlenecks (Shaffer 1981). Founder effect is the loss of genetic variation when a new population is established by a very small number of individuals. Random fixation is when some portion of loci is fixed at a selectively unfavorable allele because the intensity of selection is insufficient to overcome random genetic drift. Random genetic drift happens when only a portion of alleles in the population is transmitted from one generation to the next, because only a fraction of all possible zygotes become breeding adults. A bottleneck is an evolutionary event in which a significant percentage of a population is killed or prevented from breeding.

In small populations, such as the Owens tui chub, these factors may reduce the amount of genetic diversity retained within populations and may increase the chance that deleterious recessive genes are expressed. Loss of diversity could limit the species' ability to adapt to environmental changes and contributes to inbreeding depression (i.e., loss of reproductive fitness and vigor). Deleterious recessive genes could reduce the viability and reproductive success of individuals. Isolation of the six remaining populations preventing any natural genetic exchange will lead to a decrease in genetic diversity.

Long-term prospects for the conservation of rare fishes depend on the availability of genetic variation within a population. This is the raw material to respond to natural selection and allow for continued evolutionary change (Meffe 1990). The remnant Toikona tui chubs descended from 24 founder fish that were relocated from Cabin Bar Ranch in 1987; their extant populations are confined to two small artificial ponds (Mule Spring and White Mountain Research Station) (Chen 2006).

Environmental stochasticity is the variation in birth and death rates from one season to the next in response to weather, disease, competition, predation, or other factors external to the population (Shaffer 1981). Drought or predation in combination with a low population year could result in extinction. The origin of the environmental stochastic event can be natural or human-caused. The Owens tui chub has experienced population loss from environmental stochastic events and will likely do so in the future. The Cabin Bar Ranch population was lost because of an apparent failure to maintain adequate water quality and quantity and the introduction of non-native predators (largemouth bass and sunfish) (Parmenter *in litt.* 2006). Owens tui chubs have also disappeared from the Owens Valley Native Fishes Sanctuary (Fish Slough). Reasons for the loss of this population are not known, but the small, isolated nature of this population likely contributed to their extirpation.

Catastrophic events are an extreme form of environmental stochasticity. Although they generally occur infrequently, catastrophic events, such as severe floods or prolonged drought, can have disastrous effects on small populations and can directly result in extinction.

All three of these factors may also act in combination. One possible scenario of how these factors in combination could increase the risk of extinction for the Owens tui chub would be the loss of one or two populations during a drought period at the same time a predator is introduced to one of the remaining populations. Although one or two of the populations may survive and be a source for future reintroductions, the resulting loss of genetic diversity would further increase the risk of extinction.

Climate change

Impacts to the Owens tui chub under predicted future climate change are unclear. However, a trend of warming in the Sierra Nevada and Inyo Mountains is expected to increase winter rainfall, decrease snowpack, hasten spring runoff, reduce summer stream flows, and reduce ground water recharge (Cayan 2008). Increased summer heat may increase the frequency and intensity of wildfires (Parmesan and Matthews 2005, Intergovernmental Panel on Climate Change 2007). Loss of upland and riparian vegetation leads to soil erosion, increased sedimentation, downcutting of waterways, loss of bank stabilization, and decreased ability of soils to hold moisture and slowly release it into nearby waterways, all of which would negatively affect Owens tui chub habitat. While it appears reasonable to assume that the species may be affected, we lack sufficient certainty regarding: the magnitude and intensity of these impacts; the timing of these effects to the species; the extent of average temperature increases in California/Nevada; or potential changes to the level of threat posed by drought, fire regime, or heavy rainfall events. The most recent literature on climate change includes predictions of hydrological changes, higher temperatures, and expansion of drought areas, which would result in a northward and/or upward elevation shift in range for many species (Intergovernmental Panel on Climate Change 2007). While northward and/or higher elevation habitats could be important factors in the future conservation of this species, currently the isolated populations of the Owens tui chub are unable to access these habitats because of other threats, including a lack of connectivity of habitats caused by physical barriers (e.g., dams and diversion structures); habitat destruction and alteration; and predation, competition, and hybridization with introduced species. We have no knowledge of more detailed climate change information specifically for the range of the Owens tui chub.

III. RECOVERY CRITERIA

Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was issued may provide better ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, follow fully the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

The Recovery Plan describes the recovery criteria for the Owens tui chub. Although the five factors are not mentioned specifically, the Recovery Plan addressed factors A, C, and E. Listing factors B and D were not identified specifically as threats to the species at the time the Recovery Plan was prepared.

The Recovery Plan states that the Owens tui chub will be considered for downlisting to threatened status when the following goals have been achieved:

1. Reproducing and self-sustaining populations of the Owens tui chub must exist throughout six Conservation Areas. Two of the Conservation Areas must be in the Long Valley and four in the Owens Valley. The Conservation Areas are Little Hot Creek, Hot Creek, Fish Slough, Round Valley, Warm Springs, Blackrock, and Southern Owens (see Figure 3).

   This criterion addresses Factors A and E.

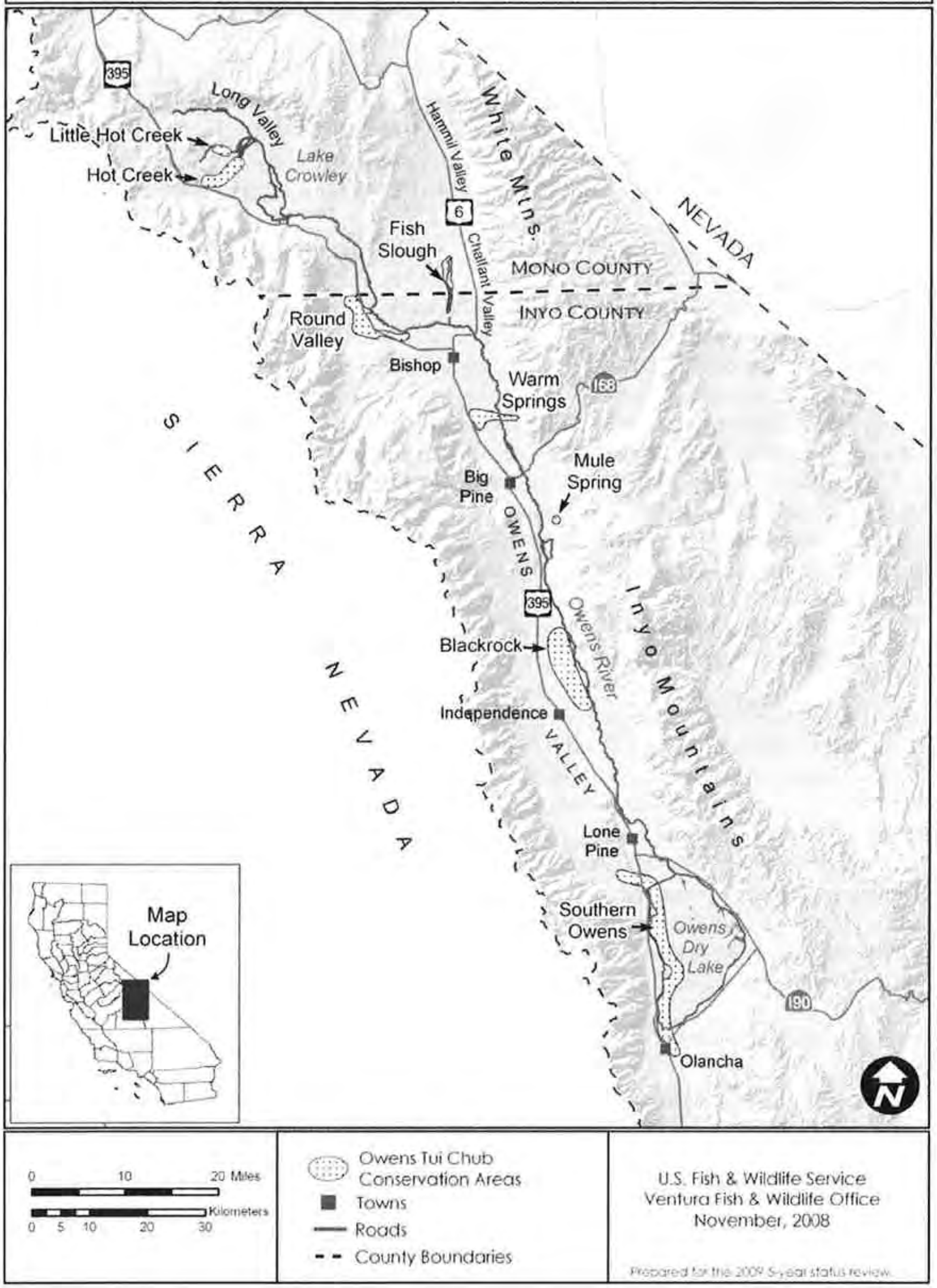
   The concept behind the Conservation Area approach is that the past approach of managed refuges that are wholly or partially isolated from non-native fish and severe habitat alteration has successfully averted extinction of the species, but the populations continue to experience extirpation or deleterious effects from demographic, genetic, and environmental stochasticity. Consequently, reliance on small, isolated refuges cannot accomplish recovery of the Owens tui chub (Service 1998). Instead, the Recovery Plan focuses on protection and management of Conservation Areas, which are landscape units that include habitat for the Owens tui chub and sufficient buffers to maintain ecological and geological processes necessary to protect aquatic ecosystems. They were selected because the impacts of existing land and water uses are minimal and chances for recovery of the Owens tui chub are greatest. If population abundance can be increased and if new populations can be established, the amount of stochasticity from inbreeding depression, genetic drift, and other sources will decrease, allowing for more genetic variation and preventing the loss of alleles (Holmes et al. 2008).

   When the Recovery Plan was approved, the Owens tui chub occurred at Hot Creek Headwaters, Little Hot Creek Pond, Upper Owens Gorge, White Mountain Research Station, Sotcher Lake, Cabin Bar Ranch, and Mule Spring. Recent surveys found that the Owens tui chub has been extirpated from Cabin Bar Ranch. Sotcher Lake is outside the historical range of the Owens tui chub and is not within the Owen Basin hydrologic unit. No introductions have occurred at Fish Slough, Round Valley, Warm Springs, Blackrock, or Southern Owens. There are no plans to establish new populations of Owens tui chubs at any of these sites. Since the approval of the Recovery Plan in 1998, one population of the Owens tui chub has been established and one has been lost. Reproducing and self-sustaining populations do not exist within the six Conservation Areas. Therefore, criterion 1 has not been achieved.

2. Threats must be controlled.

   This criterion addresses Factors A, C and E. Threats to the Owens tui chub under Factors A, C and E are described in the Recovery Plan and are still present. Since release of the Recovery Plan, the threat to the Owens tui chub from overutilization of ground water in the

Figure 3. Conservation Areas identified for Owens tui chub downlisting and delisting in the 1998 Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties, California.



valleys adjacent to the Owens Valley (Long, Chalfant, and Hammil Valleys), which reduces spring flow and habitat for the Owens tui chub, has been identified. Because threats to the Owens tui chub under Factors A, C and E continue to occur and no efforts have been implemented to control these threats, criterion 2 has not been achieved.

3. Each Conservation Area must have an approved management plan and implementing agreement with the landowner and the Service.

   This criterion addresses Factors C and E.

   None of the six existing populations of Owens tui chubs has approved management plans or implementing agreements between the Service and the landowners, and therefore this criterion has not been achieved.

4. Successful establishment of populations includes presence of juveniles and three additional age classes of Owens tui chubs.

   This criterion addresses Factors C and E.

   Surveys of population demographics for the Owens tui chub since approval of the Recovery Plan have been implemented for only one of the six populations. Therefore, data are not available to assess whether criterion 4 has been achieved.

5. Ensure that hybrid tui chubs do not occur in the Conservation Areas.

   This criterion addresses Factor E.

   Genetic analysis of 23 populations has been completed and has identified eight introgressed populations of Owen tui chubs (Chen and May 2003). These populations were at Hot Creek (including Little Hot Creek), Mammoth Creek, Twin Lakes near Mammoth, June Lake, and the Upper Gorge Tailbay in Mono County, and A1 Drain, C2 Ditch, and McNally Canal in Inyo County. Because none of these hybrid populations have been eliminated and efforts to prevent future introductions of hybrids and non-native Lahontan tui chubs to non-introgressed populations have not been implemented, criterion 5 has not been achieved.

6. The biomass of the Owens tui chub must exceed the biomass of deleterious, non-native fish species at each site.

   This criterion addresses Factor C.

   This criterion has been addressed where current populations of Owens tui chubs occur. However, populations must occur in the six Conservation Areas before the species may be considered for downlisting . Currently, populations occur in the Little Hot Creek and Hot Creek Conservation Areas. Therefore, criterion 6 has not been achieved.

The Owens tui chub can be considered for delisting when all of the following goals have been achieved:

1. Reproducing and self-sustaining populations of the Owens tui chub must exist throughout seven Conservation Areas for 5 consecutive years. Two of the Conservation Areas must be in the Long Valley and five in the Owens Valley. The Conservation Areas are Little Hot Creek, Hot Creek, Fish Slough, Round Valley, Warm Springs, Blackrock, and Southern Owens.

   This criterion addresses Factors A and E.

   Criterion 1 for downlisting has not been achieved yet (see downlisting above); therefore, this criterion for delisting has not been achieved.

2. Threats must be controlled.

   This criterion addresses Factors A, C and E. Threats to the Owens tui chub under Factors A, C and E are described in the Recovery Plan. Since release of the Recovery Plan, the threat to the Owens tui chub from overutilization of ground water, which reduces spring flow and habitat for the Owens tui chub, has been identified.

   Criterion 2 for downlisting has not been achieved yet (see downlisting above); therefore, this criterion for delisting has not been achieved.

3. Each Conservation Area must have an approved management plan and implementing agreement with the landowner and the Service.

   This criterion addresses Factors C and E.

   Criterion 3 for downlisting has not been achieved yet (see downlisting above); therefore, this criterion for delisting has not been achieved.

4. Successful establishment of populations includes presence of juvenile and three additional age classes of Owens tui chubs.

   This criterion addresses Factors C and E.

   Data are not available to assess whether Criterion 4 for downlisting has been achieved (see downlisting above); therefore, this criterion for delisting has not been achieved.

5. Ensure that hybrid tui chubs do not occur in the Conservation Areas.

   This criterion addresses Factor E.

   Criterion 5 for downlisting has not been achieved yet (see downlisting above); therefore, this criterion for delisting has not been achieved.

6. The biomass of the Owens tui chub must exceed the biomass of deleterious non-native fish species at each site.

   This criterion addresses Factor C.

   Criterion 6 for downlisting has not been achieved yet (see downlisting above); therefore, this criterion for delisting has not been achieved.

In summary, for the Owens tui chub to meet the downlisting or delisting criteria in the Recovery Plan, the following recovery tasks must be successfully implemented:

- establish multiple, self-sustaining populations of Owens tui chubs throughout much of the historical range of the species in identified Conservation Areas;
- ensure these populations are self-sustaining;
- ensure that each population contains juvenile and three additional age classes and that the biomass of Owens tui chubs exceed the biomass of deleterious, non-native aquatic predatory species, which would demonstrate successful recruitment and minimal predation on smaller Owens tui chubs by non-native aquatic species;
- reduce competition with non-native aquatic species;
- increase the ability to conserve and protect aquatic habitats;
- implement measures to prevent hybridization with introduced Lahontan tui chubs;
- to the extent possible, reduce the probability of the loss of Owens tui chub populations from stochastic events; and
- complete an approved management plan and implementing agreement that address water quantity and groundwater management with the land managers.

These Recovery Plan criteria do not address threats from disease; catastrophic events that may affect the Owens Basin; demographic, genetic, or environmental stochasticity; or climate change to the Owens tui chub. The Recovery Plan identifies no recovery criteria for the Toikona lineage, as the occurrence of this lineage was unknown when the Recovery Plan was approved.

IV. SYNTHESIS

When the Owens tui chub was first described in 1973, most of the habitat for the species had been altered or destroyed. At the time of listing in 1985, the Owens tui chub was on the edge of extinction; only the Hot Creek Headwaters, Upper Owens Gorge, and Cabin Bar Ranch populations existed, which made up about 1 percent of the species' original range (Service 1985). These three populations were isolated from each other, and the habitat between them had been destroyed or altered to such a degree that there was no possibility of genetic interchange between them.

Since its listing in 1985, new populations of Owens tui chubs have been established, bringing the current number to six. Four of these populations are in small, man-made or man-altered waters and one is outside the historical range of the species at an artificial lake (Sotcher Lake). All are isolated from each other.

The threats to the Owens tui chub that resulted in listing continue to threaten the species with extinction. They include the potential for further destruction and alteration of a greatly reduced habitat, predation by non-native aquatic species, inadequacy of existing laws and regulations to conserve and protect the remaining habitat for the species, and hybridization with introduced Lahontan tui chubs. Additional threats that were not described in the listing rule include demographic, genetic, and environmental stochasticity, catastrophic events, and climate change.

The success of the existing populations and establishing new populations, as recommended in the Recovery Plan for downlisting and delisting, is not likely for the long term unless the major threats are eliminated or reduced for these populations and new populations are established. The LADWP is the major land manager in the Owens Basin. With the CDFG and Service, they are developing a habitat conservation plan for the Owens tui chub that includes better management of populations on their lands and the creation of new aquatic habitats suitable for establishing new populations of the Owens tui chub. The LADWP's commitment to these actions makes the potential for recovery of this species high. Until LADWP implements these actions in the habitat conservation plan, the threats to the Owens tui chub remain. Therefore, we recommend that the endangered status of the Owens tui chub remain unchanged.

V. RESULTS

Recommended Listing Action:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (indicate reason for delisting according to 50 CFR 424.11):
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
_✓_ No Change

New Recovery Priority Number and Brief Rationale: We recommend that the recovery priority number be changed to 3. This number indicates that the taxon is a subspecies that faces a high degree of threat and has a high potential for recovery. The threats that were present when the Owens tui chub was listed are still present with new threats identified. Although the number of populations of Owens tui chubs has increased from three at the time of listing to six, there are now two distinct genetic lineages to consider. The major land manager in the Owens Valley (LADWP) is cooperating in the development and implementation of plans to establish and manage new populations of both lineages of Owens tui chub.

Listing and Reclassification Priority Number and Brief Rationale: No change needed

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

Develop management plans and implementation agreements for all existing and new populations. Implement population monitoring and adaptive management.

Establish and secure additional populations of the Toikona lineage of Owens tui chubs. Increasing the number of populations and the size of each population of the Toikona lineage will conserve the genetic distinctiveness of this evolutionary lineage, maintain the genetic variation, and prevent the loss of alleles. Recommended sites include but are not limited to the Cartago Springs Wildlife Management Area and the private duck club pond near Dirty Socks.

Establish new populations of the Owens lineage. Recommended locations include but are not limited to the Owens Valley Native Fish Sanctuary.

Improve habitat for existing populations at Little Hot Creek Pond, Owens Gorge, and Mule Spring. This improvement includes but is not limited to management/removal of non-native aquatic floral and faunal species. For the Upper Owens Gorge population, increase the availability of lacustrine habitat and provide for adequate water quality and quantity throughout the year.

Remove non-native aquatic species.

Conduct additional research to gain a better understanding of the origin, genetics, and ecophysiology of the Toikona lineage of the Owens tui chub. This information will help determine the best ways to conserve the unique attributes of this lineage.

Develop and implement an education and outreach program for residents of, and visitors to, the Owens and Mono Basins. The program would focus on the importance of conserving the native fish species including the Owens tui chub and the deleterious effects of non-native predatory fish species. It would involve residents and visitors, adults and children, in ways they can help conserve the Owens tui chub.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW

Owens tui chub (*Siphateles bicolor snyderi*)

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
✓____ No change needed

Review Conducted By: Judy Hohman

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve Diane K. Noda Date 5/28/09

Comment Letter I9

science for a changing world

Monitoring CO_2 Emissions in Tree-Kill Areas near the Resurgent Dome at Long Valley Caldera, California

Scientific Investigation Report 2011-5038

U.S. Department of the Interior
U.S. Geological Survey

COVER

Dead trees and thermal ground at Basalt Canyon, Long Valley Caldera, California. (USGS photograph by Deborah Bergfeld, June 2006.)

Comment Letter I9

Monitoring CO_2 Emissions in Tree-Kill Areas near the Resurgent Dome at Long Valley Caldera, California

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U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Marcia K. McNutt, Director

U.S. Geological Survey, Reston, Virginia: 2011

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Monitoring CO_2 Emissions in Tree-Kill Areas near the Resurgent Dome at Long Valley Caldera, California

By Deborah Bergfeld and William C. Evans

Abstract

We report results of yearly measurements of the diffuse CO_2 flux and shallow soil temperatures collected since 2006 across two sets of tree-kill areas at Long Valley Caldera, California. These data provide background information about CO_2 discharge during a period with moderate seismicity, but little to no deformation. The tree kills are located at long-recognized areas of weak thermal fluid upflow, but have expanded in recent years, possibly in response to geothermal fluid production at Casa Diablo. The amount of CO_2 discharged from the older kill area at Basalt Canyon is fairly constant and is around 3–5 tonnes of CO_2 per day from an area of about 15,000 m^2. The presence of isobutane in gas samples from sites in and around Basalt Canyon suggests that geothermal fluid production directly effects fluid upflow in the region close to the power plant. The average fluxes at Shady Rest are lower than average fluxes at Basalt Canyon, but the area affected by fluid upflow is larger. Total CO_2 discharged from the central portion of the kill area at Shady Rest has been variable, ranging from 6 to11 tonnes per day across 61,000 m^2. Gas collected at Shady Rest contains no detectable isobutane to link emissions chemically to geothermal fluid production, but two samples from 2009-10 have detectable H_2S and suggest an increasing geothermal character of emitted gas. The appearance of this gas at the surface may signal increased drawdown of water levels near the geothermal productions wells.

Introduction

Localized areas of elevated CO_2 flux and elevated soil temperatures on or around the resurgent dome at Long Valley Caldera, California, are identified by stressed, dying, and dead vegetation (fig.1). Our early work (Bergfeld and others, 2006) indicated that about 8.7 metric tonnes of CO_2 per day (t/d) were emitted from these kill zones, with the highest discharge occurring in areas within a few km of the Casa Diablo geothermal power plant, and that most of the kill zones developed as a response to changing conditions in the shallow hydrothermal system.

This report presents results from 2006–2010 CO_2-flux surveys of two of the largest tree-kill zones and chemical data on gas collected between 1989 and 2010 in and around several of the tree-kill zones. The flux measurements provide baseline data from a time when seismicity has waned and deformation of the resurgent dome has leveled off (http://volcanoes.usgs.gov/lvo/activity/index.php, last accessed December 15, 2010). Because of this, changes in the size of kill zones, increases in soil temperatures or steam discharge, and changes in CO_2 emissions most likely reflect the response of the shallow hydrothermal system to geothermal fluid production at the Casa Diablo power plant. Results from diffuse CO_2-flux and soil-temperature measurements collected under these conditions allow a better understanding of the shallow system and will improve our ability to detect changes in the fluxes of CO_2 and heat associated with magmatic unrest.

Field Locations

Our field studies since 2006 have focused on two main kill zones, herein referred to as Basalt Canyon and Shady Rest. The grid at Basalt Canyon and at Shady Rest are partly composed of measurement sites from the BC, BCE, and SR grids of Bergfeld and others, 2006. The outline of present-day measurement grids are irregular, and the footprints of the grids have varied with time as we encompassed more areas of thermal fluid upflow, or as new areas of kill developed.

The Basalt Canyon grid is about 1.6 km due west of the Casa Diablo power plant (fig. 1) and is sited along a localized SW-NE trending fault (Bergfeld and others, 2006). The grid consists primarily of tree-kill with a zone of live grass in the northeast section. The volcanic rocks in Basalt Canyon include Quaternary rhyolites and basalts (Bailey, 1989). During June 2010, the measurement grid covered about 23,000 m^2 and had 88 measurement sites (table 1). Gas samples occasionally are collected from thermal and nonthermal sites within the grid and from a nearby gas vent, known as Basalt Fumarole (Sorey and others, 1998), that is ~100 m west of the grid boundary.

The Shady Rest grid is about 3.4 km northwest of the Casa Diablo power plant (fig. 1) and, as of June 2010, had 129 measurement sites and covered about 100,000 m^2 (table 1).

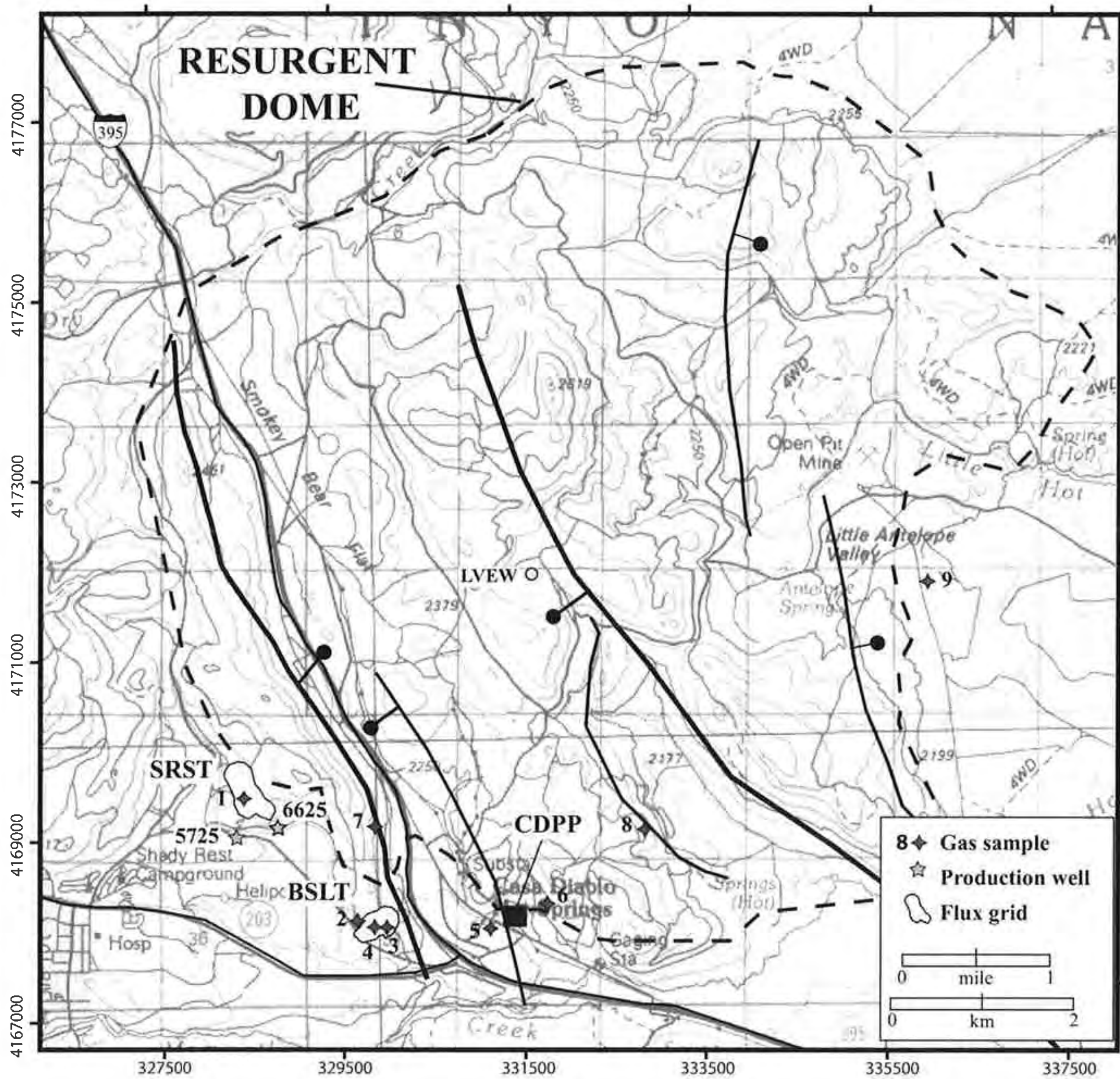

Figure 1. Map showing the resurgent dome, gas sample locations in kill zones, and the 5725 and 6625 production wells. Gray areas labeled BSLT (Basalt Canyon) and SRST (Shady Rest) show the extent of the flux grids. CDPP, Casa Diablo power plant; LVEW, Long Valley Exploration well. Locations where gas samples were collected are identified by a map number that is given in table 2.

Table 1. Summary statistics of flux data collected at Basalt Canyon and Shady Rest from 2006-2010, Long Valley Caldera, California.

[Weighted mean (*W*) and sequential Gaussian simulation (*S*) results given. Values in parentheses indicate the data did not satisfy the lognormal assumption, and are estimates calculated from weighted flux values using the arithmetically-derived mean]

Date	# of sites	Grid area m^2	Maximum flux $gm^{-2}d^{-1}$	Mean flux (*W*) $gm^{-2}d^{-1}$	Discharge (*W*) $t\ d^{-1}$	Range (*W*) $t\ d^{-1}$	Mean flux (*S*) $gm^{-2}d^{-1}$	Discharge (*S*) $t\ d^{-1}$	Range (*S*) $t\ d^{-1}$	Δ means (%)
ALL BASALT CANYON										
06/2006	64	15,200	2,589	291	4.4	4-6	334	5.1	2-9	14
09/2006	62	15,125	2,602	273	4.1	3-6	330	5.0	2-9	19
06/2007	80	21,825	2,111	162	3.5	3-5	200	4.4	1-8	21
06/2008	83	20,600	3,151	237	4.9	4-7	261	5.4	2-10	10
07/2009	85	26,375	1,693	162	4.3	3-6	243	6.4	2-13	40
06/2010	88	23,125	1,700	162	3.7	3-5	192	4.4	2-10	17
BASALT CANYON CORE SITES										
06 2006	60	14,800	2,589	283	4.2	3-6	333	4.9	2-8	16
09/2006	59	14,800	2,602	289	4.3	3-7	320	4.7	1-9	10
06/2007	60	14,800	2,111	205	3.0	2-4	255	3.8	<1-8	22
06/2008	60	14,800	3,151	258	3.8	3-6	364	5.4	2-9	34
07/2009	53	14,800	1,581	196	2.9	2-4	247	3.7	1-8	23
06/2010	61	14,800	1,327	182	2.7	2-4	190	2.8	<1-7	4
ALL SHADY REST										
09/2006	81	61,000	867	121	7.4	6-10	147	9.0	5-12	20
06/2007	90	68,175	1,290	179	12.2	10-16	216	14.7	9-22	19
05/2008	105	77,575	898	93	7.2	6-9	126	9.8	6-13	30
07/2009	106	78,950	1,465	128 (113)	10.1 (8.9)	8-13	146	11.5	8-15	13 (25)
06/2010	129	98,800	1,332	99	9.8	8-12	142	14.0	9-20	36
SHADY REST CORE SITES										
09/2006	77	61,000	820	112	6.8	5-9	135	8.2	5-12	18
06/2007	77	61,000	1,290	181	11.1	9-14	231	14.1	9-19	24
05/2008	77	61,000	898	102	6.2	5-8	121	7.4	4-11	17
07/2009	77	61,000	1,465	144	8.8	7-11	168	10.2	6-15	15
06/2010	77	61,000	492	111	6.8	5-9	121	7.4	5-10	9

The most recent area of tree kill is focused in the northeast and east portions of the grid. The center of the grid is comprised of mostly bare ground that is surrounded by live vegetation consisting of a mix of grass, brush, and widely spaced pine trees. Volcanic rocks include the same Quaternary-aged rhyolite found at Basalt Canyon (Bailey, 1989). The measurement grid includes a sub-boiling-temperature gas vent, commonly known as the Shady Rest fumarole, that is sampled routinely for gas. Two recently drilled geothermal production wells went online in summer 2006 and are about 0.5 km to the south of the grid (fig. 1).

Methods

Field Methods

The grids were established using pace and compass methods. Physical constraints imposed by dead trees, rock outcrops, steep topography, and roads are such that spacing between measurement sites is irregular. Locations are recorded using a Garmin® GPS, and each site is marked with flagging in an effort to measure the flux at the same spot during subsequent visits. Our goal is to measure flux at each site during each field visit, but sites sometimes are missed, and some sites have been abandoned. It typically requires two days to complete the flux measurements for each grid. In 2006 we made two sets of flux measurements at both grids. In subsequent years we made one set of measurements.

The CO_2-flux measurements were made using a West Systems flux meter, equipped with a LI-COR® 820 infrared CO_2 analyzer and an accumulation chamber. Detailed explanations about measurement techniques and methods for determining flux values are presented in Lewicki and others (2005) and Bergfeld and others (2006). Our protocol includes field calibration of the analyzer using CO_2-free air and a gas standard containing 1,000 ppm CO_2. At Basalt Canyon we use a 6-L accumulation chamber, which provides sufficient volume to compensate for the high fluxes without saturating the capacity of the CO_2 analyzer. At Shady Rest, the flux at most sites can be measured by using a 2.7-L chamber. Our laboratory tests using the large and small chambers show that measured fluxes underestimate the actual flux by about 7 percent and 10 percent, respectively. Soil temperatures are measured adjacent to the accumulation chamber coincident with each flux measurement. The target depth for soil-temperature measurements through 2008 was 10 cm. In 2009–10 soil temperatures were measured at 20 cm.

Gas samples are collected into evacuated glass bottles by inserting a stainless steel tube into the ground at an area of gas discharge. In some cases sample sites consist of a crack in the bedrock, and at other sites the collection tube is driven into the soil. Tygon® tubing is used to connect the stainless steel tube to the sample bottle. The collection apparatus is then purged of air, and the collection bottle is opened until gas stops flowing into the bottle.

Data Reporting

The CO_2 flux is reported as grams of CO_2 per square meter per day (g/m²/d). Total CO_2 discharged from each grid is determined by multiplying the mean flux for all the sites by the grid area. CO_2 discharge is reported in units of metric tonnes of CO_2 emitted per day (t/d). The discharge is not corrected for biogenic CO_2 contributions, nor for the systematic under-estimation of flux revealed in laboratory testing. Many studies of diffuse CO_2 flux in volcanic and geothermal environments have shown that flux data are skewed positively with lognormal distributions (Bergfeld and others, 2001; Chiodini and others, 1998, 2001; Cardellini and others, 2003; Lewicki and others, 2005). Statistical analysis of the flux data from both Basalt Canyon and Shady Rest supports this premise (figs. 2 and 3; note that figs. 2 through 13 are at the back of this report); therefore, calculations of the mean CO_2 flux were determined by using methods that are appropriate for lognormal datasets. For this report we calculated the mean CO_2 flux by using two methods, and the difference in the results is reported as the absolute difference in the mean values divided by the average mean and expressed as a percent (table 1).

The weighted method (W) uses minimum variance estimator equations to determine mean flux values. To avoid any bias related to the irregular site spacing, a weighting factor is applied to each measured flux value. Weighting factors are calculated by inputting site location coordinates and measured flux values into the DECLUS module of the GSLIB geostatistical software package (Deutsch and Journel, 1998). Once calculated, the weighted flux data are log-transformed and are tested for a lognormal distribution using D'Agostino's test (Gilbert, 1987), as described in Bergfeld and others (2006). All but one of the weighted datasets satisfies the hypothesis of a lognormal distribution. The log-transformed weighted flux values are used to calculate the mean and 95-percent confidence interval about the mean by using minimum variance estimator equations given in Gilbert (1987) as presented in the appendix of Bergfeld and others (2006). The resulting means, and lower and upper limits from the confidence interval, are back-transformed, and those results are multiplied by the grid area to provide estimates of the total CO_2 discharge for the grid.

The sequential Gaussian simulation method (sGs) for estimating the means for each dataset also uses log-transformed flux values. The method produces multiple equiprobable outcomes of the spatial distribution of the flux over a 5 m² grid cell using the sgsim module of the GSLIB program (Deutsch and Journel, 1998), following methods outlined in Cardellini and other (2003) and Lewicki and others (2005). The sGs-technique is superior to using kriging to estimate flux at unsampled locations because it honors the measured flux values (Cardellini and others, 2003). The mean flux is determined from the summation of 1,000 simulations, and results are used to produce contour plots of the flux. Differences in results from the replicate simulations yield a 95-percent upper and lower boundary on the determined discharge and provide a measurement of uncertainty.

The summary statistics for each site visit are given in table 1 and include results for a subset of locations herein defined as "core sites," where measurements have been made on at least 80 percent of the site visits. Because the footprint of the core sites is static, the data are used for temporal comparisons of CO_2 emissions. Basalt Canyon and Shady Rest grids contain 61 and 77 core sites, respectively. At Shady Rest the full contingency of core sites was not established until September 2006. Flux data from the small grid at Shady Rest in June 2006 are not presented.

Results

Basalt Canyon Tree Kills, Soil Temperatures, and CO_2 Emissions

The kill zone at Basalt Canyon is a mixture of old and recent tree kills. The core sites are in the central portion of the grid and are characterized by long-dead, downed and standing trees that are stripped of their bark and are breaking apart. Many of these kills occurred during the mid-1990s and were associated with early power-plant operations at Casa Diablo (Bergfeld and others, 2006). New tree kills include large, mature pines and are found mostly in the northeast part of the grid. These new tree kills are recent enough that the bark is intact and brown needles and pine cones often are attached. The new kills are adjacent to what appears to be healthy forest. Shallow soil temperatures in this part of the grid are up to 50°C (fig. 4). Changes in soil temperature effect different tree species in varying ways (Pregitzer and others, 2000) and may induce stress that would contribute to increased mortality rates; however, at the time of this writing, the exact cause of tree death is not known.

Sites with the highest soil temperatures are clustered in the central section of the Basalt Canyon grid (fig. 4), and are located both along the bottom of the canyon, as well as along the western slope. The highest soil temperature measured at 10 cm was 92.9°C during the July 2007 site visit. Soil at steaming ground sites has low permeability, has been altered to clay, and commonly is encrusted with sulfur-bearing minerals. Steam tends to discharge at discrete points, such as the surface exposures of tree-root tunnels.

Plots of soil temperature versus CO_2 flux at Basalt Canyon show considerable scatter (fig. 5), and correlation coefficients (R) from linear regression of the data are ≤ 0.4 for all years. The low R-values reflect both the presence of high-temperature sites with moderate flux and sites with normal soil temperatures that have high CO_2 fluxes. There appears to be no difference in correlations between flux and temperatures whether the temperatures are measured at 10 cm or 20 cm.

During this investigation the maximum flux for each set of measurements at Basalt Canyon was between about 1,700 to 3,100 g/m²/d (table 1). Comparison of contour plots of the diffuse CO_2 flux from different years shows that although the intensity of the flux at an individual site may change from year to year, the general pattern across the grid is fairly static (fig. 6). The areas around the two gas-sampling sites often have the largest CO_2 fluxes and are separated from each other by a zone of lower flux sites. The CO_2 fluxes at the non-core sites in the east were lower than the CO_2 fluxes from core sites in the center of the grid (fig. 7).

The raw and weighted flux data for all years for the core sites and the full grid at Basalt Canyon pass D'Agostino's test as having a lognormal distribution. For most years the two methods of estimating the mean flux agree within 25 percent, with slightly higher means and larger confidence intervals estimated using the sGs method (table 1). Summary statistics for the flux data from core sites show that mean fluxes were between about 200–300 g/m²/d. The upper and lower bounds on discharge estimates for all years overlap (fig. 8), and comparison of the flux maps from core sites suggests that emissions were fairly constant during the course of this investigation (fig. 6). Total CO_2 discharge from Basalt Canyon core sites is about 3–5 t/d.

Shady Rest Tree Kills, Soil Temperatures, and CO_2 Emissions

The core sites at Shady Rest are centered on an area of mostly bare ground with some scattered grass, brush, and individual trees. The full grid includes more forested areas along the boundary. Most observed kills are of recent age and are clustered in two groups on the east side of the grid (fig. 9). As compared with Basalt Canyon, the Shady Rest kill areas have fewer old decayed trees, although this may be a function of easy access and firewood scavenging.

Soil-temperature measurements at 10 cm show that, in general, Shady Rest sites are cooler than sites at Basalt Canyon (figs. 4 and 9). In winter, snow will accumulate later and melt sooner from sites around the Shady Rest fumarole, but unlike Basalt Canyon, there are no large patches of steaming ground. We have observed steam issuing only from a few point-source locations at Shady Rest. The highest soil temperature at a grid site was 75.0°C. Plots of soil temperature and CO_2 flux show the data are positively correlated with correlation coefficients around 0.7 for most years (fig. 10).

In general, Shady Rest sites with the highest fluxes are oriented along a north-south trend that incorporates the location of the Shady Rest fumarole (figs. 11 and 12). The maximum flux from each set of measurements was between about 850 and 1,500 g/m²/d (table 1) and was obtained at one of two sites in the north near one of the areas of recent tree kills. In 2009 we discovered a discrete patch of slightly thermal ground with some recent tree kills ~200 m southeast of the main grid boundary. In 2010 the area was incorporated into the Shady Rest grid. The new sites have moderately high fluxes, up to ~300 g/m²/d, and are aligned along a southeast trend in line with the 6625 geothermal production well (fig. 12*E*).

Table 2. Sample locations, gas chemistry in volume percent and permil (‰) carbon isotope values of samples collected on or around the resurgent dome, Long Valley Caldera, California.

[Sites are characterized as discrete gas vents (V), steaming ground (SG), and nonthermal (NT). n-C_4H_{10} and i-C_4H_{10} are normal- and iso-butane. Basalt Canyon Extended grid site 24 (BCE 24), Basalt fumarole (BF), Casa Diablo fumarole (CDF), Casa Diablo north (CDN), Chris' hot spot (CHS), Fumarole Valley (FV); Isha fumarole (ISHA), Shady Rest fumarole (SRF), Teapot (TPT), not analyzed (na), not recorded (nr). Datum for the UTM coordinates is referenced to WGS84 zone 1]

Location	Date	Temp. (C)	Map #	Type	Easting (m)	Northing (m)	CO_2	He	H_2	Ar
							----------volume percent-----------			
Basalt Canyon Area										
CHS	12/06/95	91.0	3	SG	329974	4168152	98.6	0.001	0.024	0.020
CHS	09/29/99	nr	3	SG	329974	4168152	98.1	0.001	0.039	0.023
Near CHS	06/08/10	91.5	3 *	SG	329977	4168147	98.8	0.002	0.022	0.012
BCE 24	07/26/04	32.5	4	NT	329872	4168129	84.2	0.001	0.001	0.143
BF	07/31/90	nr	2	V	329698	4168166	96.8	0.006	0.003	0.039
BF	11/01/95	92	2	V	329698	4168166	97.4	0.005	0.021	0.032
BF	08/03/96	nr	2	V	329698	4168166	97.4	0.004	0.010	0.031
BF	06/16/97	nr	2	V	329698	4168166	97.5	0.003	0.013	0.035
BF	01/01/98	nr	2	V	329698	4168166	96.9	0.003	0.009	0.032
BF	07/26/04	91.0	2	V	329698	4168166	97.4	0.004	0.026	0.029
BF	07/14/06	92.0	2	V	329698	4168166	97.6	0.005	0.006	0.027
Shady Rest										
SRF	09/25/96	90	1	V	328427	4169615	81.4	0.004	0.029	0.159
SRF	06/19/97	nr	1	V	328427	4169615	69.1	0.003	0.011	0.276
SRF	06/06/02	89.6	1	V	328427	4169615	85.1	0.004	0.009	0.130
SRF	07/14/06	91.0	1	V	328427	4169615	85.9	0.005	0.002	0.132
SRF	06/22/09	79.2	1	V	328427	4169615	70.9	0.004	0.035	0.271
SRF	09/08/10	87.9	1	V	328427	4169615	63.5	0.002	0.037	0.343
Other Kill Areas										
CDN	02/12/03	92.7	5	SG	331005	4167986	92.9	0.001	0.055	0.069
CDF	09/18/02	nr	6	V	331758	4168378	96.7	0.002	0.245	0.050
CDF	07/14/06	94.1	6	V	331758	4168378	97.6	0.001	0.065	0.031
TPT	03/25/04	86.0	7	SG	329860	4169286	73.5	0.004	0.057	0.239
FV	06/09/99	nr	8	V	332894	4169428	69.3	0.001	0.027	0.306
FV	Sept. 1999	nr	8	V	332894	4169428	98.4	0.002	0.014	0.018
FV	10/13/06	nr	8	V	332894	4169428	98.1	0.003	0.021	0.025
ISHA	10/24/89	nr	9	SG	336024	4171860	53.6	0.003	0.008	0.489
ISHA	11/13/03	32.8	9	SG	336024	4171860	36.4	0.004	0.001	0.612

*Near site 3 on figure 1.

O_2	N_2	CH_4	C_2H_6	H_2S	C_3H_8	n-C_4H_{10}	i-C_4H_{10}	$\delta^{13}C$-CO_2 (‰)	N_2/Ar	N_2/O_2
--------volume percent--------										
Basalt Canyon Area										
0.05	1.0	0.060	0.001	0.193	<0.0005	<0.0005	0.003	na	52	19
0.10	1.5	0.056	<0.0002	0.204	<0.0005	0.003	0.003	−4.0	65	15
0.03	0.8	0.037	<0.0002	0.364	<0.0005	<0.0005	na	−4.1	65	28
2.7	13.0	0.001	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	−3.4	91	5
0.04	2.9	0.124	<0.0002	0.090	na	na	na	−3.8	76	78
0.06	2.1	0.116	0.001	0.169	<0.0005	<0.0005	0.006	−4.0	67	34
0.11	2.2	0.112	0.001	0.203	<0.0005	<0.0005	0.007	−3.9	69	20
0.02	2.1	0.108	0.001	0.207	<0.0005	<0.0005	0.008	na	60	127
0.15	2.6	0.106	0.000	0.204	<0.0005	<0.0005	0.008	na	80	17
0.06	2.1	0.102	0.000	0.227	<0.0005	<0.0005	0.015	−4.1	75	37
0.02	2.0	0.101	0.001	0.226	<0.0005	<0.0005	0.015	−3.9	74	81
Shady Rest										
3.0	15.0	0.027	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	−3.9	97	5
5.7	25.0	0.023	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	na	90	4
2.7	12.0	0.059	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	−3.7	92	4
2.4	12.0	0.062	0.000	<0.0005	<0.0005	<0.0005	<0.0005	−4.4	87	5
5.7	23.0	0.049	0.002	0.019	<0.0005	<0.0005	<0.0005	na	85	4
7.2	29.0	0.044	<0.0002	0.030	<0.0005	<0.0005	<0.0005	−3.7	84	4
Other Kill Areas										
1.3	5.6	0.031	0.001	0.083	<0.0005	<0.0005	0.009	−4.6	80	4
0.07	2.5	0.041	<0.0002	0.332	0.001	0.001	0.058	−6.9	51	37
0.04	1.7	0.026	<0.0002	0.427	<0.0005	<0.0005	0.035	−5.7	56	45
5.1	21.0	0.046	<0.0002	<0.0005	<0.0005	<0.0005	0.007	−4.4	88	4
5.6	25.0	0.048	0.000	<0.0005	<0.0005	<0.0005	0.020	na	81	4
0.05	1.4	0.063	0.001	0.050	<0.0005	0.001	0.030	−5.4	79	31
0.07	1.5	0.062	<0.0002	0.231	0.001	0.001	0.079	na	58	20
8.5	37.0	0.030	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	na	77	4
12.0	51.0	0.037	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	−5.1	83	4

All but one of the flux datasets from Shady Rest pass D'Agostino's test as having a lognormal distribution. The test was negative for the full grid from 2009, and we calculated the simple arithmetic mean of the weighted flux values (shown in the parentheses in table 1), as well as the mean, by using the minimum variance estimator. For all datasets the mean flux determinations from the sGs method are higher, and the confidence intervals are larger, than those derived from the weighted-flux values (table 1). Differences in the means derived from the two methods are ≤36 percent and generally are better than 25 percent.

Estimates of the total CO_2 emissions from Shady Rest core sites in 2006, 2008, 2009, and 2010 are similar, and the ranges in the discharge estimates for these 4 sets of measurements overlap (fig. 13). The results indicate about 6–9 tonnes of a CO_2 per day (7–10 from sGs) discharged from the central portion of the grid (table 1). The discharge estimate (11–14 t/d) and the contour plot from the 2007 measurements stand out as having higher emissions than in other years (figs. 11 and 13).

Gas Chemistry from Sites on or Around the Resurgent Dome

Table 2 gives analyses of gas samples collected from discrete gas vents (V), steaming ground (SG) sites, and a nonthermal (NT) high flux (500–900 g/m²/d) site in the Basalt Canyon grid. The gas compositions are dominated by CO_2, but gas from many sites contains significant amounts of atmospheric components (Ar, N_2 and O_2). H_2S is a component in the gas from thermal sites around Basalt Canyon, as well as other sites near the Casa Diablo power plant, but until recently was not detected at the Shady Rest fumarole. CH_4 is detectable in all gas samples, irrespective of location. The carbon isotope composition of CO_2 collected at nine locations is between –6.9 and –3.4 permil. The $\delta^{13}C$ values of CO_2 from sites around Basalt Canyon and Shady Rest are indistinguishable and range from –4.4 to –3.4 permil. These values are similar, but slightly higher than the $\delta^{13}C$ composition of CO_2 from Mammoth Mountain fumarole (–5.5 to –4.5 permil, Sorey and others, 1998). Isobutane (i-C_4H_{10}), the working fluid used at the Casa Diablo power plant, is detected at numerous thermal sites, but has not been found in gas from the Shady Rest fumarole.

Summary

Comparison of the Two Areas

In a visual sense, the kill areas at Basalt Canyon and Shady Rest are distinct. The prominent tree and brush kills in the center of Basalt Canyon have been the focus points for steam and gas upflow for decades, and many of the old logs and stumps are coated with a layer of sulfur. The kill area at Shady Rest contains more subtle features and stands out from its surroundings as unusual in that there is a large area of mostly bare ground. Both Basalt Canyon and Shady Rest are, however, similar in that development of new areas of tree kill is an ongoing phenomena.

The Basalt Canyon and Shady Rest study areas are located over thermal fluid upflow zones. Overall, the CO_2 fluxes are higher at Basalt Canyon than at Shady Rest, but the extent of discharge zone at Basalt Canyon is confined to a smaller area. At Shady Rest the CO_2 flux and soil temperatures are moderately-to-well correlated, indicating that CO_2 and steam are transported together. The correlation between flux and soil temperature at Basalt Canyon is poor. Sites with a low flux and high soil temperatures occur in areas of strong fluid upflow where alteration products, such as clays and mineral sublimates, occlude void spaces, decreasing permeability. The presence of low-temperature, high-flux sites at Basalt Canyon may reflect steam condensation in the subsurface.

During the course of this investigation, total CO_2 emissions from the Basalt Canyon core sites were constant. We estimate that about 3–5 tonnes of CO_2 per day discharge from the central core part of the grid. CO_2 emissions from the Shady Rest core sites were more variable and ranged from 6 to 14 t/d. The variability could be related to changes in the shallow hydrothermal system resulting from geothermal fluid production at the new wells. At present, we do not have the temporal data needed to fully assess this hypothesis, but the alignment of high CO_2 flux sites in the direction of the 6625 well (fig. 12) lends support to this idea.

The composition of gases collected from sites at Shady Rest and Basalt Canyon distinguishes gas across the two areas. While the carbon isotope composition of CO_2 indicates a common source of CO_2, other components, such as isobutane, and until recently H_2S, are distinct to thermal features around Basalt Canyon. All samples collected from the Shady Rest fumarole have entrained air, which tends to oxidize H_2S and may be part of the reason that it rarely is detected. The presence of H_2S in 2009-10 samples could, however, indicate a change in fluid chemistry related to production from the new wells. Isobutane, which is unaffected by the presence of air, has never been detected at Shady Rest.

Isobutane enters the thermal aquifer at Long Valley when occasional leaks in heat exchangers at the Casa Diablo power plant cause it to be injected along with spent geothermal fluids into deep parts of the geothermal reservoir (Evans and others, 2004). It has been detected in gas samples collected at Basalt Canyon since 1995 (table 2) and may have reached the area before that time. The purpose of injection is to provide pressure support in the geothermal reservoir and the presence of isobutane in gas samples at Basalt Canyon shows that volatiles from the injectate have reached the underlying area. The pressure support provided by the injectate would stabilize the depth of boiling in the reservoir and, consequently, would control the upflow of steam and CO_2, producing more constant CO_2 emissions.

The absence of isobutane at Shady Rest may be a function of distance from the injection wells and may indicate the shallow reservoir in the area lacks pressure support.

Without sufficient pressure support, the shallow hydrothermal system would respond to the 2006 onset of fluid production at the 5725 and 6625 wells. Variations in CO_2 emissions since that time may reflect adjustments in the shallow reservoir to the fluid production.

Further Work

Results of CO_2 flux mapping since 2006 provide a well-constrained estimate of diffuse CO_2 emissions at Basalt Canyon. As a tool for volcano monitoring, the baseline information needed is now available for comparison if, in the future, seismicity or deformation rates change. Barring such changes, continued study of CO_2 flux at Basalt Canyon provides only information on geothermal fluid upflow. Our understanding of baseline CO_2 emissions at Shady Rest also is well constrained, but drilling of a new production well west of Shady Rest commenced in late 2010. Additional study of the CO_2 fluxes, and a more in-depth study of soil temperatures, is warranted as the new well goes into production. Collection of gas samples at both sites should continue as part of future monitoring efforts at both sites.

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Figures 2–13

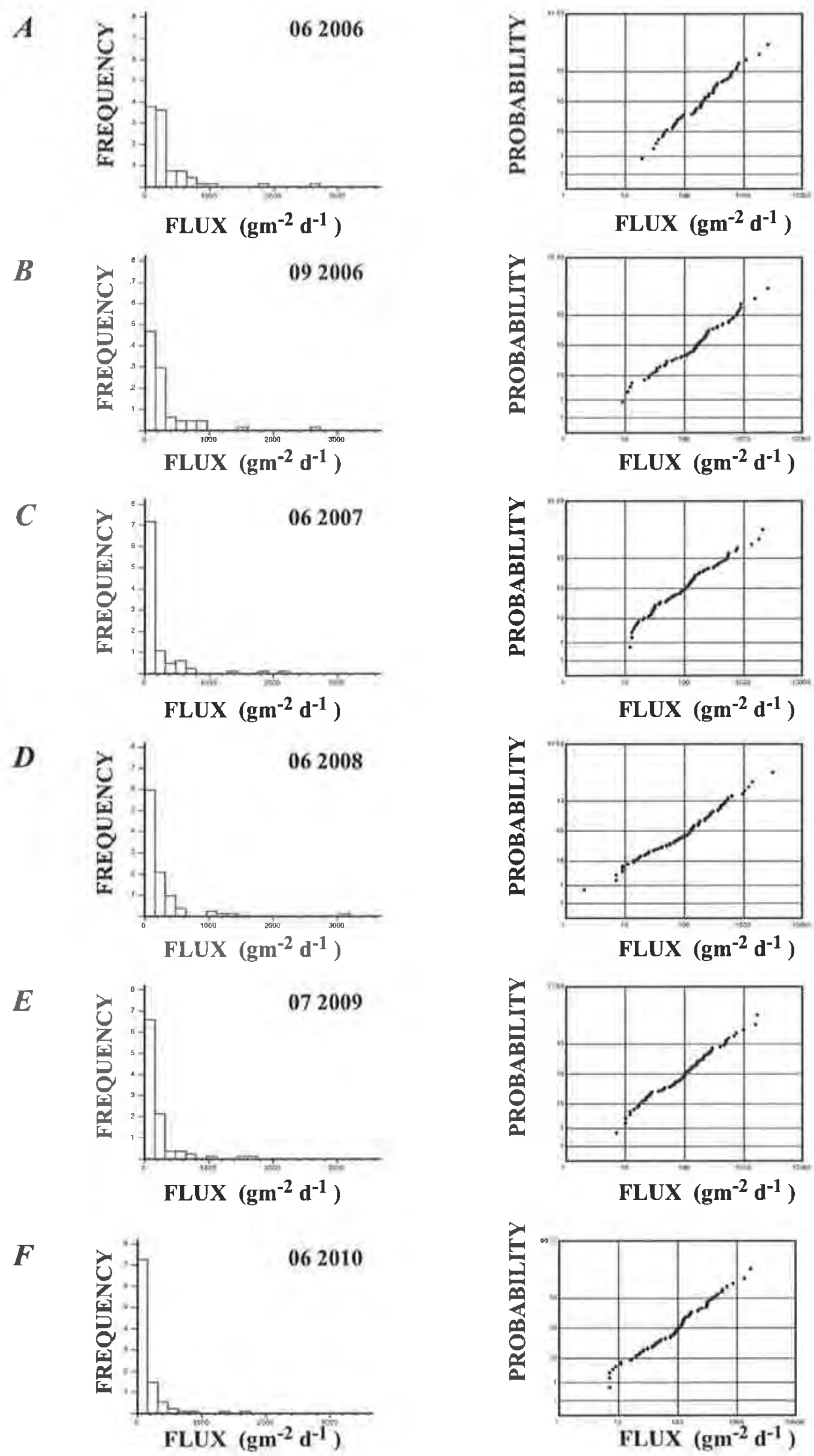


Figure 2. Histograms and cumulative probability plots showing flux values from the Basalt Canyon grid from the June 2006–June 2010 site visits. Flux data are positively skewed. Kinks in the probability plots indicate multiple populations of data, and linear trends within a population suggest a lognormal distribution.

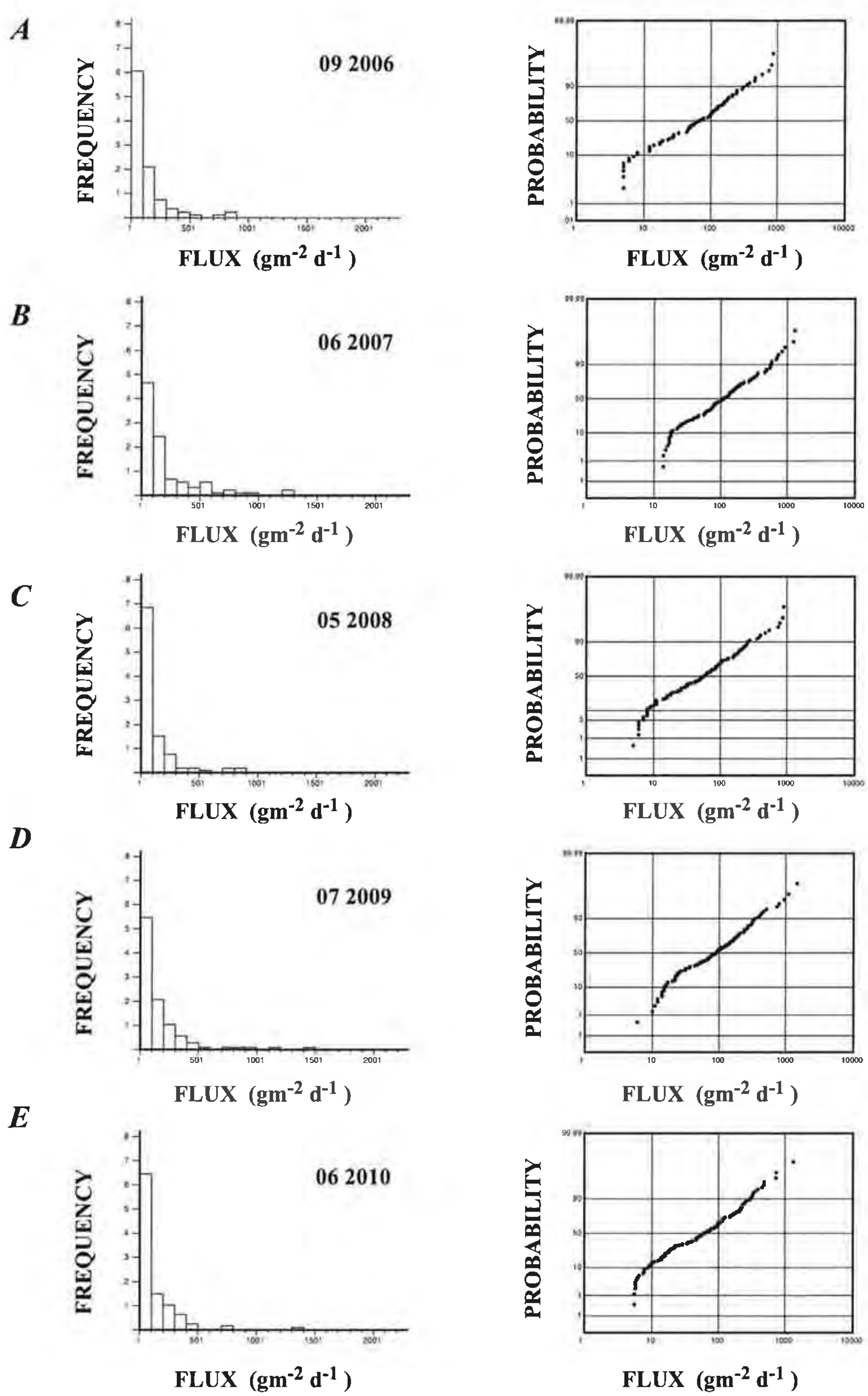


Figure 3. Histograms and cumulative probability plots showing flux values from the Shady Rest grid from the September 2006–June 2010 site visits. Flux data are positively skewed. Kinks in the probability plots indicate multiple populations of data, and linear trends within a population suggest a lognormal distribution.

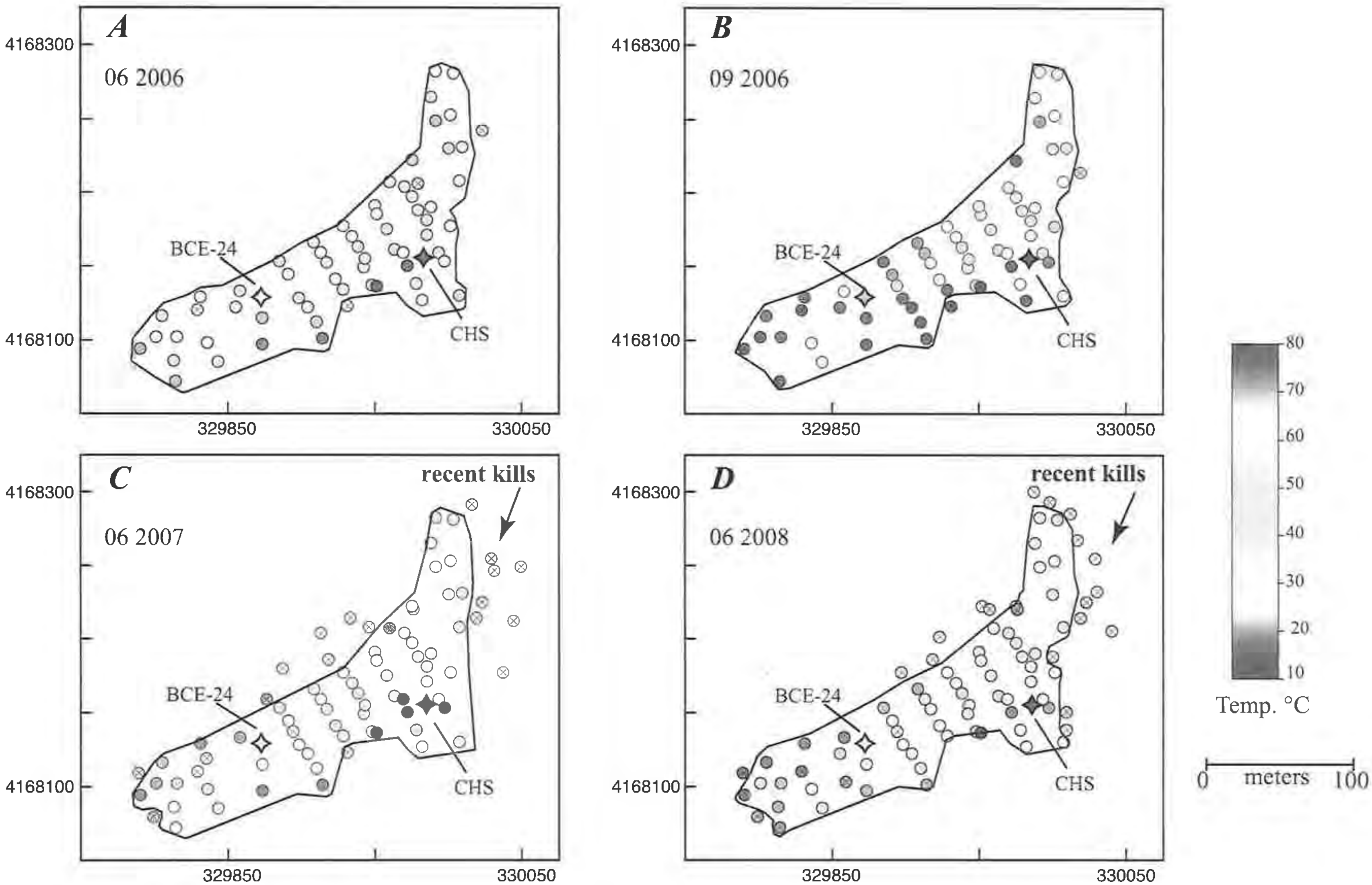


Figure 4. Map showing color-coded soil temperatures at 10 cm for the Basalt Canyon grid from the June 2006–June 2008 site visits. Star symbols are color-coded according to soil temperature and show the CHS and BCE-24 gas-sample locations. The heavy black line delineates the extent of the core sites. Circles marked with an "x" indicate that the location is not a designated core site. The black arrow in *C* and *D* shows the general location of the most recent tree kills.

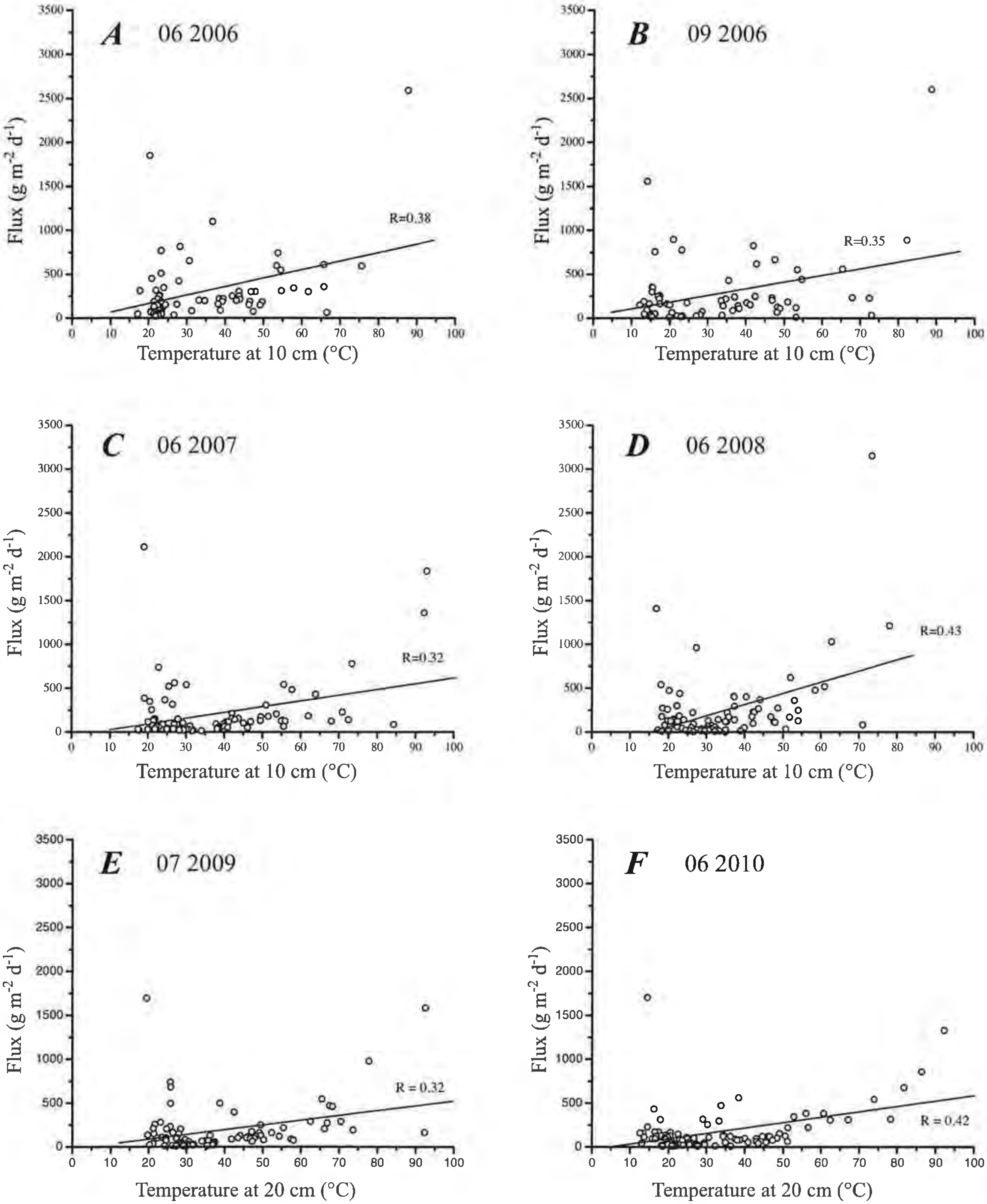


Figure 5. Scatter plots showing CO_2 flux versus soil temperature for the Basalt Canyon grid from June 2006–June 2008 at 10 cm and for July 2009–June 2010 at 20 cm. The R-values are the correlation coefficients calculated for linear regressions of the datasets.

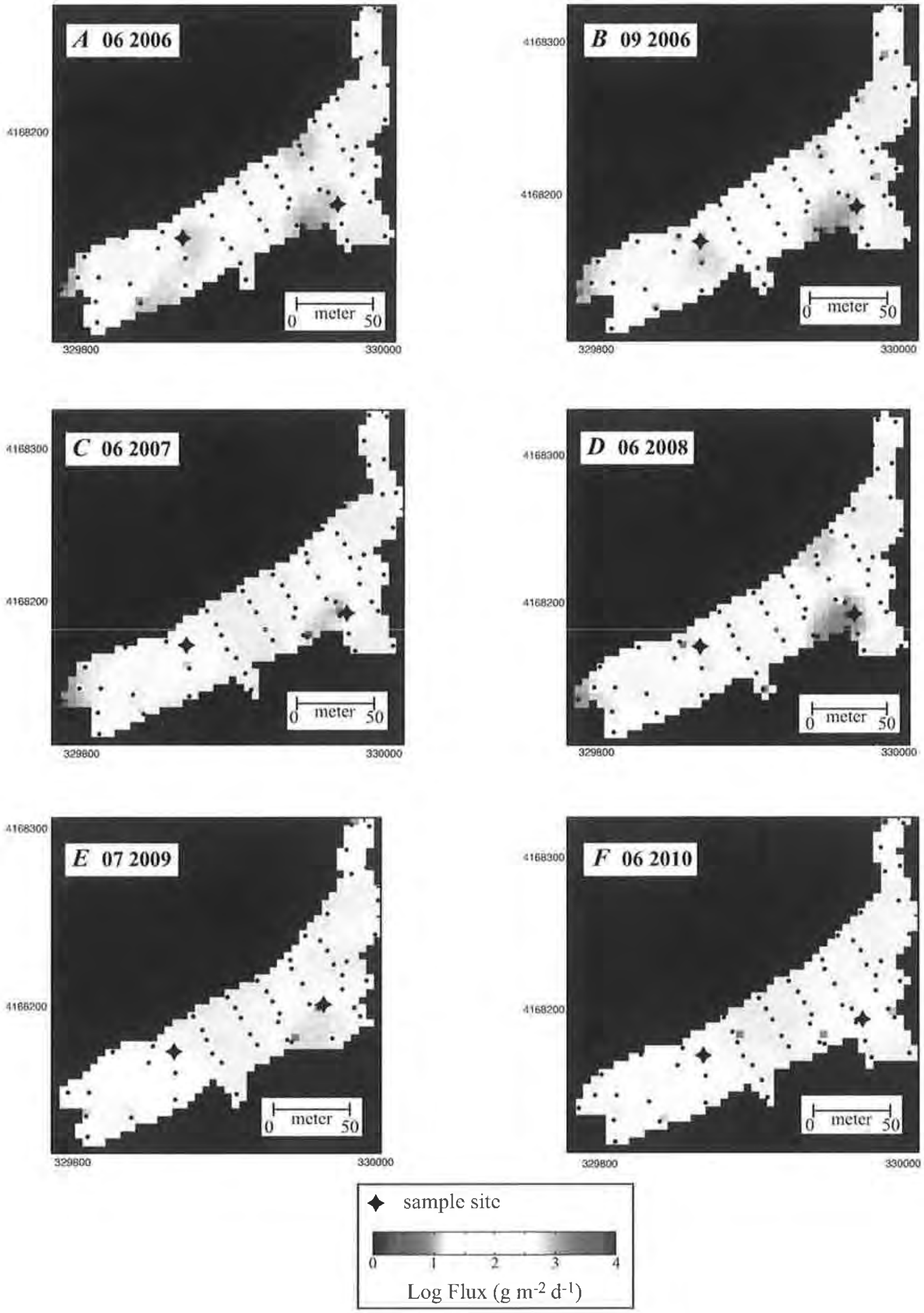


Figure 6. Contour plots from sGs calculations showing the diffuse CO_2 flux at core sites in the Basalt Canyon grid from the June 2006–June 2010 site visits. The black stars show the CHS (east) and BCE-24 (west) gas-sample locations.

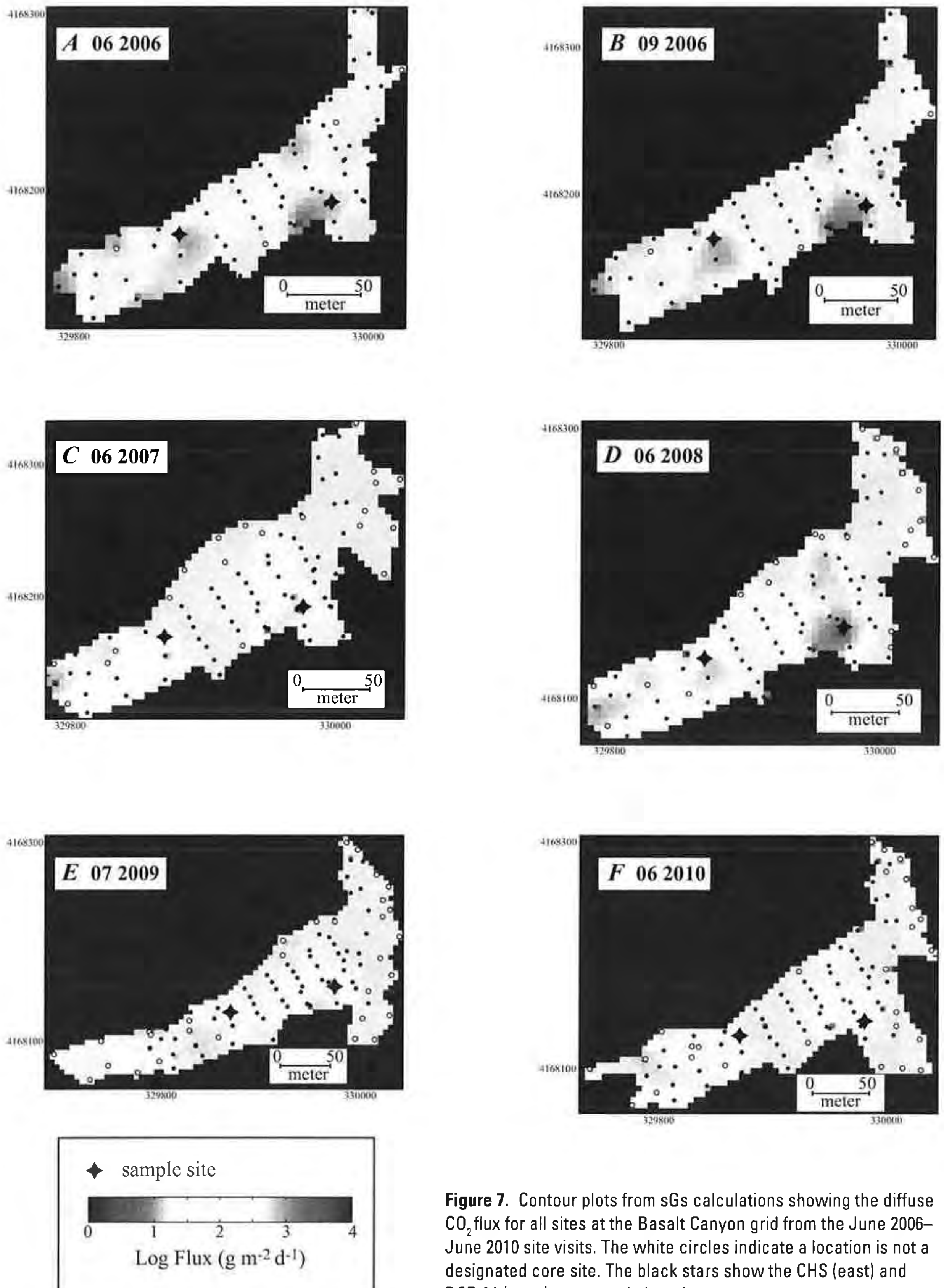


Figure 7. Contour plots from sGs calculations showing the diffuse CO_2 flux for all sites at the Basalt Canyon grid from the June 2006–June 2010 site visits. The white circles indicate a location is not a designated core site. The black stars show the CHS (east) and BCE-24 (west) gas-sample locations.

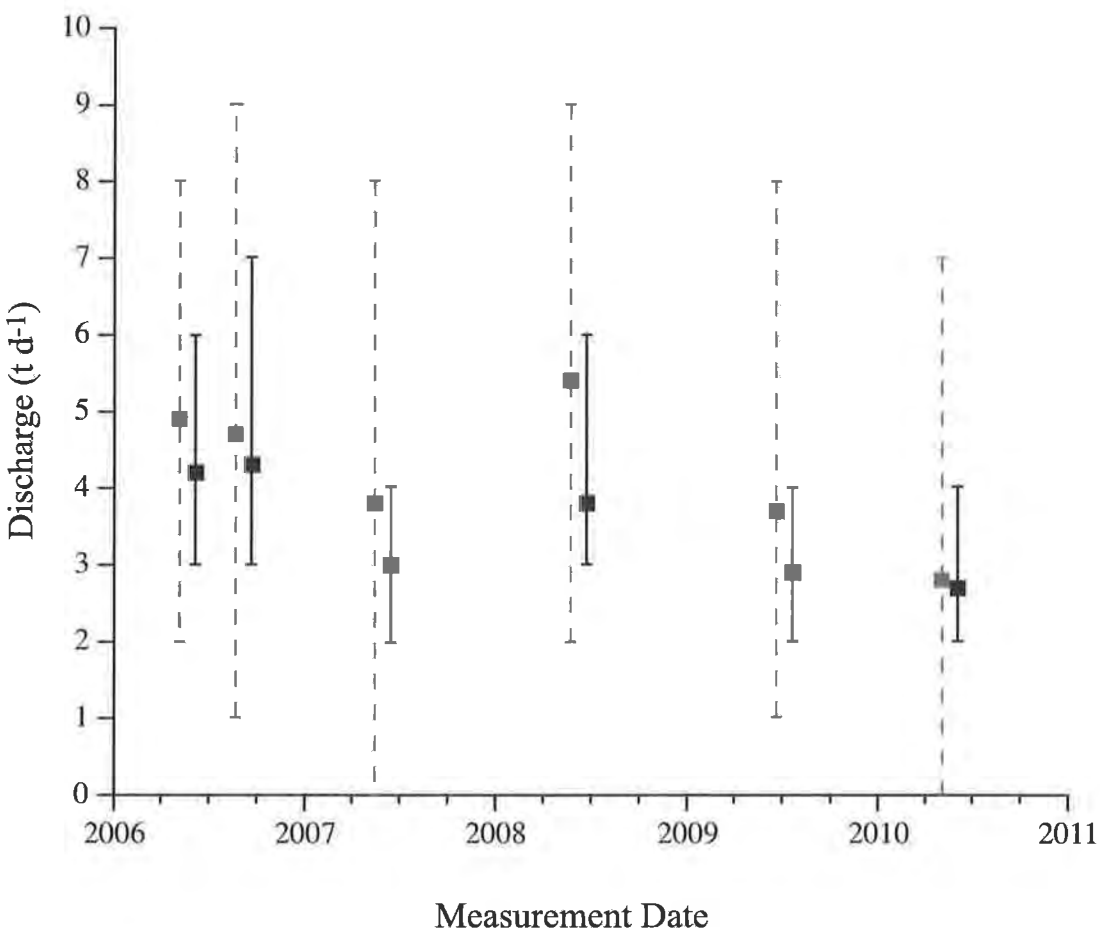
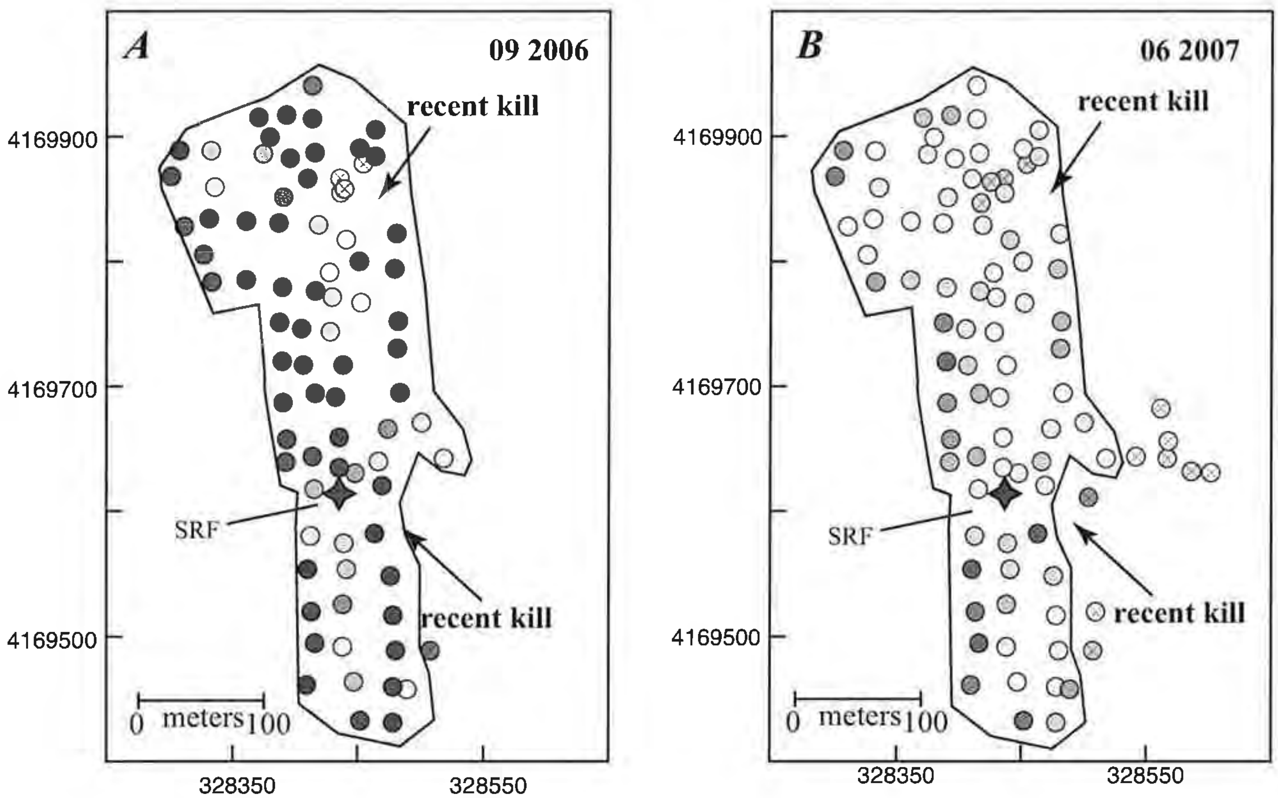
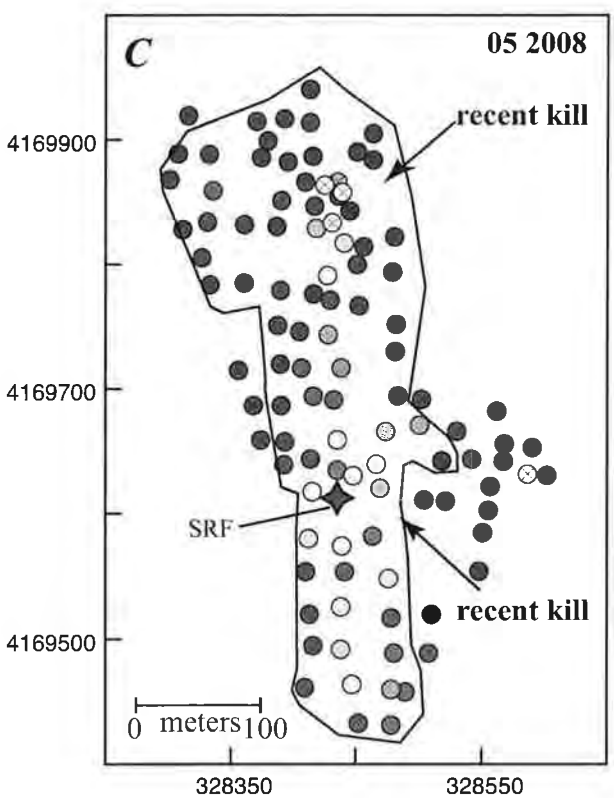


Figure 8. Plot showing the average CO_2 discharge from core sites at Basalt Canyon for 6 sets of measurements between June 2006 and June 2010. Error bars represent the range in emissions estimated for a 95-percent confidence interval. Black squares show average emissions calculated from minimum variance estimator equations. Red squares show average emissions based on sGs determinations and are offset slightly for clarity.





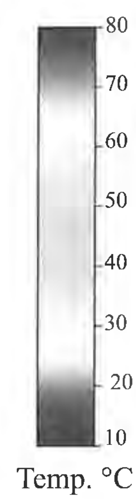


Figure 9. Map showing color-coded soil temperatures at 10 cm at the Shady Rest grid from the September 2006–May 2008 site visits. The star symbol is color-coded according to soil temperature and shows the location of the Shady Rest fumarole. The heavy black line delineates the extent of the core sites. Circles marked with an "x" indicate that the location is not a designated core site. The arrows show general locations of recent tree kills.

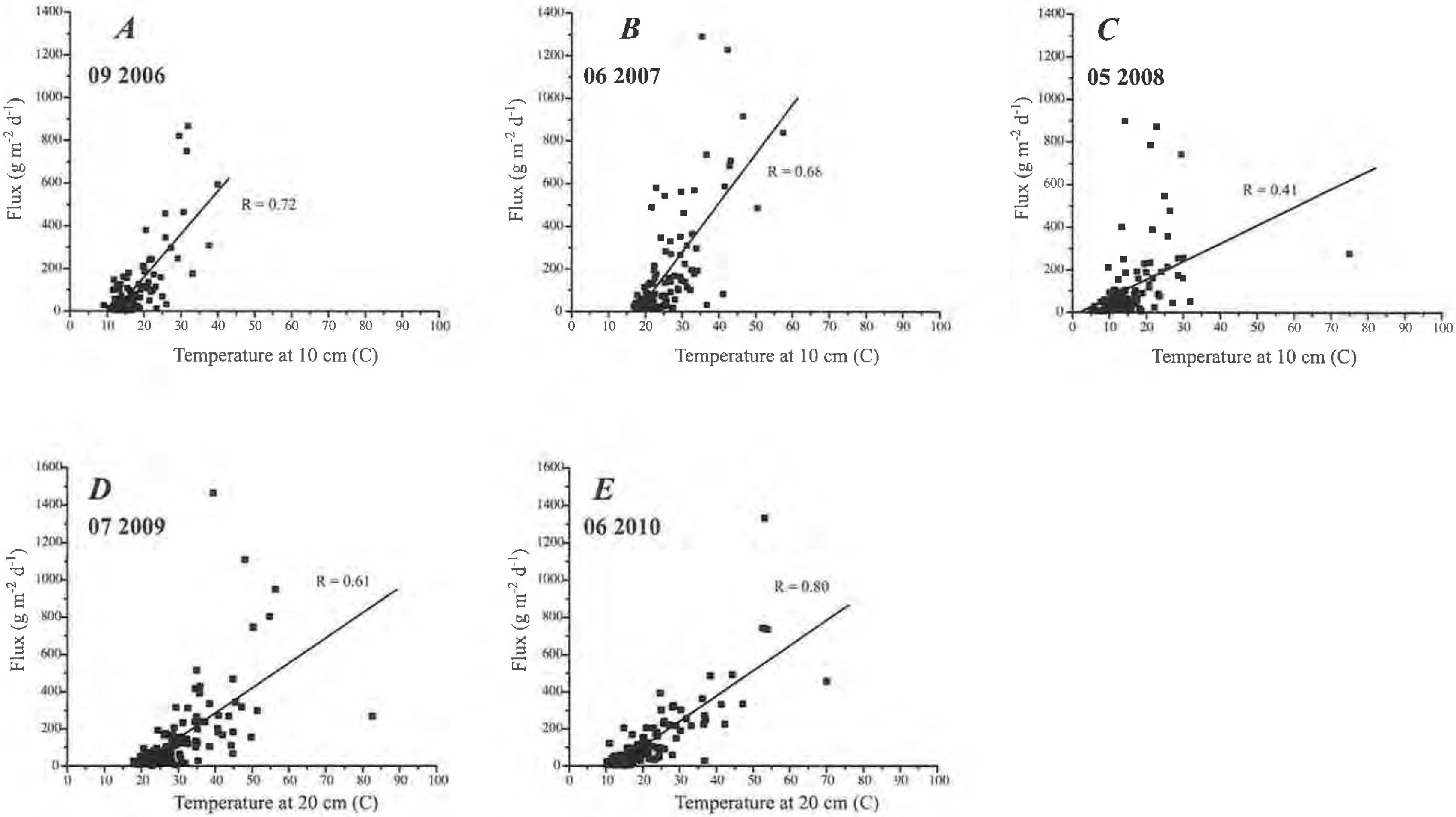


Figure 10. Scatter plots showing CO_2 flux versus soil temperature for the Shady Rest grid from September 2006–May 2008 at 10 cm and for July 2009–June 2010 at 20 cm. Note the larger scale for flux values (y-axis) from the 2009–10 data. The R-values are the correlation coefficients calculated for linear regressions of the datasets.

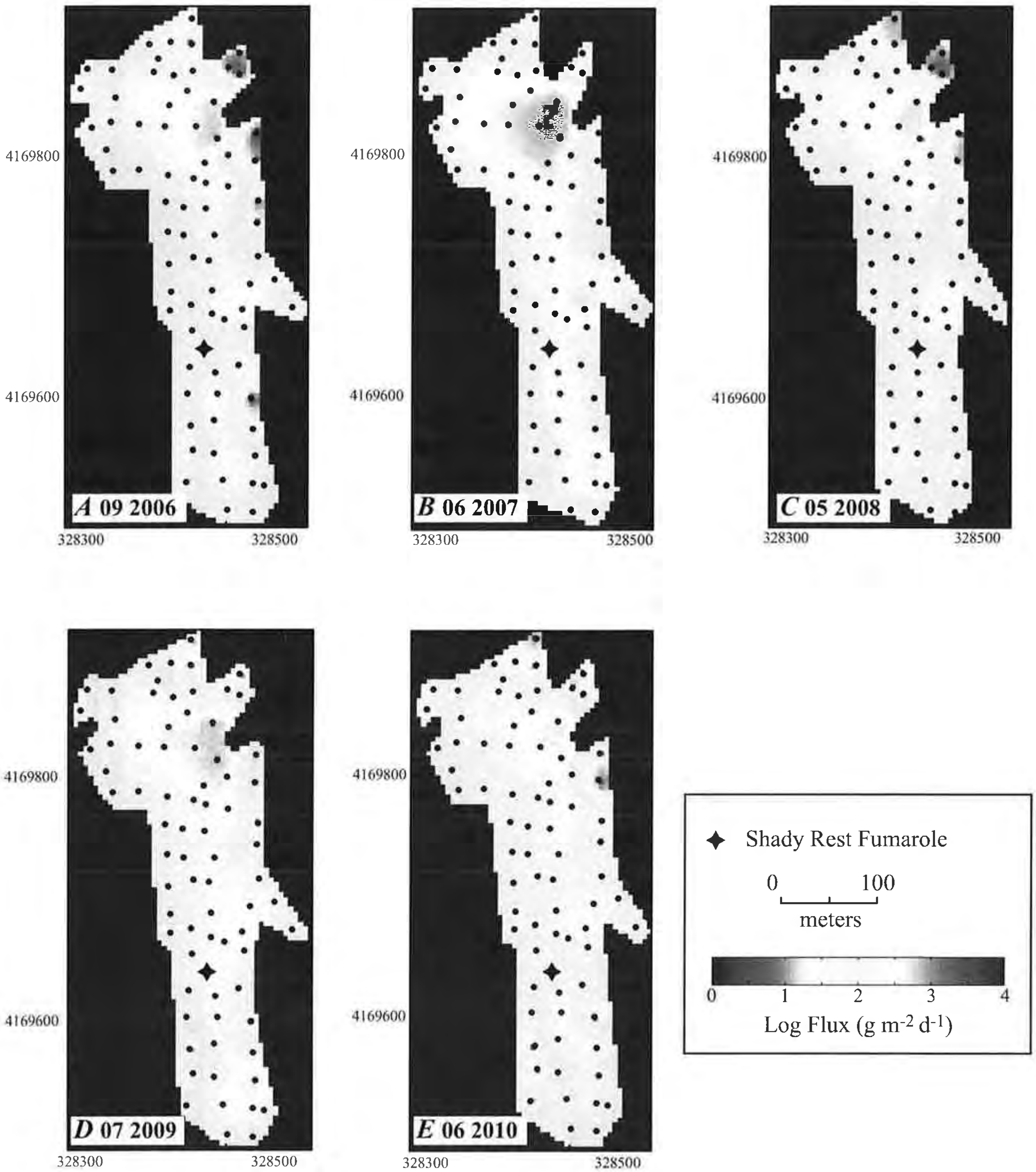
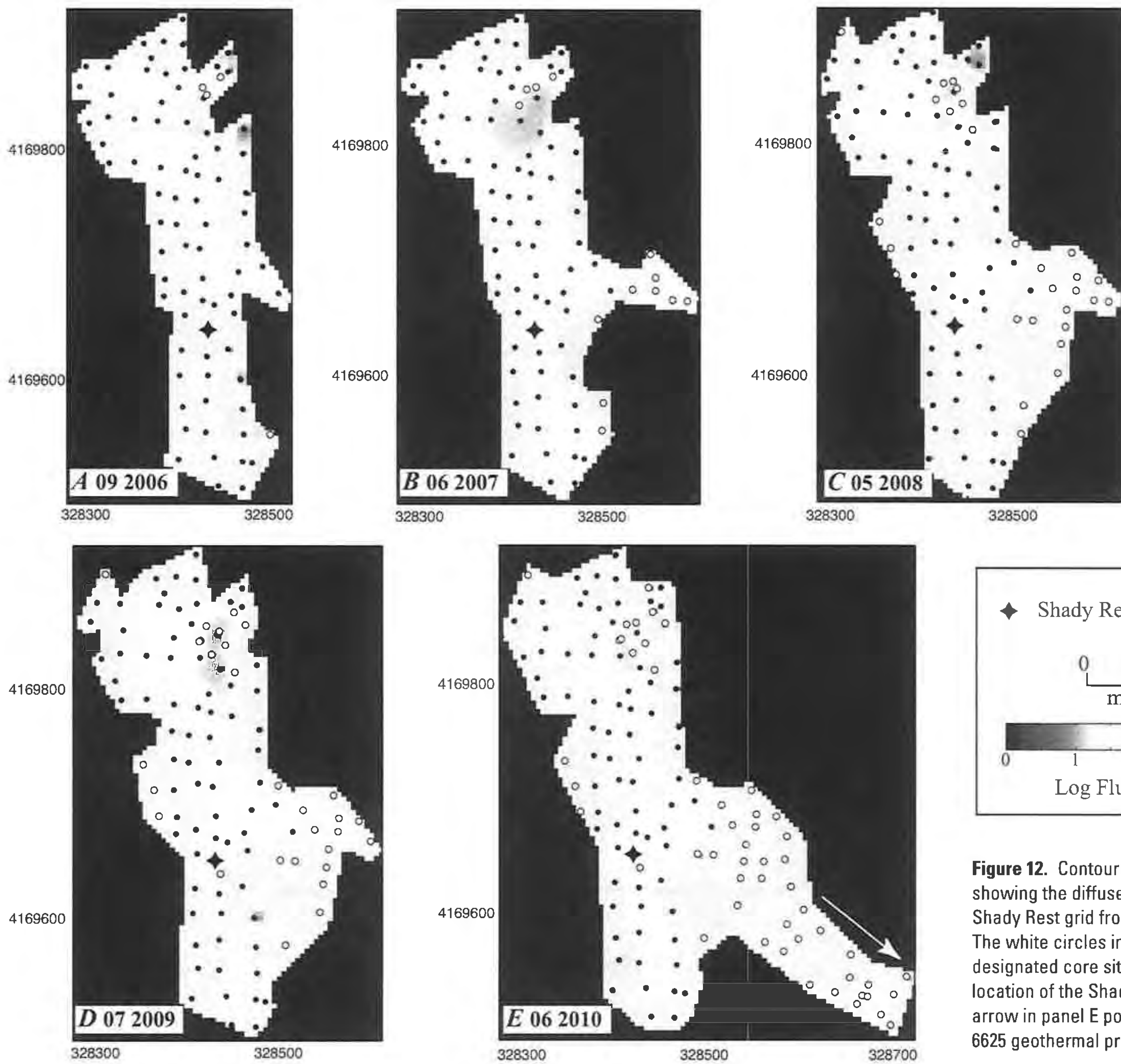


Figure 11. Contour plots from sGs calculations showing the diffuse CO_2 flux at core sites in the Shady Rest grid from the September 2006–June 2010. The black star shows the location for Shady Rest fumarole.



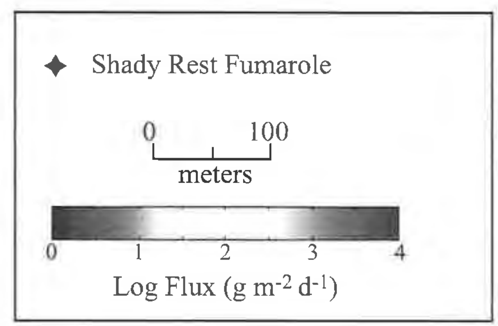


Figure 12. Contour plots from sGs calculations showing the diffuse CO_2 flux for all sites at the Shady Rest grid from September 2006–June 2010. The white circles indicate a location is not a designated core site. The black star shows the location of the Shady Rest fumarole. The white arrow in panel E points toward the location of the 6625 geothermal production well.

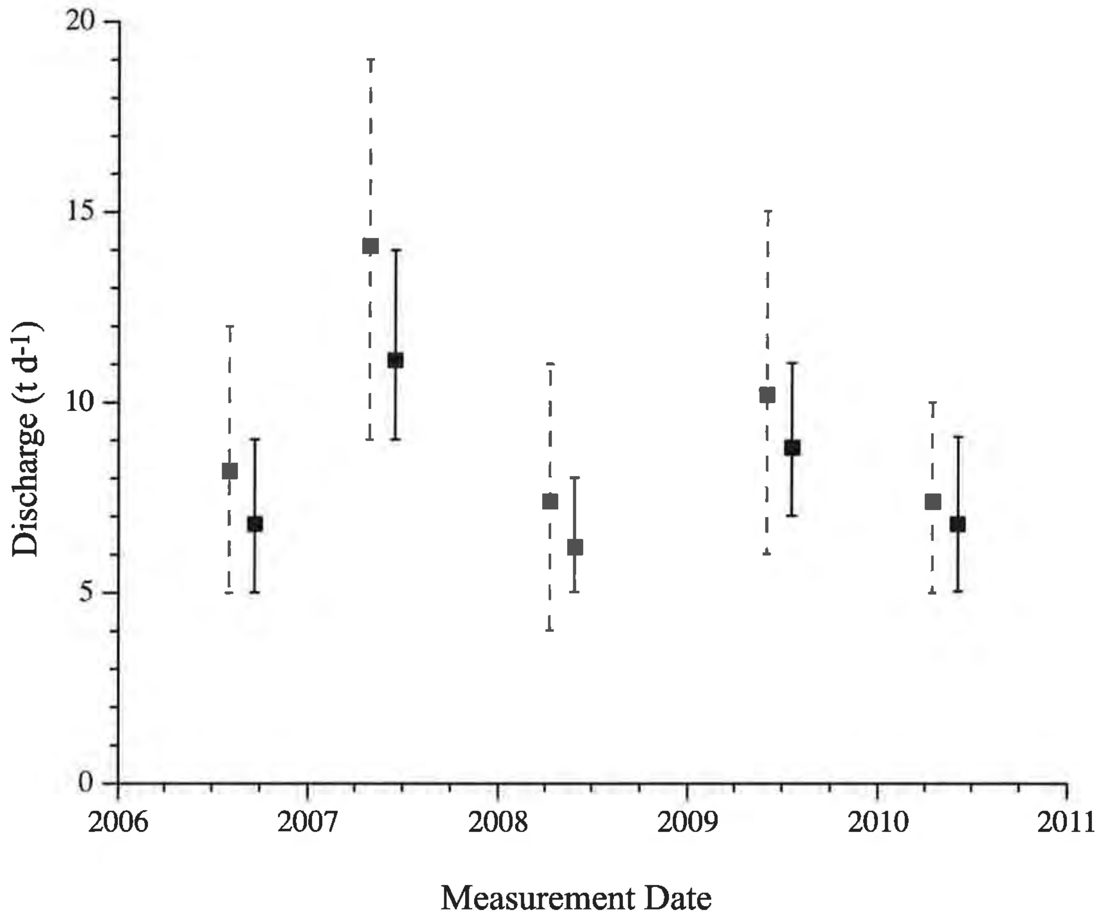


Figure 13. Plot showing the average CO_2 discharge from core sites at Shady Rest for five sets of measurements made between September 2006 and June 2010. Error bars represent the range in emissions estimated for a 95-percent confidence interval. Black squares show average emissions calculated from minimum variance estimator equations. Red squares show average emissions based on sGs determinations and are offset slightly for clarity.

Comment Letter I9

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Layout and design by Judy Weathers

Comment Letter I9

profiles at two of the high-emissions areas indicate that the conductive thermal gradient in the center of the areas is around 320°C m- 1. We estimate total heat loss from the two areas to be about 6.1 and 2.3 MW. Given current thinking on the rate of hydrothermal fluid flow across the caldera and using the CO_2 concentration in the thermal fluids, the heat and CO_2 loss from the kill areas is easily provided by the shallow hydrothermal system, which is sourced to the west of the resurgent dome. We find no evidence that the development of new areas of vegetation kill across the resurgent dome are related to new input of magma or magmatic fluids from beneath the resurgent dome. Our findings indicate that the areas have developed as a response to changes in the shallow hydrologic system. Some of the changes are likely related to fluid production at the power plant, but at distal sites the changes are more likely related to seismicity and uplift of the dome.

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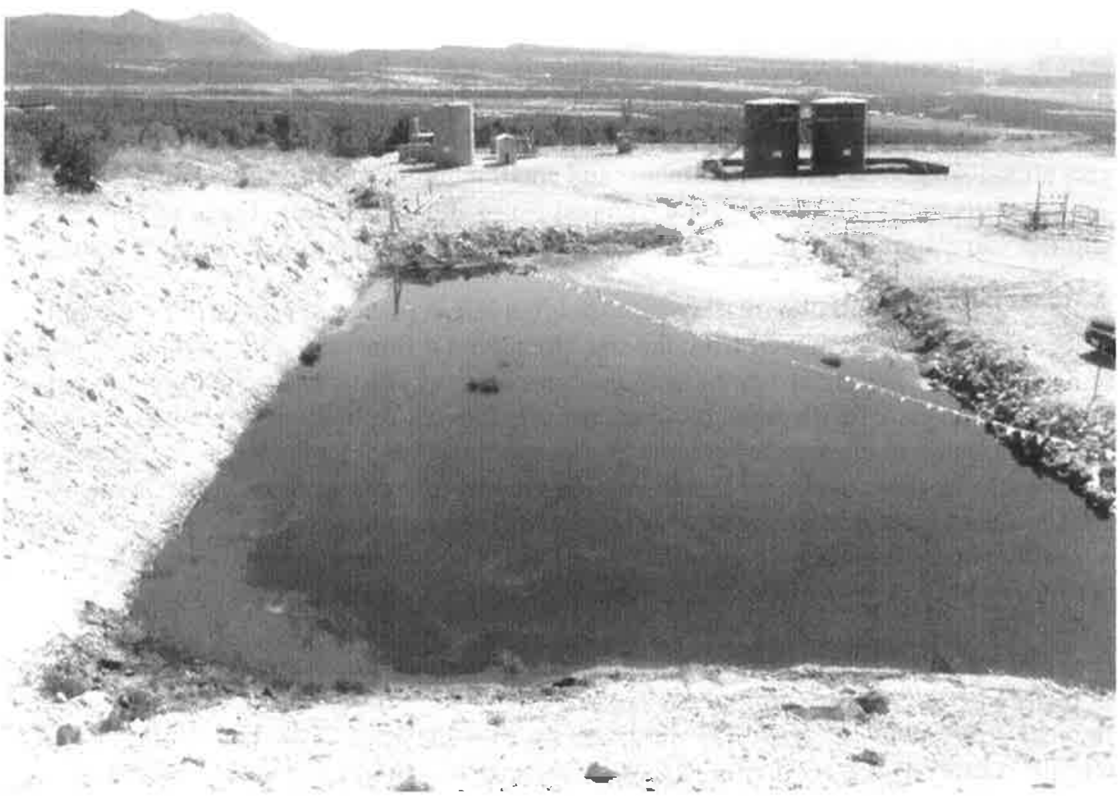
U.S. FISH & WILDLIFE SERVICE
REGION 6

ENVIRONMENTAL CONTAMINANTS PROGRAM

Reserve Pit Management: Risks to Migratory Birds

By Pedro Ramirez, Jr., Environmental Contaminants Specialist
U.S. Fish and Wildlife Service
Cheyenne, Wyoming



September 2009

Executive Summary

This document is intended to help U.S. Fish and Wildlife Service (Service) employees and other natural resource managers understand reserve pits, their uses, associated mortality risk to birds and other wildlife, and alternatives to the use of reserve pits in drilling for oil and gas. The information is provided to help Service employees in the review of oil and gas development projects and development of recommendations to prevent or minimize impacts to Service trust resources such as migratory birds, federally-listed threatened and endangered species, and National Wildlife Refuge system lands. The document also provides a summary of state and federal oil and gas rules that relate to reserve pits.

Earthen pits, also known as reserve pits, excavated adjacent to drilling rigs are commonly used for the disposal of drilling muds and well cuttings in natural gas or oil fields. The contents of reserve pits depend on the type of drilling mud used, the formation drilled, and other chemicals added to the mud circulation system during the drilling process. If the reserve pit contains oil or oil-based products (*i.e.*, oil-based drilling fluids), the pit can entrap and kill migratory birds and other wildlife. During the drilling process, reserve pits probably do not attract aquatic migratory birds such as waterfowl due to human activity and noise. However, once the drilling rig and other equipment are removed from the well pad, the reserve pit is attractive to birds and other wildlife. Birds are attracted to reserve pits by mistaking them for bodies of water. Insects entrapped in reserve pit fluids also attract songbirds, bats, amphibians, and small mammals. The sticky nature of oil entraps birds in the pits and they die from exposure and exhaustion. Birds and other wildlife can also fall into oil-covered reserve pits when they approach the pit to drink.

Following well completion, reserve pits are often left in place after the drilling rig and other equipment are removed from the site. Reserve pit fluids are allowed to dry and the remaining solids are encapsulated with the reserve pit synthetic liner and buried in place. Depending on state regulations, oil operators are allowed from 30 days to one year after well completion to close a reserve pit. The longer the reserve pit is left on site, the greater the probability that aquatic birds will land on the pit. If the reserve pit contains oil, condensates, or other hydrocarbons or hydraulic fracturing fluids, the risk of bird mortality is very high. Hydraulic fracturing fluids can contain chemicals that may be harmful to birds (*e.g.*, surfactants, hydrochloric acid, caustic potash, and diesel fuel).

Bird and other wildlife mortality in reserve pits is preventable. Several states recommend or require netting or screening of reserve pits containing oil to prevent access by wildlife. Immediate removal of the drilling fluids after well completion is the key to preventing wildlife mortality in reserve pits. An alternative to the use of earthen reserve pits is closed-loop drilling systems using steel tanks to hold the drilling muds and cuttings. Other options to dispose of drilling wastes include: downhole injection; solidification and burial; or treatment and reuse.

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Introduction

Earthen pits excavated adjacent to drilling rigs are commonly used for the disposal of drilling muds and well cuttings in oil and gas fields (Figure 1). These pits are referred to as reserve pits. The contents of reserve pits depend on the type of drilling mud used, the formation drilled, and other chemicals added to the mud circulation system during the drilling process.

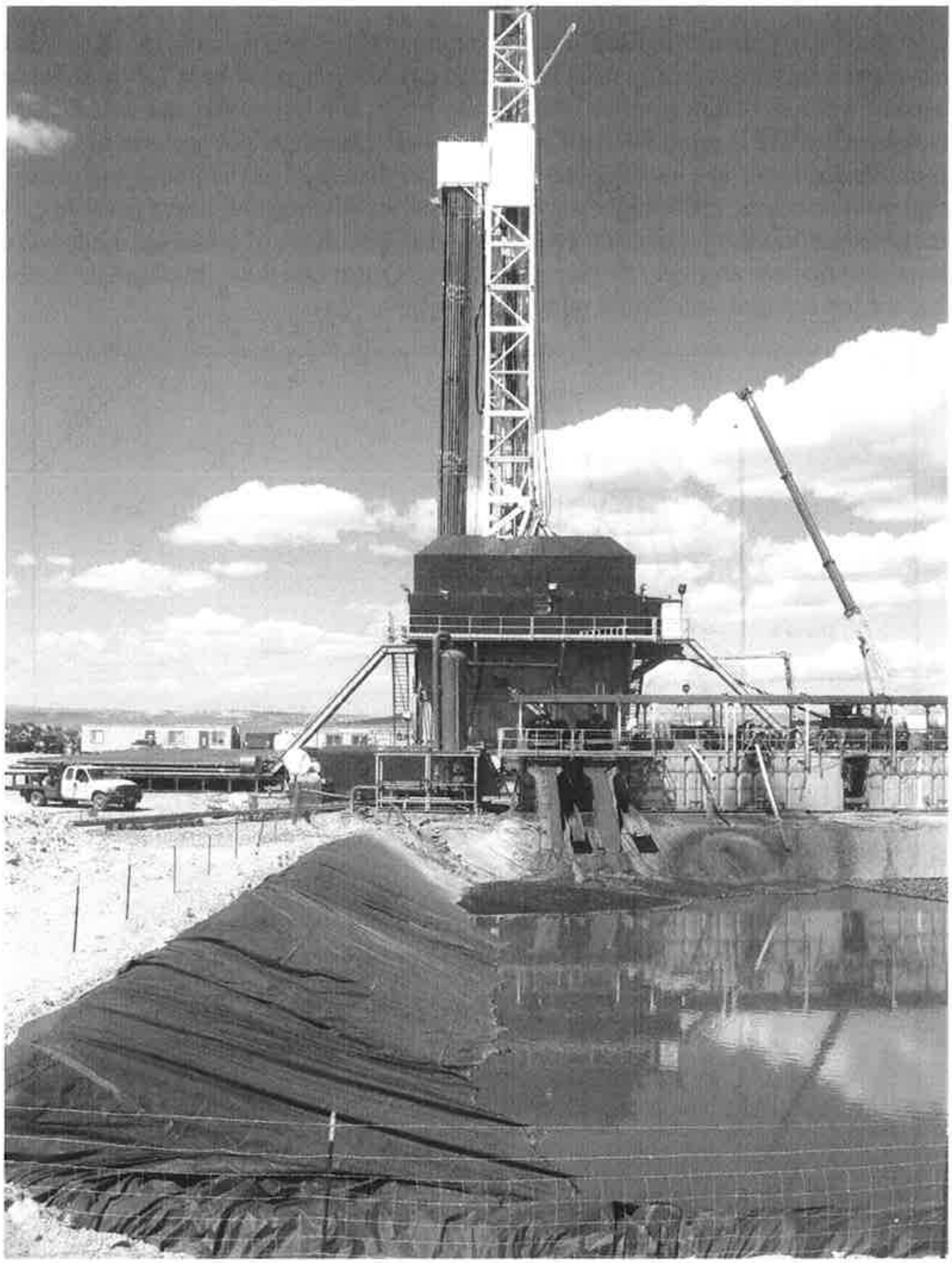

Figure 1. Reserve pit adjacent to a drilling rig near La Barge, Wyoming.
(USFWS Photo by P. Ramirez)

Reserve pit size depends on well depth. The average reserve pit volume for wells less than 4,000 feet in depth is approximately 3,600 barrels (bbls) and for wells greater than 15,000 feet in depth is more than 15,000 bbls (USOTA 1992). Reserve pits in the Pinedale Anticline and Jonah natural gas fields in Wyoming average 0.6 acres in size (approximately 120 by 200 feet). Reserve pits in the natural gas fields near Wamsutter, Wyoming average 0.3 acres in size (approximately 85 by 140 feet).

Drilling fluids or muds consist of a base fluid or carrier (water, diesel, mineral oil, or a synthetic compound), weighting agents (typically barium sulfate or barite), and bentonite clay to remove the cuttings from the well and line the walls of the hole (Figure 2). Drilling fluid also contains lignosulfonates and lignites to keep the mud in a fluid state. Water-based muds are typically used in drilling due to their lower cost. Oil-based muds are used in wells drilled in reactive shales, deep wells, and horizontal and extended-reach wells, where drilling is more difficult and water-based muds do not perform as well. Synthetic-based muds use nonaqueous fluids (other than oils) as their base and include internal olefins, esters, linear alpha-olefins, poly alpha-olefins, and linear paraffins. Synthetic-based muds have drilling properties similar to those of oil-based muds but do not have polynuclear aromatic hydrocarbons (PAHs), are less toxic, biodegrade faster, and have a lower bioaccumulation potential.

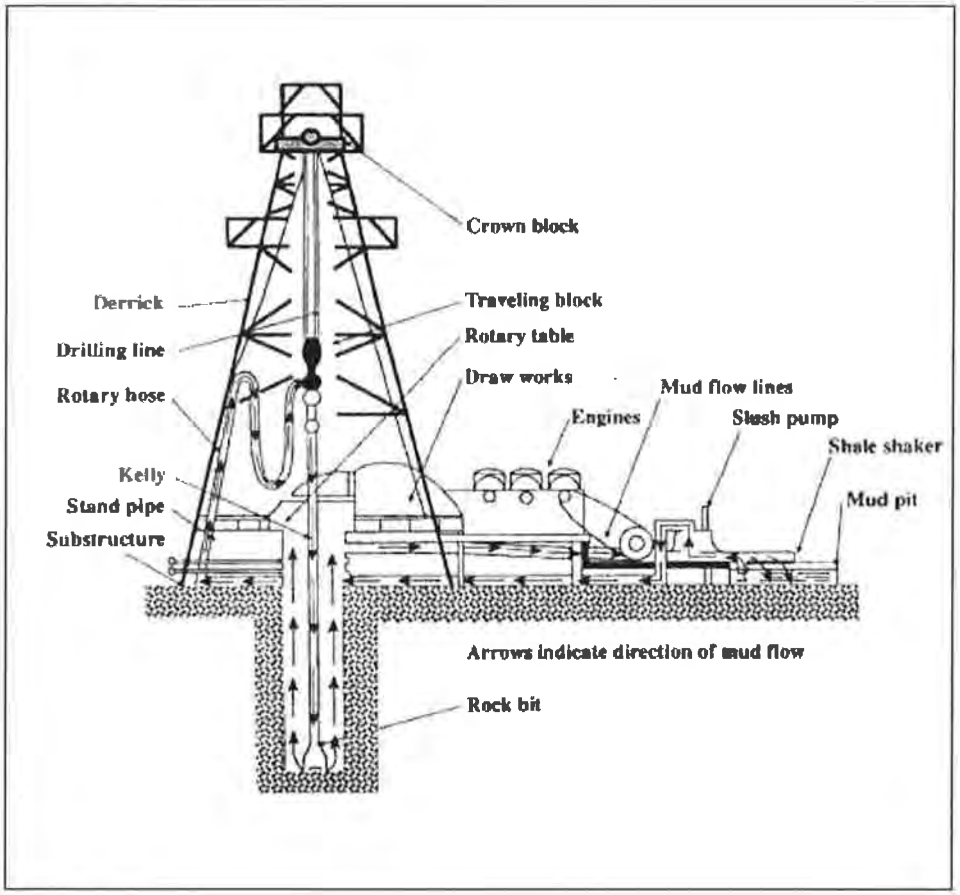

Figure 2. Rotary drilling rig diagram with reserve pit (mud pit).

Following well completion, reserve pits are left in place after the drilling rig and other equipment are removed from the site (Figure 3). Reserve pit fluids are allowed to dry (Figure 4) and the remaining solids are encapsulated with the reserve pit synthetic liner and buried in place (Figure 5).

Figure 3. Reserve pit at a completed well site near Parachute, Colorado. (USFWS Photo by P. Ramirez)

Figure 4. Reserve pit after fluids have evaporated. (USFWS Photo by P. Ramirez)

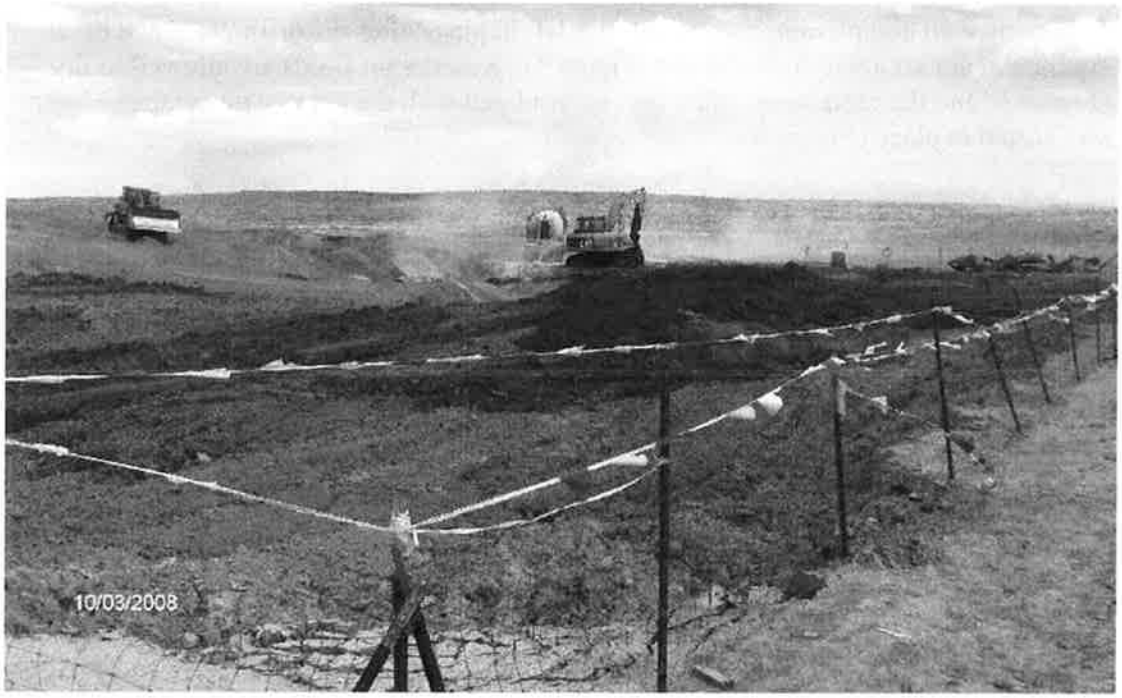

Figure 5. On-site burial of reserve pit wastes, Carbon County, Wyoming.

Contaminants in Reserve Pits

Reserve pits can contaminate soil, groundwater, and surface water with metals and hydrocarbons if not managed and closed properly. As reserve pit fluids evaporate, water-soluble metals, salts, and other chemicals become concentrated. Precipitation, changes in shallow groundwater levels, and flooding can mobilize these contaminants into adjacent soils and groundwater. Liners most often do not adequately seal the drilling wastes, especially if they are torn (Figure 6). Beal *et. al.* (1987) documented the migration of leachate 400 feet from reserve pits buried in 1959 in north-central North Dakota and reported groundwater contamination 50 feet below the buried reserve pits. Migration of salts from buried drilling wastes from unlined reserve pits has been documented in U.S. Fish and Wildlife Service (Service) managed Waterfowl Production Areas in northeastern Montana and northwestern North Dakota (K. Nelson, U.S. Fish & Wildlife Service, pers. com., Dec. 10, 2008). Caustic soda, rig wash, diesel fuel, waste oil from machinery, and other refuse could be placed in reserve pits either deliberately or inadvertently. Reis (1996) states that "improper reserve pit management practices have created sources of benzene, lead, arsenic, and fluoride, even when these contaminants were not detected or were not present in the drilling mud system." Water-based drilling muds can contain glycols, chromium, zinc, polypropylene glycol, and acrylamide copolymers (Fink 2003). Synthetic-based muds contain mineral oil and oil-based muds can contain diesel oil, although diesel oil is being replaced by a palm oil derivative or hydrated caster oil (Fink 2003).

Other additives typically used in drilling fluids include: polymers (partially hydrolyzed polyacrylamide (PHPA) and polyanionic cellulose (PAC)); drilling detergents; and sodium carbonate (soda ash) (Papp 2001). PHPA is used to increase viscosity of fluid and inhibit clay and shale from swelling and sticking. PAC is used to increase the stability of the borehole in unconsolidated formations. Drilling detergents or surfactants are used with bentonite drilling fluids to decrease the surface tension of the drill cuttings. Soda ash is used to raise the pH of the water and precipitate calcium out of the water.

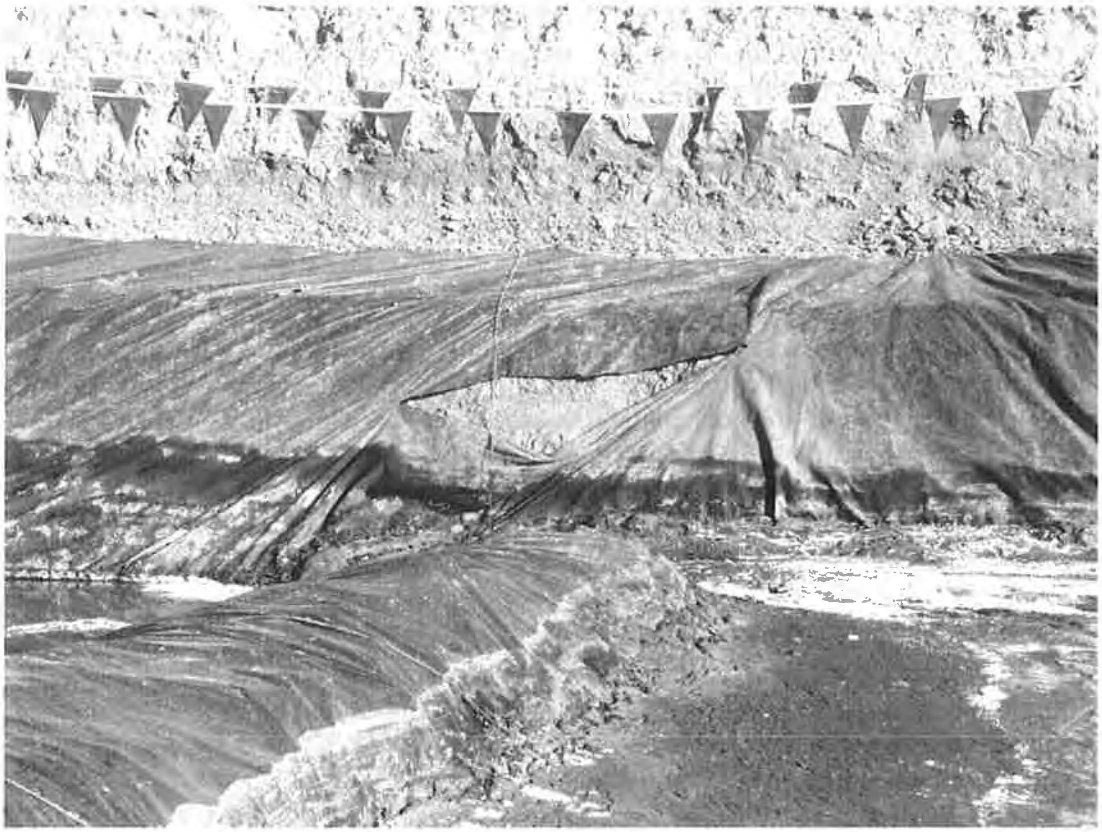

Figure 6. Reserve pit with torn synthetic liner. (USFWS Photo by P. Ramirez)

Disposal of Drilling Wastes

The most recent data on drilling waste disposal by the American Petroleum Institute (API) (2000) shows the oil industry used reserve pits in 68 percent of the oil and conventional natural gas wells drilled in 1995 and closed loop drilling systems in 25 percent of the wells. An estimated 92 percent of onshore drilling wastes were derived from freshwater based mud systems, compared to 64 percent of drilling wastes in 1985. In 1995, 68 percent of drilling wastes were disposed onsite through evaporation and burial. Approximately 1.2 bbls of drilling waste are produced per foot of well depth drilled (API 2000). In 1995, an estimated 148 million bbls of drilling waste were produced. According to the U.S. Energy Information Administration, a total of 335 million feet were drilled in the exploration and development of oil and natural gas in 2008 (EIA 2009). Assuming the drilling of those wells resulted in an average of 1.2 bbls of drilling waste per foot of well depth drilled; approximately 402 million bbls of drilling waste were produced in 2008.

On-site Disposal and Burial of Reserve Pit Wastes

On-site disposal and burial involves allowing reserve pit fluids to dry and encapsulating the remaining solids with the reserve pit synthetic liner and burying the wastes in place. Depending on state regulations, oil operators are allowed from 30 days to one year after well completion to close a reserve pit. Assuming that 68 percent of the drilling wastes are currently disposed onsite through evaporation and burial, an estimated 273 million bbls of drilling wastes were disposed onsite in 2008.

Solidification of Drilling Wastes

If reserve pits must be used, cost-effective technology exists to solidify pit fluids immediately following well completion. Solidification can add to the waste volume but prevents mobilization of potential contaminants into the soil and/or groundwater (EPA 2000). Solidification involves the removal of the free liquid fraction of reserve pit fluids and then adding solidifiers such as commercial cement, fly ash, or lime kiln dust. Removal and off-site disposal of liquids removes most of the water soluble metals, salts, and chemicals from the drilling waste material.

Pitless or Closed Loop Drilling

Pitless drilling or closed-loop drilling reduces the amount of drilling waste, recycles drilling fluids, and reduces drilling costs (Rogers et. al. 2006a and b). Pitless drilling can reduce the volume of waste by 60 to 70 percent (Rogers et. al. 2006b). Pitless drilling also conserves water and prevents soil contamination.

Pitless drilling systems are equipped with a "chemically-enhanced" centrifuge that separates drilling mud liquids from solids (Rogers et. al. 2006b). The separated drilling mud solids are stored in a steel tank and then transferred to a synthetically-lined clay pad for drying (Figure 7). The pads are designed to prevent the runoff of any liquids. The drill cuttings are either buried on site or are transferred to an approved commercial disposal facility for disposal (Rogers et. al. 2006b). The drill cuttings can create environmental problems and pose a risk to wildlife if the trench or excavated burial pit collects water from snowmelt or rainfall. Ponded water in the trench or burial pit may become contaminated with hydrocarbons present in the drill cuttings. Immediate burial of drill cuttings and contouring of the site should prevent the ponding of snowmelt or rainwater. Sheens, oil, and sludges in the disposal pit will pose a risk to migratory birds and other wildlife (Figures 8 and 9). Additionally, if the pits are not lined, soil and groundwater contamination can occur if the drill cuttings contain leachable concentrations of hydrocarbons and metals.

Treatment and Reuse of Drilling Fluids

Operators in the Jonah natural gas field in southwestern Wyoming are currently using new technology to treat and reuse drilling fluids (Figure 10). Drilling fluids are treated using a patented combination of fluid and thermal dynamics to remove oil and salts. The treatment separates the drilling fluid into fresh water, heavy brine, condensate, and methanol. The condensate is recovered and sold. The methanol and brine are reused in drilling fluids. The fresh water is either reused at other drilling locations or is used for the benefit of livestock or wildlife.

Figure 7. Closed-loop or pitless drilling site with synthetically-lined pad for temporary storage of drill cuttings.

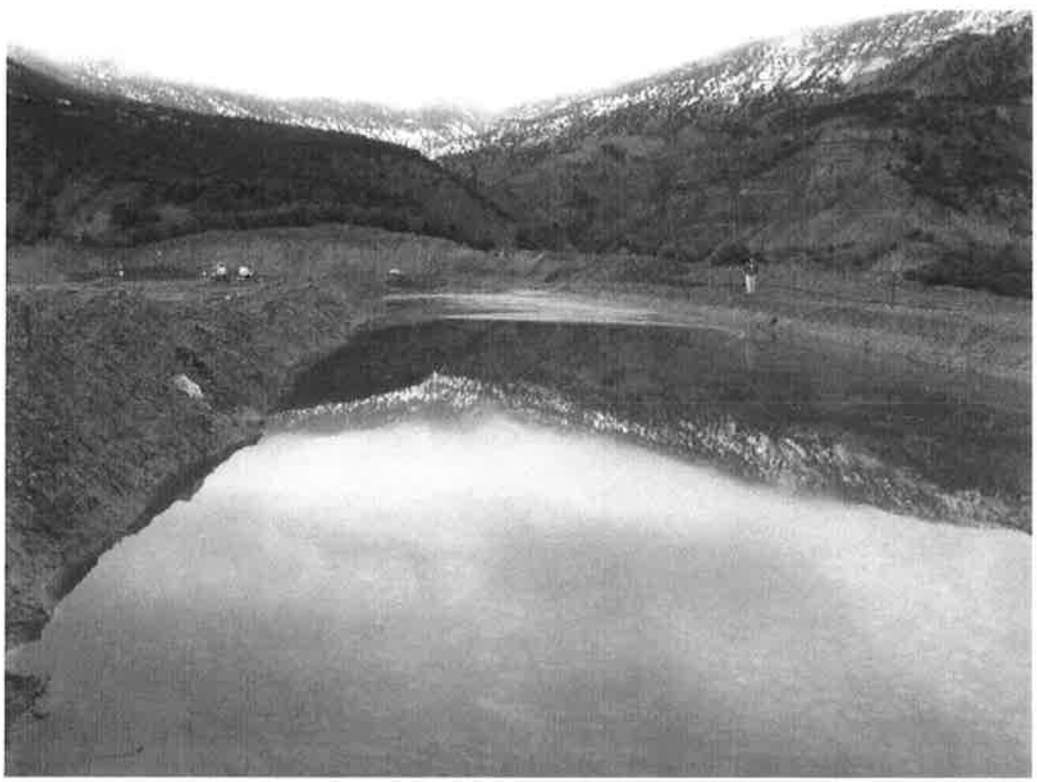

Figure 8. Trench used for burial of drill cuttings from closed-loop drilling. Sheens are visible on the water surface. (USFWS Photo by P. Ramirez)

Figure 9. Ponding of snowmelt and rainfall in trench used for the disposal of drill cuttings from closed-loop (pitless) drilling system.

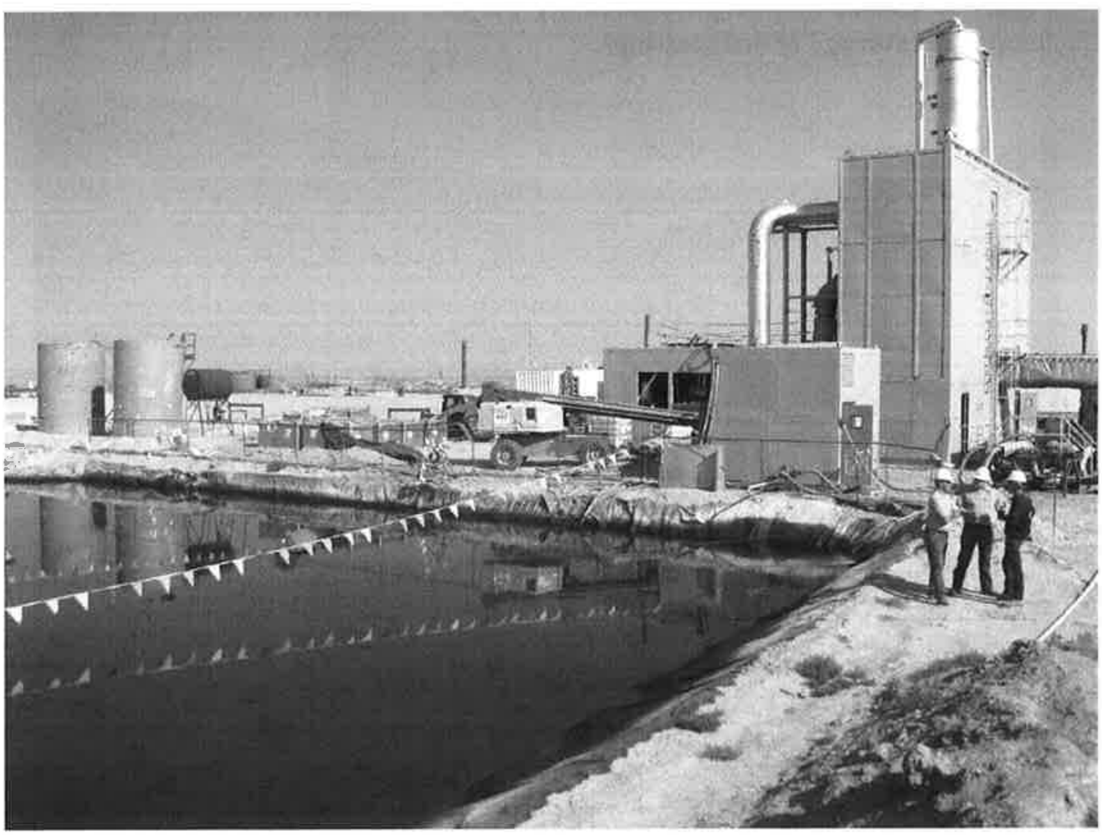

Figure 10. Treatment facility at the Jonah Gas Field, Sublette County, Wyoming used to separate condensate, methanol, brine, and water from drilling fluids.
(USFWS Photo by P. Ramirez)

Down-hole Disposal of Drilling Fluids

Oil operators in Alaska inject the drill cuttings underground after the solids are finely ground and mixed with a liquid to form a slurry (Veil and Dusseault 2003). This disposal technique is typically used in conjunction with pitless drilling. Open earthen reserve pits are not used to temporarily store the drilling fluids. The elimination of open pits removes the mortality threat to migratory birds and other wildlife. Slurry injection of drilling wastes also poses less environmental impacts when properly managed and monitored as the wastes are disposed deep underground and isolated from aquifers (Veil and Dusseault 2003).

Threats to Migratory Birds

Reserve pits containing oil or oil-based products (i.e. oil-based drilling fluids) can entrap and kill migratory birds and other wildlife. Birds, including hawks, owls, waterfowl, and songbirds, are attracted to reserve pits by mistaking them for bodies of water. Reserve pits also attract other wildlife such as insects, bats, small mammals, amphibians, and big game. Wildlife can fall into oil-covered reserve pits while attempting to drink along the pits' steep sideslopes. The steep, synthetically-lined pit walls make it almost impossible for entrapped wildlife to escape. Insects entrapped in the oil can also attract songbirds, bats, amphibians, and small mammals. The struggling birds or small mammals in turn attract hawks and owls to the oil-covered pit. The sticky nature of oil entraps birds in the reserve pits and they die from exposure and exhaustion. Birds that do manage to escape die from starvation, exposure or the toxic effects of oil ingested during preening. Birds ingesting sublethal doses of oil can experience impaired reproduction. Cold stress can kill the animal if oil damages the insulation provided by feathers or fur. Animals not killed in the reserve pits can suffer ill effects later from contact with the oil and chemicals in the pits. If they absorb or ingest oil in less than acutely lethal amounts they may suffer a variety of systemic effects and may become more susceptible to disease and predation. During the breeding season, birds can transfer oil from their feet and feathers to their eggs. In some cases, a few drops of oil on an egg shell can kill the embryo (King and LeFever 1979).

Service law enforcement agents and environmental contaminants specialists have documented bird mortality in reserve pits in Colorado, Montana, North Dakota, Utah, and Wyoming. The presence of small amounts of hydrocarbons, such as diesel, and condensate, can create sheens on the reserve pit fluid. The presence of visible sheens on reserve pit fluids is just as deadly to birds that come into contact with them (Figure 11). A light sheen will coat the bird's feathers with a thin film of oil. Although light oiling on a bird may not immediately immobilize the bird, it will compromise the feathers' ability to insulate the bird. Furthermore, the affected bird will ingest the oil when it preens its feathers and suffer acute or chronic effects.

Well stimulation chemicals, such as corrosion inhibitors and surfactants, disposed into reserve pits, pose additional risk to migratory birds. Surfactants reduce the surface tension of water; thus, allowing water to penetrate through feathers and onto skin. This compromises the insulation properties of the feathers and subjects the bird to hypothermia (Stephenson 1997). Furthermore, loss of water repellency in feathers due to reductions in surface tension will cause the bird to become water logged.

Figure 11. Reserve pit with visible sheen on surface. Sheens on the fluid surface can be lethal to birds landing on reserve pits. (USFWS Photo by P. Ramirez)

Loss of buoyancy will cause the bird to drown. Stephenson (1997) reports that water surface tension reduced to approximately 38 to 50 mNm^{-1} will cause feather wetting in adult waterfowl and could result in potential mortality. The unit mNm^{-1} is defined as microNewtons per meter, the force necessary to break a film of a given length. Pure water has a surface tension of approximately 72 mNm^{-1}. Storage of hydraulic fracturing (frac) fluids in reserve pits can present a risk to migratory birds if the frac fluids contain hydrocarbons or surfactants.

During the drilling process, human activity and noise discourage aquatic migratory birds such as waterfowl from accessing reserve pits. However, once the drilling rig and other equipment are removed from the well pad, the reserve pit is attractive to birds and other wildlife. The longer the reserve pit is left on site, the greater the probability that aquatic birds will land on the pit. If the reserve pit contains oil, condensates, or other hydrocarbons or surfactants, the risk of bird mortality is very high. Mortality events are episodic in reserve pits. Total bird carcasses recovered from individual reserve pits range from a few birds to large mortality incidents involving many birds. The largest mortality incident in Wyoming occurred at a reserve pit in Carbon County where Service personnel recovered 77 birds, primarily puddle ducks, between July 2008 and September 2008 (Figure 12 and 13). The pit remained at the well site for over a year and contained oil and sludges on the surface.

Bird carcasses recovered from reserve pits in Colorado, Montana, North Dakota, and Wyoming include passerine songbirds, raptors, shorebirds and waterfowl (Table 1 and Figure 14). Service personnel have observed songbirds landing at the edges of reserve pits and drinking water from pits.

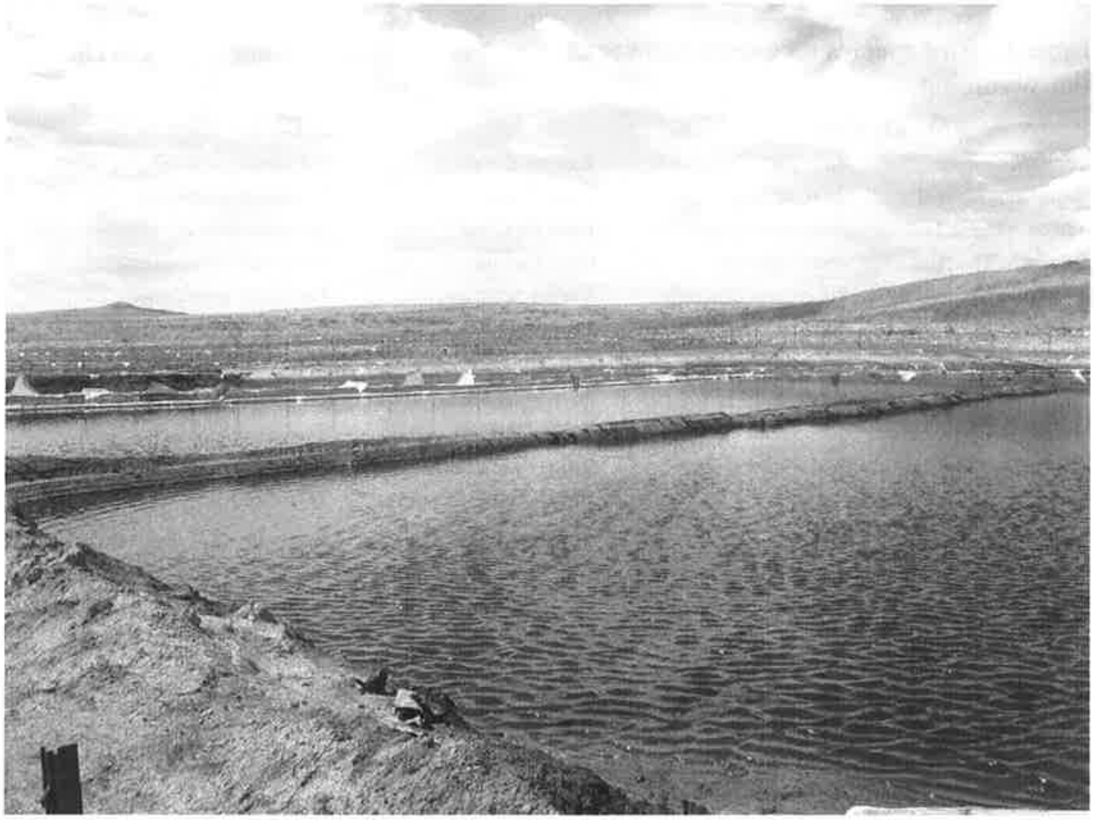

Figure 12. Reserve pit in Carbon County, Wyoming, site of a large waterfowl mortality incident (77 bird carcasses recovered). (USFWS Photo by P. Ramirez)

Figure 13. Duck carcass (lower center) in a reserve pit. (USFWS Photo by P. Ramirez)

Table 1. Bird species recovered from reserve pits in Colorado, Montana, North Dakota, and Wyoming.

Waterfowl

Mallard	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Green-winged Teal	*Anas crecca*
Northern Shoveler	*Anas clypeata*
Common Goldeneye	*Bucephala clangula*
Gadwall	*Anas strepera*

Other Aquatic Birds

Grebe	
White-faced Ibis	*Eudocimus albus*

Raptors

Great Horned Owl	*Bubo virginianus*
American Kestrel	*Falco sparverius*

Passerine Birds

Eastern Kingbird	*Tyrannus tyrannus*
Horned Lark	*Eremophila alpestris*
Barn Swallow	*Hirundo rustica*
Gray Catbird	*Dumetella carolinensis*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
Song Sparrow	*Melospiza melodia*
Dark-eyed Junco	*Junco hyemalis*
Red-winged Blackbird	*Agelaius phoeniceus*
Brewer's Blackbird	*Euphagus cyanocephalus*
Brown-headed Cowbird	*Molothrus ater*
Common Grackle	*Quiscalus quiscula*

Figure 14. Songbird in a reserve pit in North Dakota. (USFWS Photo by P. Ramirez)

Prevention of Bird Mortality in Reserve Pits

Bird and other wildlife mortality in reserve pits is preventable. Several states regulations address or recommend the netting or screening of reserve pits containing oil to prevent access by birds and other wildlife (Figure 15). However, enforcement is inconsistent. Immediate removal of the drilling fluids after well completion is the key to preventing wildlife mortality in reserve pits. The best options are to eliminate the use of open reserve pits and use closed-loop drilling systems or downhole disposal of drill cuttings. Care is still required with closed-loop systems to prevent ponding of water in the solids disposal trenches.

Regulations on Netting or Screening of Pits or Open Tanks

Figure 15. States with oil and gas regulations recommending or requiring netting or screening of pits or open tanks to prevent the mortality of migratory birds and other wildlife.

State and Federal Reserve Pit Regulations

The use of reserve pits for the storage of drilling fluids is regulated by state oil and gas regulatory agencies in private and state-owned mineral estates and by the U.S. Bureau of Land Management (BLM) in federal and tribally-owned mineral estates. Reserve pit construction requirements vary from state to state but generally, the regulations are designed to protect surface and groundwater from contamination.

The BLM requires operators to construct reserve pits at least 50 percent below ground level to prevent pit dike failure. The BLM also restricts the construction of reserve pits in areas with shallow groundwater and requires 2 feet of freeboard on reserve pits.

The BLM provides the following standard operating procedures and guidelines for reserve pits in their *Gold Book* (US DOI 2006).

> *Reserve pits should be appropriately fenced to prevent access by persons, wildlife, or livestock. During drilling in active livestock areas, the reserve pit must be fenced with an exclosure fence on three sides and then fenced on the fourth side once drilling has been completed. Refer to Figure 1 for recommended fence construction standards in active livestock areas. In areas where livestock will not be present, other types of fences may be appropriate. The fence should remain in place until pit reclamation begins. After cessation of drilling and completion operations, any visible or measurable layer of oil must be removed from the surface of the reserve pit and the pit kept free of oil. In some situations and locations, precautions, such as netting, may be required in order to prevent access and mortality of birds and other animals.*

The BLM's **Onshore Oil and Gas Order No. 7 Disposal of Produced Water** also requires fencing and other enclosures to prevent access by livestock, wildlife, and unauthorized personnel:

> ***E. Design requirements for pits***. *c. The pit shall be fenced or enclosed to prevent access by livestock, wildlife, and unauthorized personnel. If necessary, the pit shall be equipped to deter entry by birds. Fences shall not be constructed on the levees.*

After the well is completed, reserve pits are left in place after the drilling rig and other equipment are removed from the site. Operators typically have up to one year to allow the reserve pit fluids to dry and close the pit. Alabama, Kentucky, and Tennessee allow only 30 days for reserve pit closure while several states allow up to one year (Table 2 and Figure 16).

Table 2. States with specific time frames for reserve pit closure.

State	Pit Closure (in days)*	State	Pit Closure (in days)
Alabama	30	Pennsylvania	270
Kentucky	30	Kansas	365
Tennessee	30	Montana	365
New York	45	Nebraska	365
Mississippi	90	North Dakota	365
Ohio	150	Oregon	365
Arkansas	180	South Dakota	365
Illinois	180	Utah	365
Louisiana	180	Wyoming	365
Michigan	180	Texas	30 to 365
New Mexico	180	Colorado	90 to 180
West Virginia	180	Oklahoma	90 to 365

* Indiana and Virginia require immediate closure of reserve pits after well completion.

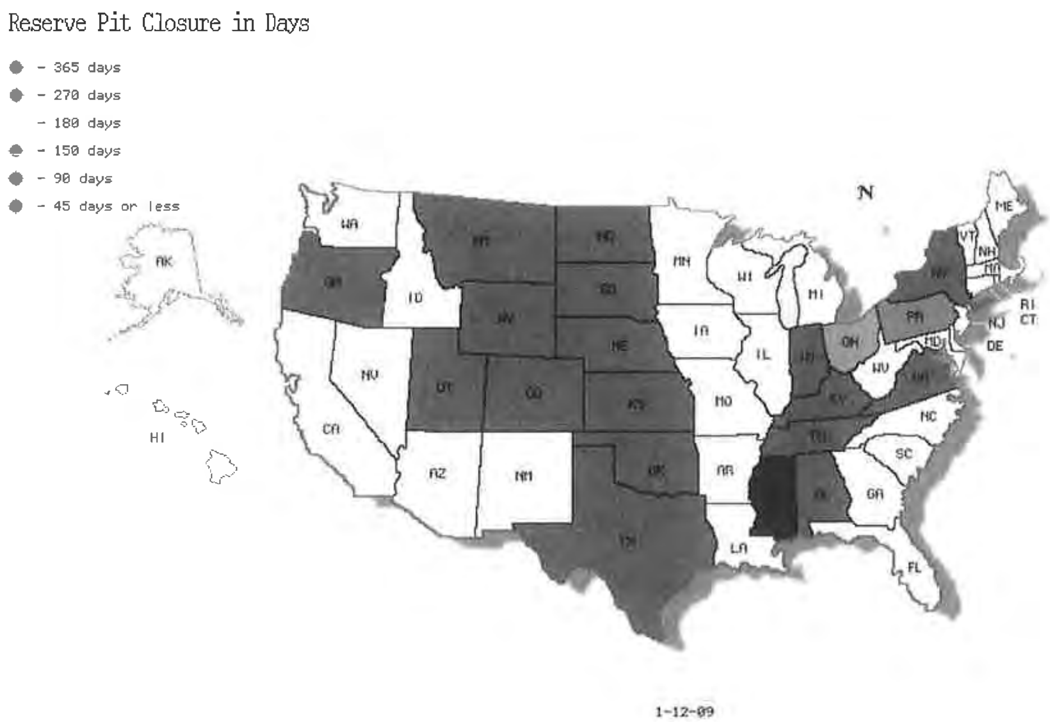

Figure 16. Maximum number of days allowed for the closure of reserve pits following well completion.

Oil operators in Alaska do not use open earthen pits for the disposal and or temporary storage of drilling fluids. The drill cuttings are injected underground. California does not specify a time limit for reserve pit closure; however, the performance bond is not released until the site is reclaimed (including reserve pit closure) (Rob Hauser, California Division of Oil, Gas and Geothermal Resources, pers. com., January 12, 2009). The performance bond release serves as an incentive to close the reserve pit and restore the site as soon as possible. The Maryland Department of the Environment does not specify a time limit for the closure of reserve pits; however, their policy recommends pit closure within 30 days of well completion (Mollie Edsall, Senior Geologist, Maryland Department of the Environment, pers. com., January 14, 2009).

Acknowledgements: *Thanks are extended to Roy Brown, Tim Eicher, Kevin Ellis, Richard Grosz, and Ron Armstrong of the U.S. Fish and Wildlife Service for providing data on bird mortality in reserve pits. Thanks are also extended to Pat O'Dell, Petroleum Engineer, U.S. National Park Service, Scott Covington, Scott Hicks, John Isanhart and Kevin Johnson, U.S. Fish and Wildlife Service for reviewing this manuscript.*

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Appendix A
State Rules and Regulations Pertaining To Reserve Pits

<u>**Alaska**</u>
20 AAC 25.047. Reserve pits and tankage
(a) Before a person commences drilling a well, a reserve pit must be constructed or tankage installed for the reception and confinement of drilling fluids and cuttings, to facilitate the safety of the drilling operation, and to prevent contamination of freshwater and damage to the surface environment. The confining surface of a reserve pit must be impervious. If practical, confinement diking in construction of a reserve pit must be avoided. If confinement dikes are necessary, they must be kept to a minimum. Dikes must be constructed and maintained to ensure their confinement integrity.

(b) Upon completion, suspension, or abandonment of the well, the operator shall proceed with diligence to leave the reserve pit in a condition that does not constitute a hazard to freshwater.

20 AAC 25.528. Open pit storage of oil
An operator may not, except during an emergency, store or retain crude oil in an open earthen confinement or in an open receptacle.

http://www.aogcc.alaska.gov/Regulations/RegIndex.shtml

<u>**Arkansas**</u>
RULE B-26 (j) (4) (E) - If the Director determines, based on a review of the information submitted by the operator and surface owner, the pit is not exempted, the pit shall be closed, within six (6) months.

RULE B-26 (c) (8) -All open top tanks shall be covered with bird netting, or other system designed to keep birds and flying mammals from landing in the tank.

http://www.aogc.state.ar.us/OnlineData/Forms/Rules%20and%20Regulations.pdf

<u>**Arizona**</u>
R12-7-108. **Pit for Drilling Mud and Drill Cuttings** - D. Any mud contained in an earthen pit shall be water-based and contain no more than one pound per barrel of thinner for each 25 pounds per barrel of barite or hematite. Mud containing chromium lignosulfonate, ferrochrome lignosulfonate or other chromium compounds shall not be used.

E. Drilling mud shall be disposed of by either recycling or commercial off-site disposal. Mud described in subsection (D) may be disposed of by evaporation and subsequent leveling of the pits.

http://www.azsos.gov/public_services/Title_12/12-07.pdf

California

1770. Oilfield Sumps. – (b) (3) - (3) Any sump, except an operations sump, which contains oil or a mixture of oil and water shall be covered with screening to restrain entry of wildlife in accordance with Section 1778(d).

1775. Oilfield Wastes and Refuse. – (b) Drilling mud shall not be permanently disposed of into open pits. Cement slurry or dry cement shall not be disposed of on the surface.

3781. The Legislature hereby finds and declares that it is essential in order to protect the wildlife resources of California that all hazardous exposed oil sumps in this state be either screened or eliminated.

3783. Whenever the supervisor receives notification from the Department of Fish and Game pursuant to subdivision (a) of Section 1016 of the Fish and Game Code that an oil sump is hazardous to wildlife, he shall forthwith given written notice of such hazardous condition to the owner, lessee, operator, or person responsible for the existence of the condition and set forth the hazardous conditions as specified by the Department of Fish and Game. The owner, lessee, operator, or person responsible shall, within 30 days from the date of such notification, or such longer period as may be mutually agreed upon by the supervisor, the Department of Fish and Game, and the owner, lessee, operator, or person responsible, clean up or abate the condition to the satisfaction of the supervisor and the Department of Fish and Game. If the owner, lessee, operator, or person responsible does not clean up or abate the condition to the satisfaction of the supervisor and the Department of Fish and Game within the required period of time, the supervisor shall forthwith order the closure of the oil and gas production operation maintaining the oil sump.

3782. The supervisor shall promulgate rules and regulations for the adequate screening of oil sumps to protect wildlife and shall order the closure of any oil and gas production operation maintaining an exposed or inadequately screened oil sump in violation of such rules and regulations.

http://www.conservation.ca.gov/dog/pubs_stats/Pages/law_regulations.aspx

Colorado

902. PITS - GENERAL AND SPECIAL RULES

c. Any accumulation of oil or condensate in a pit shall be removed within twenty-four (24) hours of discovery. Only de minimis amounts of hydrocarbons may be present unless the pit is specifically permitted for oil or condensate recovery or disposal use. A Form 15 pit permit may be revoked by the Director and the Director may require that the pit be closed if an operator repeatedly allows more than de minimis amounts of oil or condensate to accumulate in a pit. This requirement is not applicable to properly permitted and properly fenced, lined, and netted skim pits that are designed, constructed, and operated to prevent impacts to wildlife, including migratory birds.

d. Where necessary to protect public health, safety and welfare or to prevent significant adverse environmental impacts resulting from access to a pit by wildlife, migratory birds, domestic animals, or members of the general public, operators shall install appropriate netting or fencing.

1003. INTERIM RECLAMATION

d. Drilling pit closure. As part of interim reclamation, drilling pits shall be closed in the following manner:

(1) Drilling pit closure on crop land and within 100-year floodplain. On crop land or within the 100-year floodplain, water-based bentonitic drilling fluids, except de minimis amounts, shall be removed from the drilling pit and disposed of in accordance with the 900 Series rules. Operators shall ensure that soils meet the concentration levels of Table 910-1, above. Drilling pit reclamation, including the disposal of drilling fluids and cuttings, shall be performed in a manner so as to not result in the formation of an impermeable barrier. Any cuttings removed from the pit for drying shall be returned to the pit prior to backfilling, and no more than de minimis amounts may be incorporated into the surface materials. After the drilling pit is sufficiently dry, the pit shall be backfilled. The backfilling of the drilling pit shall be done to return the soils to their original relative positions. Closing and reclamation of drilling pits shall occur no later than three (3) months after drilling and completion activities conclude.

(2) Drilling pit closure on non-crop land. All drilling fluids shall be disposed of in accordance with the 900 Series rules. Operators shall ensure that soils meet the concentration levels of Table 910-1, above. After the drilling pit is sufficiently dry, the pit shall be backfilled. Materials removed from the pit for drying shall be returned to the pit prior to the backfilling. No more than de minimis amounts may be incorporated into the surface materials. The backfilling of the drilling pit will be done to return the soils to their original relative positions so that the muds and associated solids will be confined to the pit and not squeezed out and incorporated in the surface materials. Closure and reclamation of drilling pits shall occur no later than six (6) months after drilling and completion activities conclude, weather permitting.

http://cogcc.state.co.us/

Florida

62C 27.001 General. (4) Mud Tanks, Reserve Pits, and Dikes. Before spudding the well, mud tanks of sufficient size to hold the active mud volume at the surface shall be installed for containment of all active drilling fluids. Earthen mud pits shall not be used for this purpose.

http://www.dep.state.fl.us/geology/rules/oilandgasrules.htm

Illinois

Section 240.540 Drilling and Completion Pit Restoration

a) Sediment, drilling fluid circulation and reserve pits, except sediment pits used as completion pits, shall be filled and leveled within 6 months after drilling ceases. Drilling fluid wastes may be disposed of by on-site burial or surface application in accordance with subsection (b) of this Section at the site of drilling. Saltwater or Oil Drilling Fluid wastes shall be removed from the site and disposed of in an Illinois Environmental Protection Agency permitted special waste landfill, injected in a Class II well, disposed of in a well during the plugging process or buried in one of the lined pits and the liner folded over and additional liner material added to completely cover the drilling waste buried at least 5 feet below the ground surface.

Section 240.810 Tanks, Tank Batteries and Containment Dikes

(b) (4) All open top tanks shall be covered with bird netting, or other system designed to keep birds and flying mammals from landing in the tank.

Section 240.861 Existing Pit Exemption For Continued Production Use
(g) (4) All pits shall be covered with bird netting or other systems designed to keep birds and flying mammals from landing in the pit.

http://dnr.state.il.us/legal/adopted/62-240.pdf

Indiana
312 IAC 16-5-12 Mud pits, Authority: IC 14-37-3, Affected: IC 14-37
Sec. 12. (a) An owner or operator shall construct and maintain necessary mud circulation and reserve pits.
(b) Upon completion of a well, pits shall be filled and leveled. The surface shall be restored as nearly as practicable to conditions existing before drilling commenced. (Natural Resources Commission; 312 IAC 16-5-12; filed Feb 23, 1998, 11:30 a.m.: 21 IR 2342; readopted filed Nov 17, 2004, 11:00 a.m.: 28 IR 1315)

http://www.in.gov/legislative/ic/code/title14/ar37/index.html

Kansas
82-3-602. TIME LIMITATION; PENALTY; CLOSURE OF PITS; CLOSURE FORMS; DRILLING FLUID MANAGEMENT; WASTE TRANSFER; SURFACE RESTORATION.
(a) (1) The time limitation for the closure of each pit, unless otherwise specified in writing by the commission, shall be according to the following schedule:
(A) Drilling pits or haul-off pits shall be closed within a maximum of 365 calendar days after the spud date of a well.
(B) Work-over pits shall be closed within a maximum of 365 days after work-over operations have ceased.

http://www.kcc.state.ks.us/conservation/index.htm

Kentucky
401 KAR 5:090 Section 10 - Drilling Pits
Drilling pits shall be constructed to have the capability and the capacity to contain drilling fluids so that contamination of the waters of the Commonwealth do not occur. Spills or releases having the potential of degrading the environment or impacting human health and safety must be reported to the Environmental Response Team at (502) 564-2380 or 1-800-928-2380. For drilling and workover activities, the following need to be addressed:
• A pit must be constructed which will contain all the cuttings and fluids anticipated for the area and depth to be drilled. Adequate freeboard (distance of fluid level in pit to upper rim) should be maintained and checked regularly during drilling. If necessary, a secondary pit should be constructed in such a manner as to contain or prevent overflow.

• Containment structures should be placed to contain all spilled fuel, crude oil and drilling fluids.
• Consideration given to the type of material used in the construction of the pit to prevent groundwater contamination and leakage.

Within thirty (30) days following completion of drilling activities, the pits shall be closed. Waste shall be removed from the pit and disposed of in accordance with Kentucky laws and regulations. All visible contamination must be removed from the pit during closure. The appropriate waste disposal method is dependent upon the waste's components (make-up). The pit area shall be backfilled, graded and revegetated. The vegetative cover shall be capable of preventing soil erosion. Pits in place longer than thirty (30) days shall be considered as "Holding Pits" and shall meet their requirements (See Holding Pits). However, the Director of the Division of Water may, with good cause, extend the pit's life up to a maximum of ninety (90) days. A written request seeking that extension should be submitted before the day of completion

401 KAR Chapter 30, 401 KAR 31:030, 401 KAR 47:030 and 401 KAR 47:150 - Disposal of Completion Fluids
Completion fluids fall under the definition of solid non-hazardous waste. Temporary storage of these fluids is regulated as a solid waste permit-by-rule. Permit-by-rule sites do not need to submit any paperwork to the Division, but do need to comply with the environmental performance standards. Disposal of such waste is not covered by a permit-by-rule, and the applicable regulations depend on the disposal method to be employed. In order to dispose of the waste at the site by applying it to the land, a permit shall be obtained. The waste can be hauled off-site and disposed of in a permitted solid waste landfill, as long as it is allowed under the permit for that landfill.

http://www.lrc.ky.gov/kar/401/005/090.htm

Louisiana
§307. Pit Classification, Standards, and Operational
B. Reserve pits 4. Pits shall be emptied of fluids in a manner compatible with all applicable regulations, and closed in accordance with §311 and §313 within six months of completion of drilling or work over operations.

http://dnr.louisiana.gov/title43/43v19.pdf

Michigan
R 324.407 Drilling mud pits. Rule 407. The drilling mud pit shall be carefully encapsulated and buried as soon as practical after drilling completion, but not more than 6 months after drilling completion.

http://www.deq.state.mi.us/documents/deq-ogs-land-fuelsmineral-oilandgas-regs.pdf

Montana

36.22.1005 DRILLING WASTE DISPOSAL AND SURFACE RESTORATION
(1) The operator of a drilling well must contain and dispose of all solid waste and produced fluids that accumulate during drilling operations so as not to degrade surface water, groundwater, or cause harm to soils. Said waste and fluids must be disposed of in accordance with all applicable local, state and federal laws and regulations.

(2) When a salt-based or oil-based drilling fluid is used to drill a well located within a floodplain, as defined by ARM 36.15.101, or in irrigated cropland, drilling waste and produced fluids that accumulate during drilling operations must be disposed of off-site in a manner allowed by local, state, and federal laws and regulations unless an alternative on-site disposal method is approved in writing by the board administrator.

(3) The operator of a drilling well must construct, close, and restore any reserve pits in a manner that will prevent harm to the soil and will not degrade surface waters or groundwater. When a salt-based or oil-based drilling fluid is used, the reserve pit must be lined with a synthetic liner approved by the board administrator.

(4) **Within 10 days after the cessation of drilling or completion operations, all hydrocarbons must be removed from earthen pits used in association with drilling or completion operations or such pits must be fenced, screened, and netted**. Such pits that contain water with more than 15,000 parts per million total dissolved solids or salt-based drilling fluids must be fenced within 90 days after the cessation of drilling and completion operations.

(5) Earthen pits used in association with drilling and completion operations must not be used for the disposal of any additional fluids or materials after the cessation of drilling and completion operations.

(6) All earthen pits used in association with drilling and completion operations must be closed and the surface restored according to board specifications **within one year after the cessation of drilling operations**. Upon written application by the operator, an exception to the one-year pit closure requirement may be granted in writing by the board administrator upon a showing that:

(a) no dumping or disposal of waste or fluids in the pit will occur; and

(b) delayed closure of the pit will not present a risk of contamination to soils or water or a hazard to animals or persons.

http://data.opi.mt.gov/bills/mca_toc/82.htm

Nebraska

012.14 All pits shall be backfilled within one year after completion of drilling operations.

022.12A All pits or ponds used to retain produced water shall:

- Be constructed in cut material or at least fifty (50) percent below original ground level.
- Be lined with a material compatible with the waste contained.

- Not be located in a natural drainage and shall be constructed above the seasonal high water table.
- Be bermed or diked and shall have at least two (2) feet of freeboard between the normal operating level of the water in the pit and the top of the banks, dikes or berms.
- Be fenced, screened, or netted to prevent access by livestock, wildlife and migratory birds if free oil is likely to be discharged to the pits.

http://www.nogcc.ne.gov/NOGCCrulesstatutesindex.htm

Nevada

NAC 522.350 Open reservoirs. Oil or the waste from an oil field may not be stored or retained in unlined pits in the ground or open receptacles without the approval of the division. [Div. of Mineral Res., § 407, eff. 12-20-79]—(NAC A by Dep't of Minerals, 7-22-87)

NAC 522.255 Collecting pits. 1. No operator who conducts oil or gas development and production may use unlined collecting pits for storage and evaporation of brines from the oil field. The division may approve the use of impervious collecting pits in conjunction with approved operations for disposal of salt water. 2. The provisions of subsection 1 do not apply to burning pits which are used exclusively for the burning of the accumulated waste from the bottom of a tank. [Div. of Mineral Res., § 200 subsec. 3, eff. 12-20-79]—(NAC A by Dep't of Minerals, 7-22-87)

http://www.leg.state.nv.us/NAC/NAC-522.html

New Mexico

19.15.17.11 DESIGN AND CONSTRUCTION SPECIFICATIONS:

E. Netting. The operator shall ensure that a permanent pit or a permanent open top tank is screened, netted or otherwise rendered non-hazardous to wildlife, including migratory birds. Where netting or screening is not feasible, the operator shall on a monthly basis inspect for, and within 30 days of discovery, report discovery of dead migratory birds or other wildlife to the appropriate wildlife agency and to the appropriate division district office in order to facilitate assessment and implementation of measures to prevent incidents from reoccurring.

19.15.17.12 OPERATIONAL REQUIREMENTS

(4) The operator shall remove all free liquids from a temporary pit within 30 days from the date that the operator releases the drilling or workover rig.

19.15.2.50 PITS AND BELOW-GRADE TANKS

C. Design, construction, and operational standards.

(1) In general. Pits, sumps and below-grade tanks shall be designed, constructed and operated so as to contain liquids and solids to prevent contamination of fresh water and protect public health and the environment.

(2) Special requirements for pits.

(e) Disposal or storage pits. No measurable or visible layer of oil may be allowed to accumulate or remain anywhere on the surface of any pit. Spray evaporation systems

shall be operated such that all spray-borne suspended or dissolved solids remain within the perimeter of the pond's lined portion.
(f) Fencing and netting. All pits shall be fenced or enclosed to prevent access by livestock, and fences shall be maintained in good repair. Active drilling or workover pits may have a portion of the pit unfenced to facilitate operations. In issuing a permit, the division may impose additional fencing requirements for protection of wildlife in particular areas. All tanks exceeding 16 feet in diameter, exposed pits, and ponds shall be screened, netted, covered, or otherwise rendered non-hazardous to migratory birds. Drilling and workover pits are exempt from the netting requirement. Immediately after cessation of these operations such pits shall have any visible or measurable layer of oil removed from the surface. Upon written application, the division may grant an exception to screening, netting, or covering requirements upon a showing that an alternative method will adequately protect migratory birds or that the tank or pit is not hazardous to migratory birds.

F. Closure and restoration.
(1) Closure. Except as otherwise specified in Section 50 of 19.15.2 NMAC, a pit or below-grade tank shall be properly closed within six months after cessation of use. As

http://www.emnrd.state.nm.us/OCD/documents/RULEBOOK060328_002.pdf

__New York__
Part 554: Drilling Practices and Reports (Statutory authority: Environmental Conservation Law, §§ 23-0301, 23-0305[8])
§554.1 Prevention of pollution and migration
(c)(3) Storage of brine, salt water or other polluting fluids in such watertight tanks or earthen pits, prior to disposal, shall be for a maximum of 45 days after cessation of drilling operations, unless the department approves an extension based on circumstances beyond the operator's control.

§556.4 Safety
(a) Oil shall not be produced, stored or retained in earthen reservoirs.

http://www.dec.ny.gov/energy/1630.html

__North Dakota__
43-02-03-19. RESERVE PIT FOR DRILLING MUD AND DRILL CUTTINGS - RECLAMATION OF SURFACE. A reserve pit may be utilized to contain solids and fluids used and generated during well drilling and completion operations, providing the pit can be constructed, used and reclaimed in a manner that will prevent pollution of the land surface and freshwaters. In special circumstances, the director may prohibit construction of a reserve pit or may impose more stringent pit reclamation requirements. Under no circumstances shall reserve pits be used for disposal, dumping, or storage of fluids, wastes, and debris other than drill cuttings and fluids used or recovered while drilling and completing the well. Reserve pits shall not be located in, or hazardously near, bodies of water, nor shall they block natural drainages.

When required by the director, the reserve pit or site or appropriate parts thereof must be fenced.

1. Within a reasonable time, but not more than one year, after the completion of a well, the reserve pit shall be reclaimed. All pit water and oil on the pit must be removed prior to reclamation. Drilling waste should be encapsulated in the pit and covered with at least four feet [1.22 meters] of backfill and topsoil and surface sloped, when practicable, to promote surface drainage away from the reclaimed pit area.

43-02-03-19.1. FENCING, SCREENING, AND NETTING OF PITS. All open pits and ponds which contain saltwater must be fenced. All pits and ponds which contain oil must be fenced, screened, and netted. This is not to be construed as requiring the fencing, screening, or netting of a reserve pit or other earthen pit used solely for drilling, completing, recompleting, or plugging unless such pit is not reclaimed in excess of ninety days after completion of the operation.

History: Effective May 1, 1992.

https://www.dmr.nd.gov/oilgas/rules/rulebook.pdf

Ohio

[1509.07.2] 1509.072. Well owner's duty to restore disturbed land surface; waiver; extension.

No oil or gas well owner or agent of an oil or gas well owner shall fail to restore the land surface within the area disturbed in siting, drilling, completing, and producing the well as required in this section.

(A) Within five months after the date upon which the surface drilling of a well is commenced, the owner or the owner's agent, in accordance with the restoration plan filed under division (A)(10) of section 1509.06 of the Revised Code, shall fill all the pits for containing brine, other waste substances resulting, obtained, or produced in connection with exploration or drilling for, or production of, oil or gas, or oil that are not required by other state or federal law or regulation, and remove all concrete bases, drilling supplies, and drilling equipment.

http://www.dnr.state.oh.us/Portals/11/publications/pdf/oil%20and%20gas%20laws%20and%20rules.pdf

Oklahoma

165:10-7-16, Use of non-commercial pits

(B) The protection of migratory birds shall be the responsibility of the operator. Therefore, the Conservation Division recommends that to prevent the loss of birds, oil be removed or the surface area covered by the oil be protected from access to birds [See Advisory Notice 165: 10- 7-3(c)] .

(A) Any Category 1A, 1B, or 2 reserve/circulation pit, either on-site or off-site, shall be closed within twelve months after drilling operations cease.

(B) Any Category 3 (oil-based) reserve/circulation pit, either on-site or off-site, shall be closed within 6 months after drilling operations cease.

(C) Any Category 4 pit shall have closure procedures commenced within 30 days and completed within 90 days after drilling operations cease.

http://www.occ.state.ok.us/Divisions/GC/OCCRULES/permrules/Ch%2010%20Oil%20and%20Gas%20Conservation%20Rules%20eff%20July%2011%202008.pdf

Oregon

632-010-0140 - Reserve Pits or Sumps

Materials and fluids or any fluid necessary to the drilling, production, or other operations by the permittee shall be discharged or placed in pits and sumps approved by the department and the State Department of Environmental Quality. The operator shall provide pits, sumps, or tanks of adequate capacity and design to retain all materials. In no event shall the contents of a pit or sump be allowed to:

(1) Contaminate streams, artificial canals or waterways, groundwaters, lakes, or rivers.

(2) Adversely affect the environment, including but not limited to, persons, plants, fish, and wildlife and their populations.

(3) When no longer needed and within one year of completion, suspension of abandonment, fluid in pits and sumps shall be disposed of in a manner approved by the Department of Environmental Quality and the sumps filled and covered and the premises reclaimed. The restoration need not be done if arrangements are made with the surface owner to leave the site suitable for beneficial subsequent use. The permittee shall notify the department to inspect the site reclamation

Stat. Auth.: ORS 520
Stats. Implemented: ORS 520.095

http://arcweb.sos.state.or.us/rules/OARS_600/OAR_632/632_010.html

Pennsylvania

§ 78.56. Pits and tanks for temporary containment.

(a) Except as provided in § 78.60(b) and 78.61(b) (relating to discharge requirements; and disposal of drill cuttings), the operator shall contain pollutional substances and wastes from the drilling, altering, completing, recompleting, servicing and plugging the well, including brines, drill cuttings, drilling muds, oils, stimulation fluids, well treatment and servicing fluids, plugging and drilling fluids other than gases in a pit, tank or series of pits and tanks.

(d) Unless a permit under The Clean Streams Law (35 P. S. § § 691.1—691.1001) or approval under § 78.57 or § 78.58 (relating to control, storage and disposal of production fluids; and existing pits used for the control, storage and disposal of production fluids) has been obtained for the pit, the owner or operator shall remove or fill the pit within 9 months after completion of drilling, or in accordance with the extension granted by the Department under section 206(g) of the act (58 P. S. § 601.206(g)). Pits used during servicing, plugging and recompleting the well shall be removed or filled within 90 days of construction.

http://www.dep.state.pa.us/dep/deputate/minres/oilgas/laws&regulations.htm

South Dakota

74:10:03:13. Pit construction and reclamation. All pits used for storage of exploration and production wastes must be constructed, maintained, and reclaimed so as to prevent contamination of soil and all waters of the state. Under no circumstances may these pits be used for disposal, dumping, or storage of solid or hazardous wastes, and other debris not commonly used in these operations.

(2) Pit reclamation procedures:

(a) Within one year of site abandonment the pit must be reclaimed in a manner approved by the secretary that will prevent ground water or surface water contamination. If conditions that prevent reclamation within one year exist, a six-month extension may be granted by the secretary.

74:10:05:15.01. Pits to be constructed and operated to protect certain birds and other species. Any permanent or semipermanent pit used for the production of oil or gas must be constructed and operated to protect migratory birds and state and federal threatened, endangered, or protected species.

74:10:05:11. Oil storage in open receptacles prohibited -- Fire walls required on oil tanks. Oil may not be stored or retained in earthen reservoirs or in open receptacles.

http://legis.state.sd.us/rules/DisplayRule.aspx?Rule=74:10

Tennessee

1040-2-6-.04 ENVIRONMENTAL PROTECTION All oil and gas operations shall be conducted in a manner that will prevent or mitigate adverse environmental impacts such as soil erosion and water pollution. All areas disturbed by the operations, including access roads, shall be reclaimed as prescribed in rule 1040-2-9-.05.

1040-2-9-.05 SURFACE RECLAMATION.

(1) Abandonment of well sites, oil or gas pipeline right-of-way, storage facility sites, and access roads.

(a) Except for active work areas, the operator shall drain and fill all surface pits that are not needed for production purposes, and shall grade and stabilize the well location and location road within thirty (30) days of the initial disturbance, in order to minimize surface run-off and prevent excessive erosion and sedimentation. All drilling supplies and equipment, trash, discarded materials and other refuse not contained and covered in the reclaimed pits shall be removed from the site. Temporary vegetative cover shall then be established on all graded areas.

(b) Within thirty (30) days of the plugging and abandonment of any well, the operator shall remove all production and storage structure, supplies and equipment, any oil, salt water and debris, fill any remaining excavations, and grade any remaining disturbed areas, including access roads.

http://www.state.tn.us/sos/rules/1040/1040-02/1040-02.htm

<u>Texas</u>

RULE §3.22 Protection of Birds

(b) An operator must screen, net, cover, or otherwise render harmless to birds the following categories of open-top tanks and pits associated with the exploration, development, and production of oil and gas, including transportation of oil and gas by pipeline:

(1) open-top storage tanks that are eight feet or greater in diameter and contain a continuous or frequent surface film or accumulation of oil; however, temporary, portable storage tanks that are used to hold fluids during drilling operations, workovers, or well tests are exempt;

(2) skimming pits as defined in §3.8 of this title (relating to Water Protection) (Statewide Rule 8); and

(3) collecting pits as defined in §3.8 of this title (relating to Water Protection) that are used as skimming pits.

(c) If the commission finds a surface film or accumulation of oil in any other pit regulated under §3.8 of this title (relating to Water Protection), the commission will instruct the operator to remove the oil. If the operator fails to remove the oil from the pit in accordance with the commission's instructions or if the commission finds a surface film or accumulation of oil in the pit again within a 12-month period, the commission will require the operator to screen, net, cover, or otherwise render the pit harmless to birds.

RULE §3.8 Water Protection - (iii) The director may require that a person who uses or maintains a reserve pit, mud circulation pit, fresh makeup water pit, fresh mining water pit, completion/workover pit, basic sediment pit, flare pit, or water condensate pit backfill the pit sooner than the time prescribed by clause (i) of this subparagraph if the director determines that oil and gas wastes or oil field fluids are likely to escape from the pit or that the pit is being used for improper storage or disposal of oil and gas wastes or oil field fluids.

(iv) Prior to backfilling any reserve pit, mud circulation pit, completion/workover pit, basic sediment pit, flare pit, or water condensate pit whose use or maintenance is authorized by this paragraph, the person maintaining or using the pit shall, in a permitted manner or in a manner authorized by paragraph (3) of this subsection, dispose of all oil and gas wastes which are in the pit.

(G) Backfill requirements.

(i) A person who maintains or uses a reserve pit, mud circulation pit, fresh makeup water pit, fresh mining water pit, completion/workover pit, basic sediment pit, flare pit, or water condensate pit shall dewater, backfill, and compact the pit according to the following schedule.

(I) Reserve pits and mud circulation pits which contain fluids with a chloride concentration of 6,100 mg/liter or less and fresh makeup water pits shall be dewatered, backfilled, and compacted within one year of cessation of drilling operations.

(II) Reserve pits and mud circulation pits which contain fluids with a chloride concentration in excess of 6,100 mg/liter shall be dewatered within 30 days and backfilled and compacted within one year of cessation of drilling operations.

(III) All completion/workover pits used when completing a well shall be dewatered within 30 days and backfilled and compacted within 120 days of well completion. All completion/workover pits used when working over a well shall be dewatered within 30 days and backfilled and compacted within 120 days of completion of workover operations.

http://www.rrc.state.tx.us/rules/rule.php

Virginia
4 VAC 25-150-300. Pits.
A. General requirements.
1. Pits are to be temporary in nature and are to be reclaimed when the operations using the pit are complete.
2. Pits may not be used as erosion and sediment control structures or stormwater management structures, and surface drainage may not be directed into a pit.
3. Pits shall have a properly installed and maintained liner or liners made of 10mil or thicker high-density polyethylene or its equivalent.
C. 3. At the conclusion of drilling and completion operations or after a dry hole, well or corehole has been plugged, the pit shall be drained in a controlled manner and the fluids disposed of in accordance with 4 VAC 25-150-420. If the pit is to be used for disposal of solids, then the standards of 4 VAC 25-150-430 shall be met.

4 VAC 25-150-420. Disposal of pit and produced fluids.
A. Applicability. All fluids from a well, pipeline or corehole shall be handled in a properly constructed pit, tank or other type of container approved by the director.
A permittee shall not dispose of fluids from a well, pipeline or corehole until the director has approved the permittee's plan for permanent disposal of the fluids. Temporary storage of pit or produced fluids is allowed with the approval of the director. Other fluids shall be disposed of in accordance with the operations plan approved by the director.

B. Application and plan. The permittee shall submit an application for either on-site or off-site permanent disposal of fluids on a form prescribed by the director. Maps and a narrative describing the method to be used for permanent disposal of fluids must accompany the application if the permittee proposes to land apply any fluids on the permitted site. The application, maps, and narrative shall become part of the permittee's operations plan.

C. Removal of free fluids. Fluids shall be removed from the pit to the extent practical so as to leave no free fluids. In the event that there are no free fluids for removal, the permittee shall report this on the form provided by the director.

http://leg1.state.va.us/000/reg/TOC04025.HTM#C0150

Utah
R649-1-1. Definitions. "Disposal Pit" means a lined or unlined pit approved for the disposal and/or storage of E and P Wastes.

R649-3-15. Pollution and Surface Damage Control.
1. The operator shall take all reasonable precautions to avoid polluting lands, streams, reservoirs, natural drainage ways, and underground water.
1.2. At a minimum, the owner or operator shall:
1.2.1. Take reasonable steps to prevent and shall remove accumulations of oil or other materials deemed to be fire hazards from the vicinity of well locations, lease tanks and pits.
1.2.4.1. The use of crude or produced water storage tanks without tops is strictly prohibited except during well testing operations.
1.2.5. Catch leaks and drips, contain spills, and cleanup promptly.
1.2.6. Waste reduction and recycling should be practiced in order to help reduce disposal volumes.
1.2.7. Produced water, tank bottoms and other miscellaneous waste should be disposed of in a manner that is in compliance with these rules and other state, federal, or local regulations or ordinances.

R649-3-16. Reserve Pits and Other On-site Pits.
1. Small onsite oil field pits including, but not limited to, reserve pits, emergency pits, workover and completion pits, storage pits, pipeline drip pits, and sumps shall be located and constructed in such a manner as to contain fluids and not cause pollution of waters and soils. They shall be located and constructed according to the Division guidelines for onsite pits.

3. Following drilling and completion of the well the reserve pit shall be closed within one year, unless permission is granted by the Division for a longer period.

R649-9-3. Permitting of Disposal Pits.
2.3.6. The pit shall be fenced and maintained to prevent access by livestock, wildlife and unauthorized personnel and if required, equipped with flagging or netting to deter entry by birds and waterfowl.

http://oilgas.ogm.utah.gov/Rules/Rules.htm

West Virginia
'35-4-16. Reclamation.
16.4.h. All drilling pits and alternative overflow prevention facilities shall be constructed, maintained, and reclaimed so as not to be left in such condition as to constitute a hazard or to prevent use of the surface for agricultural purposes after the expiration of the six (6) month or extended period for reclamation prescribed by W. Va. Code '22-6-30.

http://www.wvsos.com/csr/verify.asp?TitleSeries=35-04

Wyoming

Chapter 4, Section 1. Pollution and Surface Damage

(bb) Reserve pits shall be completely fenced and, if oil or other harmful substances are present, netted or otherwise secured at the time the rig substructure has been moved from the location in a manner that avoids the loss of wildlife, domestic animals, or migratory birds. Because of the same concerns, produced water pits must be fenced and, if oil or other harmful substances are present, netted or secured in such a manner as to provide protection to wildlife, domestic animals, or migratory birds. The Commission recommends netting as the preferred means of securing pits.

(dd) All retaining pits shall be kept reasonably free of surface accumulations of oil and other liquid hydrocarbon substances and shall be cleaned within ten (10) days after discovery of the accumulation by the owner or notice from the Supervisor.

(ll) The Commission specifically prohibits the use of dispersants, wetting agents, surface reduction agents, surfactants, or other chemicals that destroy, remove, or reduce the fluid seal of a reserve pit and allow the fluids contained therein to seep, drain, or percolate into the soil underlying the pit.

(qq) **Reclamation**. Reclamation of unused production pits or any other temporary retaining pits, including reserve pits, shall be completed in as timely a manner as climatic conditions allow. Production pit areas and reserve pits will be reclaimed no later than one (1) year after the date of last use unless the Supervisor grants an administrative variance for just cause.

http://soswy.state.wy.us/RULES/rules/6855.pdf

Pacific Southwest Research Station

Research Topics Ecosystem Processes

^ Main Topic | Tropical Ecosystems | Sierra Nevada Ecosystems

Sierra Nevada Ecosystems

PSW > Research Topics > Ecosystem Processes > Sierra Nevada > Biodiversity > Conservation/Restoration : **x**

About this Research:
Sierra Nevada Ecosystem Processes

Participating Programs

- Conservation of Biodiversity
- Ecosystem Function and Health

Partnership

- Kings River Project
- Research Natural Areas Program, Pacific Southwest Region and Research Station
- Teakettle Ecosystem Experiment
- San Joaquin Experimental Range

Research Emphases

- Forest Function and Health
- Conservation of Biological Diversity
- Climate and Landscape Change
- Institutional and Policy Processes

Related Topics

- Kings River Experimental Watershed

Title

Northern Goshawk: Habitat Conservation Assessment for California

Study Plan
Research Project Summary

The Research

Northern goshawks are of increasing conservation attention because of concern regarding population trends and the effects of management on habitat. As a top-trophic level carnivore with large spatial requirements, low breeding density, and associations with late-seral forest structures for some aspects of their life history, goshawks exhibit ecological characteristics of species that may be particularly sensitive to forest management practices that reduce or fragment habitat. The species has been petitioned three times in the last ten years for listing under the Endangered Species Act throughout all or portions of it's range in western North America. Currently no information exists on population trends for any bioregion and knowledge of habitat requirements is limited. We are conducting a Habitat Conservation Assessment to compile and synthesize information on the distribution and ecology of northern goshawks (Accipiter gentilis) in California in order to evaluate their current status, generate management recommendations, and identify research and monitoring priorities.

Objectives

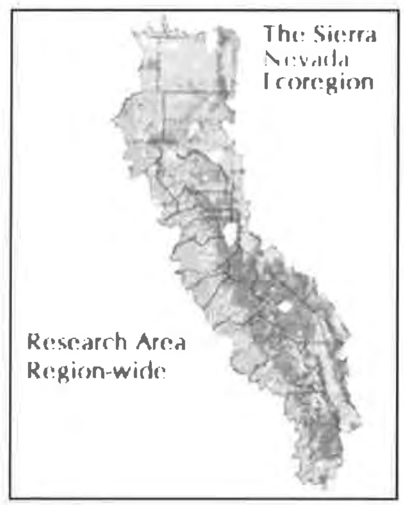
- To synthesize and evaluate historic and current distributional records of northern goshawks in California to delineate current breeding range and determine if there have been changes in the geographic range of the species over the past century.
- To compile and evaluate knowledge on northern goshawk ecology (e.g., habitat relationships, prey relations, demography) by major forest type in California
- To provide management recommendations and identify priority monitoring and research needs.

Methods and Design

Application of Research Results

Location

Sierra Nevada Bioregion plus remainder of California exclusive of the Mohave Desert.



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Publications and Reports

psw > topics > ecosystem_processes > sierra > bio_diversity > biodiversity_sub6 > northern_goshawk psw > topics > ecosystem_processes > sierra > bio_diversity > biodiversity_sub6 > northern_goshawk

None to date.

Comment Letter I9

THE NORTHERN GOSHAWK: ECOLOGY AND MANAGEMENT

WILLIAM M. BLOCK, MICHAEL L. MORRISON, AND
M. HILDEGARD REISER, EDITORS

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TERRITORY OCCUPANCY AND HABITAT PATCH SIZE OF NORTHERN GOSHAWKS IN THE SOUTHERN CASCADES OF CALIFORNIA

BRIAN WOODBRIDGE AND PHILLIP J. DETRICH

Abstract. We monitored annual occupancy of forest patches by nesting Northern Goshawks (Accipiter gentilis) in the southern Cascades Mountains in northern **California.** Goshawks typically used 3–9 alternate nests distributed among 1–5 different forest stands ranging from **4.1** to 115 hectares in size, and showed low fidelity to individual nest trees or stands. Mean distance between alternate nests was 273 ± 68.6 m. Alternate nests and nest stands were grouped into nest stand clusters, which for monitoring purposes were the equivalent of territories. Nest stand clusters ranged from 10 to 114 hectares in size, and were occupied 74%(±5.5) of years monitored. Occupancy of nest stand clusters by nesting goshawks was positively correlated with cluster area, with occupancy of clusters <20 ha typically <50%. Reproductive success was not correlated with habitat area. Two patterns of temtory occupancy were distinguishable; traditional territories (23) where nesting by goshawks was predictable within finite nest clusters and ephemeral **territories** (5) where alternate nests were widely scattered and sporadically used. Despite extensive timber harvesting and forest fragmentation within our study area, goshawks occurred at relatively high densities (0.57–1.07 temtories per 1000 ha). However, most goshawk temtories were associated with the larger remaining patches of mature forest, and occupancy of these patches was positively associated with patch area.

Key Words: Accipiter gentilis, forest fragmentation; nesting habitat; Northern Goshawk; territory occupancy.

Habitat suitability for an animal is a function of the structural characteristics and spatial arrangement of habitat patches, as well as the presence of predators, competitors and adequate food resources (Cody 1981). Fragmentation of habitat can influence habitat suitability even if the structure of the remaining habitat patches remains unchanged (Temple and Wilcox 1986). Assessing the effects of habitat fragmentation on large, mobile species such as birds of prey is further complicated by these species' use of multiple patches in a landscape, often using different types of patches to fulfill different life requisites (e.g., nesting versus foraging or cover) (Hams and **Kangas** 1988).

The structural attributes of forest stands used for nesting by Northern Goshawks (Accipiter gentilis) have been described in a variety of forest ecosystems in North America, including eastern deciduous (Speiser and **Bosakowski** 1987) and western coniferous (Reynolds et al. 1982, Hall 1984, Crocker-Bedford and Chaney 1988, **Hay**ward and Escano 1989) forests, and Great Basin shrubsteppe communities (White and Lloyd 1965, **Younk** and **Bechard,** this volume). Although conducted in different communities, these studies and others (summarized in Reynolds 1989, Reynolds et al. 1992) found that a number of structural features were common to goshawk nest stands in most areas. Nest stands are typically composed of large, densely spaced trees, with higher canopy closure and more open **un**derstories than the surrounding landscape. The majority of these studies, however, did not consider spatial relationships such as size and distribution of habitat patches, and none used long-term patterns of occupancy of habitat patches by nesting goshawks to assess habitat quality.

Estimates of stand size given by Reynolds (1983) were based on measurement of areas of intensified activity adjacent to nests (nest areas) and did not necessarily reflect the actual size of the forest stands used for nesting. **Crocker-Bedford** (1990) described the spacing and occupancy of alternate nests within goshawk territories (nest clusters) and reported a relationship between the size of unharvested buffers surrounding nest sites and subsequent occupancy by nesting goshawks. Kennedy (1991) used the movements of **radio**-marked goshawk family groups to define the **post**-fledging family area (PFA), an area of concentrated use by the family group after the young left the nest. It is not clear, however, how **PFAs** were differentiated from nest stands or clusters of nest stands. Estimating the relationship between patch size of nesting habitat and overall temtory quality is further complicated when the effects of foraging habitat quality are considered (Crocker-Bedford 1990, Reynolds et al. 1992).

In this study we describe spatial patterns of habitat use by nesting Northern Goshawks at four levels of resolution: nest trees, nest stands, temtories (clusters of nest stands), and spacing between territories. At each level we compare spatial attributes to rates of occupancy by nesting goshawks.

STUDY AREA AND METHODS

This study took place in the southern Cascades Mountains of northern California, on the Goosenest Ranger District of the Klamath National Forest. The area was composed of three major forest types. Sierran Montane Forest and Upper Montane Forest (Kiichler 1977) occurred at higher elevations and were dominated by red fir (Abies *magnifica*), white fir (Abies *concolor*), ponderosa pine (*Pinus* ponderosa), lodgepole pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii*), and incense cedar (*Calocedrus* decurrens). Lower elevation forests were comprised primarily of Northern Yellow Pine Forest (Kiichler 1977), dominated by ponderosa pine and white fir. Most of the study area was between 1400 m and 2330 m elevation and was relatively dry, with most precipitation falling as snow in winter. The area had a long history of timber harvest, with intensive harvesting occurring as early as 1900 (Laudenslayer and Darr 1990). The resulting forest landscape occurred as scattered patches of unmanaged mature forest dispersed in a matrix of thinned or regenerated stands. Suppression of natural fire within this ecosystem resulted in increased density of fire-susceptible conifer species such as white fir in areas formerly dominated by fire resistant species (ponderosa pine, incense cedar; Biswell 1989, Laudenslayer et al. 1989).

We surveyed for nesting northern goshawks each spring and summer from 1984 to 1992. Our initial sample of territories was derived from Forest Service records and survey transects conducted in areas of potential goshawk habitat. In 1988 we began using broadcast of taped conspecific alarm calls along established transects (Fuller and Moser 1981, Rosenfield et al. 1985, Kennedy and Stahlecker 1993) within two 12,000 hectare survey blocks. We returned annually to all known territories to determine occupancy and reproductive success. We intensively surveyed an area of 1.6 km radius surrounding each previously active nest to locate alternate nest sites. Terminology proposed by Postupalsky (1974) and Steenhof and Kochert (1982) was used to define occupancy and nesting success of goshawk territories. We defined nest productivity as the number of large (minimum 5 week old) nestlings. Each year that a given territory was monitored was termed a territory-year. Alternate nests within temtories were typically clumped and could be distinguished from adjacent territories. However, in cases where alternate nests were widely spaced we used simultaneous occupancy of both adjacent territories to distinguish between them. We measured distances between the geometric centers of nest clusters at adjacent territories to estimate nearest-neighbor distances. Locations of occupied nests, alternate nests, and habitat boundaries were mapped each year on aerial photographs (scale 1:13,000).

We defined nest stands as patches of forest that were homogeneous in composition, age, and structure relative to the surrounding forest (Spurr and Barnes 1980) and were used for nesting. Boundaries of most stands were the result of forest management activities and natural features such as meadows and lava flows, and were clearly distinguishable on aerial photographs. Areas of nest stands were ı
photographs with a Nun
classified a stand as occı

or reused an existing nest within it. We calculated occupancy rates for individual stands by dividing the number of years the stand was occupied by the total number of years the stand was monitored.

Nest stand clusters were defined as the aggregate area of all stands within a territory that were used for nesting, and for monitoring purposes were the equivalent of temtories. Nest stand clusters were considered occupied if goshawks attempted to nest, exhibited defensive behavior, or were sighted repeatedly within them. The occupancy rate of each cluster was calculated by dividing the number of years the cluster was monitored by the total number of years the cluster was monitored.

Comparisons of stand and nest cluster size with occupancy rates were made using the Spearman Rank Correlation (Zar 1984). Only stands ($N = 71$) or clusters ($N = 23$) with >5 years of monitoring were used in statistical comparisons. We found that five years of monitoring was sufficient to delineate the area of most nest stand clusters. Mean values in the text are presented with standard errors ($\pm$SE).

RESULTS

MONITORING

We monitored 141 territory-years at 28 goshawk territories within the study area. Occupancy by at least one adult goshawk was confirmed in 100 (71%) of monitored territory-years, and breeding attempts were observed in 89 (63%). Rates of occupancy and breeding were likely underestimated due to the secretive behavior (Kennedy and Stahlecker 1993) and annual movements of nesting goshawks observed in this study. The sample of monitored territories increased each year of the study, from 18 in 1984 to 28 in 1992. Six territories were monitored for over 10 years, 17 were monitored 5–9, and five were monitored ≤ 4 years.

Productivity for 84 nesting attempts averaged 1.93 young per attempt (range = 0–4). Eighty-seven percent of observed nesting attempts were successful. Primary causes of nest failure included failed incubation (cause unknown = 7), severe spring storms (2), and predation by Great Homed Owls (2; *Bubo virginianus*). Brood size was reduced in nine successful nest attempts when nestlings fell from the nest or were killed by siblings. Nest success and productivity were probably overestimated because nesting attempts failing prior to the nestling stage and mortalities occurring after fledging were less likely to be detected.

OCCUPANCY OF NEST TREES

Territories typically contained more than one nest, most having from 3 to 9. Many of these inactive alternate nests were not observed to be used by goshawks during the study. The mean number of nests actually used during the study

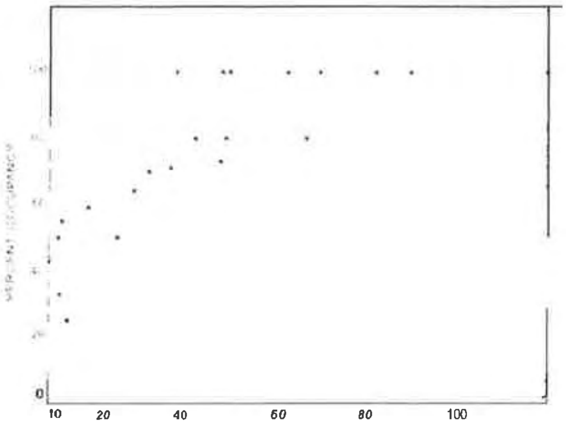

FIGURE 1. Correlation of percent occupancy of goshawk nest stand clusters versus cluster size for 26 territories in the southern Cascades of California, 1984–1992.

used the previous year. The average reoccupancy rate of individual nests at 26 territories over at least 5 years was 49% (±11%). Reoccupancy of alternate nests was highly variable; at some territories goshawks did not re-use the same nest twice in 4–7 years, whereas others used a single nest for 2–6 years and then moved to or built another.

DISTRIBUTION OF ALTERNATE NESTS

Spacing and distribution of alternate nests varied widely among territories. Nests in most territories were clumped in two or three adjacent stands, whereas others contained nests scattered in stands up to 2.1 km apart. The mean distance between alternate nests in 65 nest attempts in this study was 273 (±68.6) m, (range = 30–2066 m). This estimate of nest spacing was conservative in that it included only movements actually observed between years. Longer movements were more difficult to detect and were likely underrepresented.

USE OF NEST STANDS

Goshawk territories typically contained 1–5 different forest stands used for nesting ($\bar{X}$ = 2.4 ± 0.7). Stands used for nesting ranged from 4.1 to 115 hectares in size (X = 27.8 ± 5.3 ha, N = 71 stands).

At territories with at least five successive years of monitoring, individual nest stands were occupied by nesting goshawks an average of 46% (±6%) of the years monitored (N = 71). The maximum distance recorded between nest stands was 1.8 km. However, over 85% of alternate nest stands were less than 0.7 km apart (X = 0.52 ± 0.11 km, N = 71 stands). Occupancy rates of individual nest stands were positively correlated with stand size (r_s = 0.85, P = 0.001). Smaller stands (<10 ha) typically contained 1–2 nests and were only occasionally occupied by goshawks, whereas larger stands (>20 ha) often contained several nests and were occupied in a high proportion of territory-years.

NEST STAND CLUSTERS

Nest stand clusters ranged from 10.5 to 114 ha in size ($\bar{X}$ = 41.7 ± 5.89, N = 26 territories). The mean occupancy rate of nest stand clusters was 0.74 (±0.055, N = 26). Occupancy rates of 23 nest stand clusters with at least five years of monitoring was positively correlated with cluster size (r_s = 0.88, P = 0.008). Occupancy rates of clusters of <20 hectares were typically <50%. At approximately 40 ha occupancy rose to 75–80%, and was nearly 100% for stand clusters >61 ha (Fig. 1). We found no significant relationship between stand cluster size and productivity (r_s = 0.052, P = 0.819). The mean number of young produced per occupied territory (minimum five year average) was relatively uniform among territories.

TERRITORY SPACING AND DENSITY

Nearest-neighbor distances for 21 goshawk territories within intensive survey blocks ranged from 1.3 to 6.1 km, averaging 3.25 ± 0.34 km. Spacing appeared to be reduced around landscape features such as meadows and riparian systems, where goshawk territories were clumped. Eleven territories were located within a 10,230 ha block of Sierran Montane Forest yielding a density of 1.07 territories per 1000 ha, compared with 0.575 territories per 1000 ha in a 10,440 ha block of Upper Montane Forest.

DISCUSSION

Territory use by goshawks in this study was characterized by alternate use of nest sites up to 2.1 km apart. and low fidelity to any particular nest site. Over time the number of nest sites recorded in most territories increased, as did the area of habitat containing them. From 4 to 6 years of monitoring were required to define the actual area used for nesting within most territories. The resulting area of nesting habitat (nest stand cluster) was considerably larger than area estimates derived from a single year (Crocker-Bedford 1990), or measurement of activity centers surrounding individual nests (Reynolds 1983).

Comparison of nest habitat area in this study with results of other studies is complicated by differences in terminology and basic study design. Measurements of nest stands and stand clusters in this study were made using physical boundaries of nest stands. It is likely that only a small portion of each stand is actually used for nesting in a given year. Reynolds et al. (1992) proposed a hierarchy of spatial components comprising goshawk home ranges: nest area, post fledging family area, and foraging area. Each of these components was based on measurement of goshawk activity and cannot be estimated without radio-telemetry. Estimates of nest habitat area based on observations of nest-tending activities (Reynolds 1983) overlook the possibility that selection of nest sites by goshawks is based at least partially on patch size. Our observations of reduced occupancy in smaller stands suggest that patch size may be an important factor determining quality of nesting habitat.

The post fledging family areas (PFA) described by Kennedy (1991) may be somewhat analogous to nest stand clusters in that the PFA is a larger area encompassing at least one nest site. It is not clear whether the **PFAs** studied by Kennedy (1991) contained all known nest sites within each territory, or if goshawk pairs moved outside of PFA boundaries in subsequent years. This relationship could be assessed by comparison of PFA boundaries with the distribution of alternate nest sites and the boundaries of nest stands, particularly over a number of years.

Alternate nest sites within most territories appeared as clusters, spatially distinct from nest clusters at neighboring territories. At five territories (18%), however, alternate nests were very widely spaced and territory boundaries were less distinct. Maximum distances between alternate nests at these territories were similar to minimum distances between simultaneously occupied neighboring territories.

Mean occupancy rates of habitat components increased as spatial scale increased from nest trees to nest stands and nest stand clusters. Annual movements of nesting goshawks may have reduced our ability to detect some nest attempts in remote nest sites, resulting in underestimation of occupancy at larger scales (nest stand clusters). Patterns of occupancy at goshawk **territories** fell into two categories: traditional territories **(23)**, where nesting by goshawks was predictable and typically occurred within finite nest clusters; and ephemeral territories **(5)**, where nesting was sporadic and nest sites were widely distributed. Ephemeral territories were occupied in less than three of five years and appeared to be associated with highly fragmented areas of lodgepole pine and mixed pine stands where extensive tree mortality due to bark beetles (Dendroctonusspp.) had to nest in areas where little mature forest habitat was available.

Although occupancy of nest stand clusters was clearly correlated with cluster size, other factors may have affected occupancy of specific clusters by nesting goshawks. Reduction and fragmentation of mature forest habitat may favor early successional competitors and predators such as Red-tailed Hawks (Buteojamaicensis) and Great Homed Owls (Moore and **Henny** 1983, Johnson 1993) and reduce **occupancy** by goshawks **(Crocker-Bedford** 1990). Occupancy of traditional goshawk nests or nest stands by Great Homed Owls, Long-eared Owls (Asio otus), Northern Spotted Owls ***(Strix*** occidentalis ***caur***ina), Red-tailed Hawks and Cooper's Hawks ***(Ac***cipiter cooperi) was recorded in this study, but was not associated with territory abandonment by goshawks. In three instances, however, goshawks moved outside of their traditional nest cluster after it was occupied by Northern Spotted Owls.

Despite intensive timber harvest and fragmentation of mature forest, our study area supported high densities of nesting goshawks. Goshawk territories, however, were associated with the larger remaining patches of mature forest, and territory occupancy was positively correlated with the size of nesting habitat patches.

Several factors may act to mitigate the effects of timber harvest and forest fragmentation on goshawk habitat quality in our study area. Timber harvests **occurring** after the early 1960s typically consisted of commercial thinning, **shelter**wood, and sanitation prescriptions, resulting in less distinction between harvested areas and remaining mature forest than in large **clearcut** regimes. Golden-mantled Ground Squirrels ***(Spermophilus*** lateralis), a primary prey species for goshawks in the southern Cascades **(Wood**bridge, unpubl. data), are abundant in open habitats **(Ingles** 1965) and were frequently observed in previously harvested areas. This prey resource could act to offset losses of prey species associated with mature forest. Finally, effects of forest fragmentation on goshawk populations may be less important in forest ecosystems such as the southern Cascades that are naturally fragmented by topography, xeric conditions, and wildfire. Comparison of our results with data collected in different forest ecosystems may provide insights into the relative importance of nesting habitat area.

ACKNOWLEDGMENTS

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Studies in Avian Biology No. 16:88–91, 1994.

DENSITY AND PRODUCTIVITY OF NORTHERN GOSHAWKS: IMPLICATIONS FOR MOMTORING AND MANAGEMENT

STEPHEN DESTEFANO, SONYA K. DAW, STEVEN M. DESIMONE, AND E. CHARLES MESLOW

Abstract. We studied Northern Goshawk (Accipitergentilis) breeding populationson five study areas on the Fremont, Malheur, and Wallowa-Whitman National Forests in eastern Oregon during 1992 and 1993. We found 50 active territories, with average densities of 0.07 active temtories per 100 ha (SE = 0.15, N = 3 study sites) in 1992 and 0.06 (SE = 0.15, N = 5 sites) in 1993. However, densities were variable both between years and among areas within each year, and no consistent patterns were seen based on forest cover type. Productivity (number of young fledged per nest) was also variable between years and among study sites within the same year. Current USDA Forest Service management for goshawks emphasizes reducing tree harvest around specific nest sites or post-fledging family areas (PFAs). Our data, however, show that numbers of nesting goshawks are variable among years, and not all breeding sites will be discovered in a single year of survey. We recommend multiple-year surveys for nesting birds and habitat management on a landscape rather than "per nest" basis.

Key Words: Accipiter gentilis, breeding; nesting; Northern Goshawk; Oregon.

Timber harvesting has been implicated as a factor in reducing the number and altering the distribution of nest sites of Northern Goshawks (Accipiter gentilis) throughout much of the forested western United States (Reynolds et al. 1982, Crocker-Bedford 1990, Ward et al. 1992). In Oregon, this concern has led the Oregon Department of Fish and Wildlife to place the Northern Goshawk on the state's list of sensitive species.

In the Pacific Northwest, scientific research and public attention has focused on forest ecosystems and wildlife populations on the west side of the Cascade Mountain Range, largely due to concern for the status of Northern Spotted Owls (*Strix* occidentalis caurina). Interest is growing, however, in east-side forest issues, such as timber harvest, forest health, and wildlife habitat. The Northern Goshawk has been identified as a species of special concern and is being considered as a potential indicator of the health of mature ponderosa pine (Pinusponderosa) and mixed conifer forests in eastern Oregon (Marshall 1992).

We studied goshawk populations in eastern Oregon to determine the distribution, density, and productivity of nests in major forest types, describe diet, and make recommendations for goshawk management and monitoring of breeding populations.

METHODS

STUDY SITES

Research took place on three National Forests in eastern Oregon: the Fremont, Malheur, and Wallowa-Whitman. These Forests were located across eastern Oregon and represented a wide spectrum of forest types. Mixed conifer forest (including combinations of ponderosa pine, Douglas-fir[Pseudotsuga *menziesii*], westem larch [Larix occidentalis], incense-cedar [Calocedrus decurrens], sugar pine [*Pinus* lambertiana], and firs [Abies spp.]) and forest stands with a large component of ponderosa pine were found on all three Forests. In addition, large expanses of lodgepole pine (Pinus *contorta*) were present on the Fremont National Forest. Topography on all Forests ranged from gently sloping ridges to steep-walled drainages, with elevations between 900–2000 m. Natural openings, such as wet meadows, grasslands, and bums, were distributed throughout the study sites. Partial cuts (shelterwood, overstory removal, commercial thinning) and some clear-cutting were the major tree harvesting practices.

Five survey areas (called Density Study Areas [DSA]) were established on the three National Forests and ranged from 11,500 to 15,500 ha. Two DSAs were located on the Fremont National Forest: the Paisley DSA contained mostly lodgepole pine (80%), with some ponderosa pine (15%) and mixed conifers (5%); the Bly DSA was primarily mixed conifer (70%) and ponderosa pine (30%). Two DSAs were located on the Malheur National Forest: Bear Valley East DSA was dominated by ponderosa pine, with about 25% of the area covered by islands of lodgepole pine and mixed conifers; Bear Valley West DSA was mostly mixed conifer, with about 25% of the area in ponderosa pine. The Spring Creek DSA on the Wallowa-Whitman National Forest was comprised of mixed conifer stands.

SURVEYS

We used survey protocol recommended by Woodbridge (pers. comm.) and Kennedy and Stahlecker (1993) to search for all nesting goshawks within the five DSAs. Survey stations were about 300 m apart and were set up on roads and trails and along transects through roadless areas to obtain complete coverage of each DSA. From mid-May to early August, taped goshawk calls were broadcast through a megaphone (modified Realistic" model 32-2030 coupled to a Sony® walkman model WMA53). Responses to the taped calls and incidental sightings of goshawks were followed by intensive searches to locate nests. Nest locations were marked on topographic maps and aerial photographs.

Sage-Grouse Conservation Objectives Draft Report

Submitted August 1, 2012

Sage-Grouse Conservation Objectives Team

Table of Contents

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Sage-Grouse Conservation Objectives Team Report

1. Background and Purpose

On March 23, 2010, the U. S. Fish and Wildlife Service (FWS) determined that the Greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) and the Bi-state (California/Nevada) Distinct Population Segment (DPS) of the sage-grouse warranted the protections of the Endangered Species Act of 1973, as amended, 1531 *et seq*. (ESA). However, the FWS also found that listing was precluded due to other higher priority actions, thereby making the sage-grouse and the Bi-state DPS candidates under the ESA. Subsequently, the Service entered into a court-approved settlement agreement with environmental groups which set a schedule for making listing determinations on over 200 candidate species nationwide, including the sage-grouse and its DPSs. The schedule indicated that a decision (proposed listing rule or withdrawal) on the Bi-state DPS was due by FY2013 (September 2013) and a decision on the sage-grouse range-wide was due by FY2015 (September 2015).

In December 2011, Wyoming Governor Matt Mead and Secretary of the Interior Ken Salazar co-hosted a meeting to address coordinated conservation of the Greater sage-grouse (sage-grouse) across its range. Ten states within the range of the sage-grouse were represented, as were the U.S. Forest Service (FS), the Natural Resources Conservation Service (NRCS), and the Department of the Interior (DOI) and its Bureau of Land Management (BLM) and U.S. Fish and Wildlife Service (FWS). The primary outcome of the meeting was the creation of a Sage-Grouse Task Force (Task Force) chaired by Governors Mead (WY) and Hickenlooper (CO) and the Director of the BLM. The Task Force was directed to develop recommendations on how to best move forward with a coordinated, multi-state, range-wide effort to conserve the sage-grouse, including the identification of conservation objectives to ensure the long-term persistence of the species.

The FWS was tasked by its Director with the development of conservation objectives for the sage-grouse. Recognizing that state wildlife agencies have management expertise and retain management authority for this species, the FWS created a Conservation Objectives Team (COT) of state and FWS representatives to accomplish this task (Appendix A). Each member was selected by his or her state or agency. The purpose of the COT was to develop conservation objectives by defining the degree to which the threats need to be ameliorated to conserve the sage-grouse so that it is no longer in danger of extinction or likely to become in danger of extinction, by 2013 for the Bi-state Distinct Population Segment (DPS), and 2015 for the Greater sage-grouse range-wide. This report is the outcome of the COT's efforts.

Application of this report

Sage-grouse are a landscape-scale species (Patterson 1952; Knick *et al.* 2003; Connelly *et al.* 2004; Connelly *et al.* 2011a; Wisdom *et al,* 2011) requiring conservation actions that span ecological province and political boundaries. Individual states either have, or are in the process of completing, state plans that will guide conservation for sage-grouse within their borders. It is

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not the intent of this report to replace or supersede these state efforts. The COT's task of using the best available science to develop range-wide conservation objectives that ameliorate threats is meant to complement the state plans by ensuring that the needs of the sage-grouse are considered at the landscape scale. Achievement of the identified conservation objectives will be dependent on the conservation efforts implemented by states, land management agencies, and other stakeholders. **Nothing in this report should be construed as limiting the application of additional conservation efforts for the sage-grouse or sagebrush ecosystems beyond what is recommended in this report, nor should this report be used to curtail or eliminate any conservation efforts for sage-grouse.**

This report presents the COT's conservation strategy for sage-grouse. The COT recognizes the variability in ecological conditions, species' and threat status, and differing cultures across the sage-grouse range. As a result, the COT acknowledges that developing detailed prescriptive species or habitat actions is inappropriate at the range-wide scale. Rather, the COT is providing a framework which relies on local expertise for implementation. If the objectives identified here are met by all stakeholders within the range of the sage-grouse, essential sage-grouse populations and habitat components should be conserved, resulting in the long-term persistence of this species. This is a collaborative effort, engaging partners that span federal and state agencies, to conserve a species that is a candidate for listing under ESA by identifying a plan that ameliorates threats and provides for conservation at the range-wide scale. As such, it presents a unique opportunity to contribute to a sustained future for this western species and our western landscapes.

2. Summary of Sage-Grouse Biology and Current Status

Sage-grouse depend on a variety of shrub steppe habitats throughout their life cycle, and are considered obligate users of several species of sagebrush (e.g., *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush), *A. t.* ssp. *vaseyana* (mountain big sagebrush), and *A. t. tridentata* (basin big sagebrush)) (Patterson 1952; Braun *et al.* 1976; Connelly *et al.* 2000; Connelly *et al.* 2004; Miller *et al.* 2011). Sage-grouse also use other sagebrush species (which can be locally important) such as *A. arbuscula* (low sagebrush), *A. nova* (black sagebrush), *A. frigida* (fringed sagebrush), and *A. cana* silver sagebrush (Schroeder *et al.* 1999; Connelly *et al.* 2004). Thus, sage-grouse distribution is strongly correlated with the distribution of sagebrush habitats (Schroeder *et al.* 2004). Sage-grouse exhibit strong site fidelity (loyalty to a particular area) to seasonal habitats, which include breeding, nesting, brood rearing, and wintering areas (Connelly *et al.* 2004; Connelly *et al.* 2011a). Adult sage-grouse rarely switch from these habitats once they have been selected, limiting their adaptability to changes (Schroeder *et al.* 1999).

During the spring breeding season, male sage-grouse gather together to perform courtship displays on areas called leks. Leks are relatively bare areas surrounded by greater shrub steppe cover, which is used for escape, nesting and feeding cover. The proximity, configuration, and abundance of nesting habitat are key factors influencing lek location (Connelly *et al.* 1981, and Connelly *et al.* 2000 b, cited in Connelly *et al.* 2011a).

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Productive nesting areas are typically characterized by sagebrush with an understory of native grasses and forbs, with horizontal and vertical structural diversity that provides an insect prey base, herbaceous forage for pre-laying and nesting hens, and cover for the hen while she is incubating (Gregg 1991; Schroeder et al. 1999; Connelly *et al.* 2000; Connelly *et al.* 2004; Connelly *et al.* 2011b). Shrub canopy and grass cover provide concealment for sage grouse nests and young and are critical for reproductive success (Barnett and Crawford 1994; Gregg *et al.* 1994; DeLong *et al.*1995; Connelly *et al.* 2004). Because of average clutch sizes of 7 eggs (Connelly *et al.* 2011a), and limited re-nesting, there is little evidence that populations of sage-grouse produce large annual surpluses (Connelly *et al.* 2011a). Forbs and insects are essential nutritional components for chicks (Klebenow and Gray 1968; Johnson and Boyce 1991; Connelly *et al.* 2004).

Most sage-grouse gradually move from sagebrush uplands to more mesic areas (moist areas, such as streambeds or wet meadows) during the late brood-rearing period (three weeks post-hatch) in response to summer desiccation of herbaceous vegetation (Connelly *et al.* 2000). Summer use areas can include sagebrush habitats as well as riparian areas, wet meadows and alfalfa fields (Schroeder *et al.* 1999). These areas provide an abundance of forbs and insects for both hens and chicks (Schroeder *et al.* 1999; Connelly *et al.* 2000). As vegetation continues to desiccate through the late summer and fall, sage-grouse shift their diet entirely to sagebrush (Schroeder *et al.* 1999). Sage-grouse depend entirely on sagebrush throughout the winter for both food and cover (Schroeder *et al.* 1999).

Many populations of sage-grouse migrate between seasonal ranges in response to habitat distribution (Connelly *et al.* 2004). Migration can occur between winter and breeding and summer areas, between breeding, summer and winter areas, or not at all. Migration distances of up to 161 km (100 mi) have been recorded (Patterson 1952); however, distances vary depending on the locations of seasonal habitats (Schroeder *et al.* 1999). Very little information is available regarding the distribution and characteristics of migration corridors for sage-grouse (Connelly *et al.* 2004); however, research involving radio-collared birds is available in some areas (e.g. Utah). Sage-grouse dispersal (permanent moves to other areas) is poorly understood (Connelly *et al.* 2004) and appears to be sporadic (Dunn and Braun 1986). Estimating an "average" home range for sage-grouse is difficult due to the large variation in sage-grouse movements both within and among populations. This variation is related to the spatial availability of habitats required for seasonal use and annual recorded home ranges have varied from four to 615 square kilometers (km^2) (1.5 to 237.5 square miles (mi^2)); Connelly *et al.*, 2011a).

Sage-grouse are dependent on large areas of contiguous sagebrush (Patterson 1952; Connelly *et al.* 2004; Connelly *et al.* 2011a; Wisdom *et al.* 2011) and large-scale characteristics (e.g. agricultural conversions) within surrounding landscapes influence sage-grouse habitat selection (Knick and Hanser 2011) and population persistence (Aldridge *et al.* 2008; Wisdom *et al.* 2011). Sagebrush is the most widespread vegetation in the intermountain lowlands in the western United States (West and Young 2000); however, sagebrush is considered one of the most imperiled ecosystems in North America due to continued degradation and lack of protection (Knick *et al.* 2003; Miller *et al.* 2011, and references therein).

Sagebrush is long-lived, with plants of some species surviving up to 150 years (West 1983). Sagebrush has resistance to environmental extremes, with the exception of fire and occasionally

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defoliating insects (e.g.webworm (*Aroga* spp.); West 1983). Most species of sagebrush are killed by fire (West 1983; Miller and Eddleman 2000; West and Young 2000), and historic fire-return intervals have been as long as 350 years, depending on sagebrush type and environmental conditions (Baker 2011). Natural sagebrush re-colonization in burned areas depends on the presence of adjacent live plants for a seed source or on the seed bank, if present (Miller and Eddleman 2000), and requires decades for full recovery.

There is little information available regarding minimum sagebrush patch sizes required to support populations of sage-grouse. This is due in part to the migratory nature of some, but not all sage-grouse populations; the lack of juxtaposition of seasonal habitats; and differences in local, regional and range-wide ecological conditions that influence the distribution of sagebrush and its associated understory. Where home ranges have been reported (Connelly *et al.* 2011a and references therein), they are extremely variable (4 to 615 km^2 (1.5 to 237.5 mi^2)). Occupancy of a home range also is based on multiple variables associated with both local vegetation characteristics and landscape characteristics (Knick *et al.* 2003). Pyke (2011) estimated that greater than 4,000 ha (9,884 ac) was necessary for population sustainability; however, Pyke did not indicate whether this value was for migratory or non-migratory populations, nor if this included juxtaposition of all seasonal habitats. Large seasonal and annual movements emphasize the large landscapes required by the sage-grouse (Knick *et al.* 2003; Connelly *et al.* 2011a).

Prior to European settlement in the 19th century, sage-grouse inhabited 13 western states and three Canadian provinces, and their potential habitat covered over 1,200,483 square kilometers (463,509 square miles; Schroeder *et al.* 2004). Sage-grouse have declined across their range due to a variety of causes and now occupy 56 percent of their historic range (Schroeder *et al.* 2004). They currently occur in 11 states and two Canadian provinces (Knick and Connelly 2011). Many factors played a role in reducing sage-grouse from a once abundant, broadly distributed species, but the primary factor was loss of habitat due to increased surface disturbance and general fragmentation of the landscape (Knick and Connelly 2011). Causes of habitat loss and fragmentation were identified in the 2005 Endangered Species Act (ESA) listing determination (70 FR 2244) and remain on the landscape now, but with more intensity and increased distribution (75 FR 13910). The 2010 listing determination reaffirmed the threats identified in 2005, as well as identifying additional concerns, including an increase in the use of sagebrush habitat for renewable energy such as wind power, and the spread of West Nile virus. Sage-grouse are now a candidate for listing under the ESA (75 FR 13910).

3. Principles of Conservation Biology Used in this Report.

Three conservation parameters (parameters) identified in the scientific literature, redundancy, resiliency and representation serve as indicators of the conservation status of a species (Naeem 1998; Redford *et al.* 2011). These parameters can also be indicators of the conservation value of portions of a species' range, and as such are used extensively by FWS in listing and recovery efforts. Quantifying these biological parameters by population across a species' range provides a mechanism for evaluating habitats and population trends as they relate to species persistence (Redford *et al.* 2011). After careful review of these and the underlying conservation biology concepts, the COT members determined that application of the parameters to sagebrush habitats

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supporting sage-grouse and sage-grouse populations formed a sound scientific basis for developing long-term conservation objectives for the species.

Redundancy is defined as multiple, geographically dispersed populations and habitats across a species range, such that the loss of one population will not result in the loss of the species. Redundancy allows for a margin of safety for a species to withstand catastrophic events (e.g. fire) as well as providing a sort of "insurance policy" against threats that have high uncertainty and low predictability (e.g. climate change). ***Representation*** is defined as the retention of genetic, morphological, physiological, behavioral, habitat, or ecological diversity of the species so its adaptive capabilities are conserved. ***Resiliency*** of a species is defined as the ability of the species to recover from periodic disturbance. In general species are likely to be more resilient if large populations exist in high quality habitat that is distributed throughout the range of the species in such a way as to capture the environmental variability found within the species' range (Redford *et al.* 2011).

In addition to the parameters described above the COT also identified an additional parameter to assist in framing conservation thresholds. ***Resistance*** was defined as ability of a population or habitats to withstand a threat without experiencing negative consequences, similar to the ability of an immune system to respond to an initial assault from an offending pathogen. The resistance of a population depends on the health of the population and associated habitats and the severity of the threat. When resistance of a population is lost, the ability of the population to persist is then a function of its resilience.

For sage-grouse, the COT acknowledged that redundancy and representation could be met by having multiple and geographically distributed sage-grouse populations across the diversity of sagebrush habitats that comprise the species' range. Maintenance of the integrity (providing for an appropriate array and abundance of healthy, undisturbed sage-grouse habitats) of sage-grouse management zones, as defined by the Western Association of Fish and Wildlife Agencies (Stiver *et al.* 2006; Figure 1), and the connections between them, were identified as essential for representation. Management zones are based on floristic provinces (identified by Connelly *et al.* 2004) and reflect ecological and biological diversities and similarities. Retention of the characteristics within populations and habitats in each management zone contributes to the representation of the species. The COT's analyses of redundancy and representation for sage-grouse are described in Part 4 of this report.

For sage-grouse, resistance and resiliency are defined by threats to the species and the habitats on which it depends. For example, sage-grouse are resistant to the impacts of oil development in occupied habitats until the associated well pad densities exceed more than one per 699 acres (Holloran 2005). At higher well pad densities the resiliency of sage-grouse depends on the extent of the development, the extent and type of habitat impacted and the ability to accomplish successful habitat restoration. Sage-grouse resiliency and resistance were evaluated and assessed on population, management zone and range-wide scales in Part 5 of this report.

All of the conservation parameters considered by the COT were evaluated at a population level, rather than at an individual bird level. Populations are defined as a group of individuals occupying an area of sufficient size to permit normal dispersal and/or migration behavior in which numerical changes are largely determined by birth and death processes (Berryman 2002).

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The COT adopted the population descriptions in Garton *et al.* (2011), with the exception of Utah (described in detail below). The COT recognizes that conservation of every individual for this widely distributed and complex species and its habitats, while potentially desired by some stakeholders, is inconsistent with our charge – to define the degree to which threats need to be ameliorated to ensure long-term conservation of sage-grouse across its range. Defining conservation objectives to protect each individual would result in an unmanageable conservation strategy that would be impossible to implement given the wide distribution of the species and the diversity of challenges that it faces. Conservation of populations as defined, however, is more tenable and likely to be effective. As an example, individual sage-grouse may not be resistant or resilient to West Nile virus (Walker and Naugle 2011), but with adequate redundancy and representation the species is not likely to succumb to isolated occurrences of this disease.

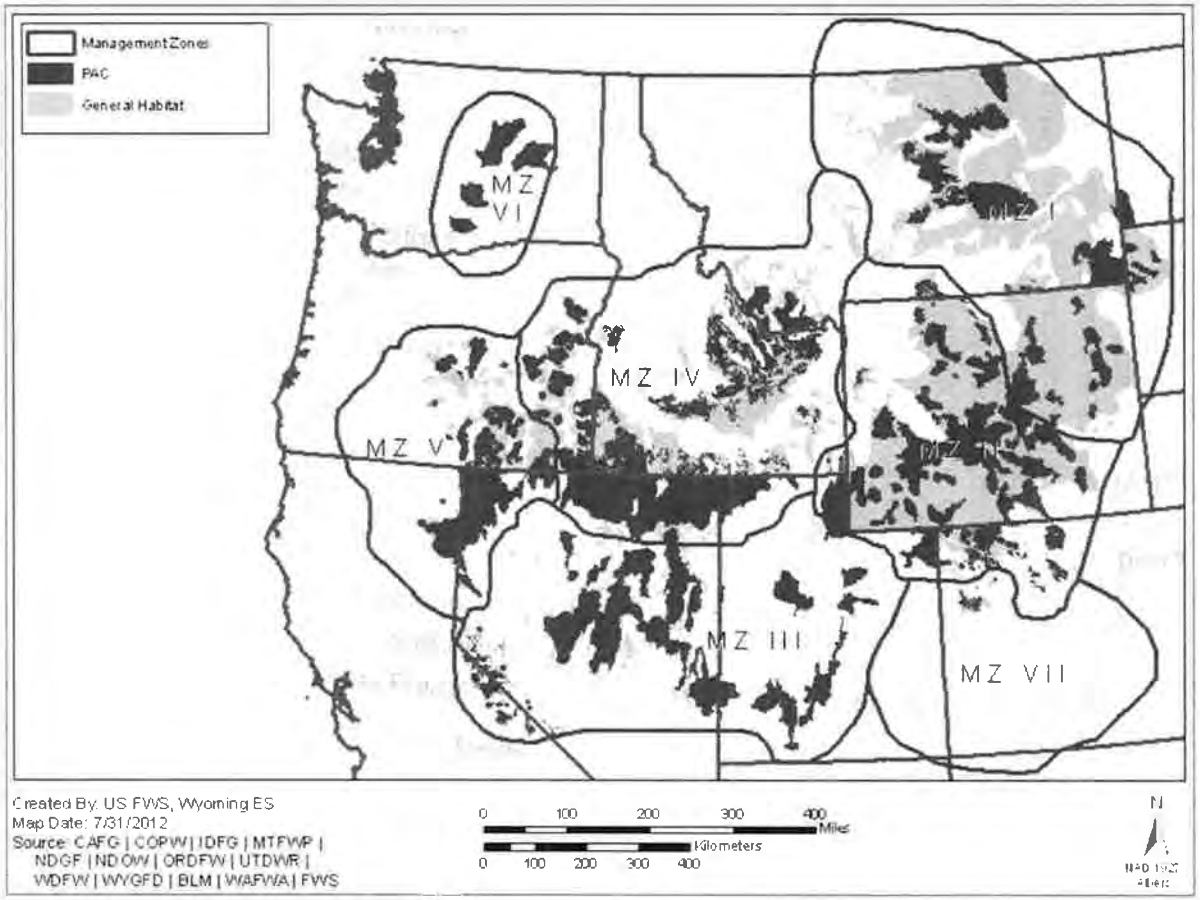
The COT considered how the redundancy, representation, and resiliency of sage-grouse could be conserved in the long-term. We examined threats and probability of persistence over several time frames (up to100 years) to classify population risk levels (see Framework for the COT's Threat Analysis below). The time frames were consistent with timeframes provided in the population viability analysis in Garton *et al.* 2011; common timeframes used for climate change projections (e.g. Bradley *et al.* 2009); and because sagebrush ecosystem restoration can take decades or centuries, depending on the species of sagebrush, its understory component, presence of nearby invasive species, a variety of environmental conditions, and the financial resources that are invested in restoration (Knick *et al.* 2003, and references therein; 75 FR 13910).

The concepts of "resiliency", "redundancy," "representation" and "resistance" are not mutually exclusive, as populations that contribute to the resiliency of a species may also contribute to its redundancy or representation. After careful review of the data prepared by each individual state (described in the following parts of this report) the COT determined that it is not necessary for a single population to contribute to all the conservation parameters in order to be important for maintaining sage-grouse on the landscape in the long term. Because the species is being evaluated across its range, a particular population may not meet the strictest test of one factor yet contribute to the others.

4. Identification of Redundancy and Representation

Individual states have already undertaken considerable efforts to identify key habitats necessary for sage-grouse conservation in the development of their state management plans for this species. Not all state maps of these key habitats were created explicitly considering the conservation parameters as discussed above. Nevertheless, after review of these maps and discussions with state biologists and others responsible for their creation, the conclusion of the COT was that state-based mapping efforts designating key habitats identified redundancy and representation for each state, even though mapping techniques varied (Table 1). These data sets were developed or updated by the state agencies between 2010 and 2012 and thereby represent the most current information available. Each state used differing terminology for key habitat areas (e.g. core, priority, habitat). In order to avoid confusion between the recommendations of this report, and individual state and Federal land management agency conservation plans, the COT has termed these key habitats as *priority areas for conservation* (PACs).

Figure 1: Range-wide map of sage-grouse management zones and priority areas for conservation (PAC) as identified by individual states.



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Although a vast array of techniques and processes were used across states, all data layers were derived from a small group of population- and habitat-based data sources. Many states also used some variation of methods developed by Doherty *et al.* (2010) and Doherty *et al.* (2011). Population data sources included Breeding Bird Densities based on male counts at leks (Doherty *et al.* 2010), the distance around leks supporting nesting birds (nesting areas), telemetry data, known distributions, and other observations. Habitat data used to create the maps include occupied habitat, suitable habitat, seasonal habitat, nesting and brood rearing areas, and connectivity areas or corridors (Table 1).

Table 1. Sources of data used by states to develop key (PAC) maps for each state.

	CA	CO	ID	MT	ND	NV	OR	SD	UT	WA	WY
Population Based Data											
BBD/Lek Counts	X	X	X	X	X		X		X	X	X
Telemetry	X	X	X	X		X	X	X	X	X	
Nesting Areas	X	X		X	X	X			X		X
Known Distribution	X		X	X	X		X			X	X
Sightings/ Observations		X	X			X		X	X	X	
Habitat Distribution											
	X	X	X	X	X	X	X	X	X	X	X

Using the state maps, the COT developed a range-wide data layer that identifies PACs across the species' range within the United States (Figure 1). These PACs represent areas identified by each state as essential for the long-term conservation of the sage-grouse. A complicating factor of developing a range-wide map from state maps is that the data-layer edges around state borders do not always match. Identified areas of incongruence were reviewed by the biologists who participated in individual state mapping processes, and most PACs were resolved by this closer examination. Most of the discrepancies were a result of either mapping errors that were subsequently resolved, or management differences that followed state boundaries due to differing regulatory mechanisms or land ownership patterns between two states. Unresolved boundary concerns are being actively addressed by the involved states.

After careful review of the resulting range-wide map (Figure 1) the COT concluded that the biological concepts of redundancy and representation were also adequately captured at the range-wide level. During this "scaling up" process, the COT discussed whether or not there may have been over-representation of either of these factors. Given the bird's current status as being warranted for listing under the ESA, however, and the unpredictability of some threats (e.g. fire) the increasing intensity and distribution of some threats with unknown impacts (e.g. wind energy development), and the lack of data regarding actual (vs. modeled) sage-grouse movements in many areas, the COT determined that the individual PACs identified at the state level are key for conservation of the species as a whole. However, the potential loss of a PAC increases the value of other PACs for retention of redundancy, representation, and management flexibility of anthropogenic activities.

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Several populations on the edge of the species' range are identified in this report as being at high risk of extirpation. While loss of these populations may not result in the loss of the entire species, there is strong scientific support for the conservation value of "peripheral" populations. These include maintenance of species, habitat richness and biodiversity, genetic diversity, and refugia for collapsing "core" populations (Hunter and Hutchinson 1994, Fraser 2000 and Bunnell *et al.* 2004 – all as cited in USFWS 2008). In many cases these populations have also been identified as essential for conservation by local entities. Additionally, continuing contraction of the species' range has contributed to the current status of the sage-grouse as warranted but precluded. The COT does not want to promote further range erosion and recommends management to conserve all PACs to the maximum extent practicable (see Conservation Strategies in Part 6 below).

As part of their effort to revise or amend Resource Management Plans (RMPs) to incorporate appropriate regulatory mechanisms for sage-grouse conservation, the BLM requested each state within the range of sage-grouse map priority habitats to assist that agency in their efforts. States with completed conservation plans (e.g. Wyoming) submitted their existing maps to the BLM, while other states (e.g. California) developed maps in response to the BLM request. The primary difference between these two efforts, however is that the maps considered by the COT include all PACs, regardless of surface or subsurface ownership. This reflects the differences in purpose of these efforts, as the BLM can only address surface and sub-surfaces under their jurisdiction while the COT was tasked with a range-wide conservation analysis. There is substantial overlap between the map developed by the BLM and the COT's map, as the final range-wide map used in this analysis includes the preliminary priority habitats identified by the most states for BLM's map. Utah did not provide BLM with habitat maps defining preliminary priority habitats. This report uses the mapping data provided by the State of Utah, and therefore there is not complete overlap with the BLM data for this state.

5. Sage-Grouse Status and Threats: Resistance and Resiliency

General Overview of Threats

The loss and fragmentation of sagebrush habitats has been cited as a primary cause of the decline of sage-grouse populations (Patterson 1952; Connelly and Braun 1997; Braun 1998; Johnson and Braun 1999; Connelly *et al.* 2000; Miller and Eddleman 2000; Schroeder and Baydack 2001; Johnsgard 2002; Aldridge and Brigham 2003; Beck *et al.* 2003; Pedersen *et al.* 2003; Connelly *et al.* 2004; Schroeder *et al.* 2004; Leu and Hanser 2011, see also discussion of threats in the 2010 listing review - 75 FR 13910). Mechanisms for declining populations from habitat fragmentation, which is largely a result of human activities, include reductions in lek persistence, lek attendance, population recruitment, yearling and adult annual survival, female nest site selection, nest initiation, and complete loss of leks and winter habitat (Holloran 2005; Aldridge and Boyce 2007; Walker *et al.* 2007; Doherty *et al.* 2008). Functional habitat loss also contributes to habitat fragmentation as greater sage-grouse avoid areas due to human activities, including noise, even though sagebrush remains intact (Blickley *et al.* 2012). In an analysis of population connectivity, Knick and Hanser (2011) demonstrated that in some areas of sage-grouse range, populations are already isolated and at risk for extirpation due to genetic,

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demographic, and stochastic (i.e., unpredictable) events such as lightning caused wildfire. Habitat loss and fragmentation contribute to the population's isolation and increased risk of extirpation.

Fire is one of the primary factors linked to loss of sagebrush-steppe habitat and corresponding population declines of greater sage-grouse (Connelly and Braun 1997; Miller and Eddleman 2001). Loss of sagebrush habitat to wildfire has been increasing in the western portion of the greater sage-grouse range due to an increase in fire frequency. The increase in mean fire frequency has been facilitated by the incursion of nonnative annual grasses, primarily *Bromus tectorum and Taeniatherum asperum*, into sagebrush ecosystems (Billings 1994; Miller and Eddleman 2001). The positive feedback loop between exotic annual grasses and fires can preclude the opportunity for sagebrush to become re-established. Exotic annual grasses and other invasive plants also alter habitat suitability for sage-grouse by reducing or eliminating native forbs and grasses essential for food and cover. Annual grasses and noxious perennials continue to expand their range, facilitated by ground disturbances, including wildfire (Miller and Eddleman 2001), improper grazing (Young *et al.* 1972, 1976), agriculture (Benvenuti 2007), and infrastructure associated with energy development (Bergquist *et al.* 2007). Concern with habitat loss and fragmentation due to fire and invasive plants has mostly been focused in the western portion of the species' range. However, climate change may alter the range of invasive plants, potentially expanding this threat into other areas of the species' range. Habitat loss is occurring from the expansion of native conifers (e.g. pinyon-pine and juniper [pinyon-juniper]), mainly due to decreased fire return intervals and the overstocking of domestic livestock, particularly during the latter 1800's and early 1900's (Miller and Rose 1999), but may not entirely explain the expansion of western juniper (Soule' and. Knapp 1999). Conifer encroachment may also be facilitated by, increases in global carbon dioxide concentrations, and climate change, but the influence of CO_2 has not been supported by some research (Archer *et al.* 1995).

Sage-grouse populations are significantly reduced, including local extirpation, by non-renewable energy development activities, even when mitigative measures are implemented (Walker *et al.* 2007). The persistent and increasing demand for energy resources is resulting in their continued development within sage-grouse range, and may cause further habitat fragmentation. Although data are limited, impacts resulting from renewable energy development are expected to have similar effects to sage-grouse populations and habitats due to their similarity in supporting infrastructure (Becker *et al.* 2009; Hagen 2010; USFWS 2012). Both non-renewable and renewable energy developments are increasing within the range of sage-grouse, and this growth is likely to continue given current and projected demands for energy.

Other factors associated with habitat loss and fragmentation are summarized well by Knick *et al.* (2011) and include conversion of sagebrush habitats for agriculture, the expanding human populations in the western United States, and the resulting urban development in sagebrush habitats, and vegetation treatments resulting in the alteration or removal of sagebrush to enhance grazing for livestock, wild ungulates and feral horses and burros.

The importance of each of the above threats to sage-grouse varies across the species' range. For example, fire is a primary issue in the western portion of the species range, while non-renewable energy development affects primarily the eastern portion of the species' range (75 FR 13910). However, no part of the species' range is immune from any of the primary threats described above. Additionally, the impact of threats on local sage-grouse populations vary based on the resistance, and subsequent resilience of that population and its associated habitats. Healthy, robust sagebrush habitats with few or no other threats are likely to be more resistant or resilient than habitats already experiencing a high level of threats, or in poor condition. However, natural conditions, such as long-term drought can affect population resistance and resilience. Therefore, threats need to be assessed at the population level for the degree of risk to each area and the appropriate response.

The lack of sufficient regulatory mechanisms to conserve sage-grouse and their habitats was identified as a primary threat leading to the warranted but precluded status in FWS 2010 listing determination. While specific regulatory mechanisms are not addressed in this report, federal land management agencies, and many state and local governments across the species range are working to develop adequate mechanisms to address this threat. For example, Wyoming's Governor Dave Freudenthal was among the first to enact regulatory mechanisms to protect core sage-grouse areas through Executive Order 2010-4. Governor Mead signed an updated version of the Sage-Grouse Core Area Protection Executive Order in 2011 (Executive Order 2011-5). The probability for the successful amelioration of the primary threats to sage-grouse and their habitat can be enhanced through the development and implementation of sufficient regulatory mechanisms.

Other threats that can negatively affect sage-grouse include inappropriate livestock management, inappropriate feral horse management, parasites, infectious diseases, predation, and weather events (e.g., drought or late spring storms), and the loss of Conservation Reserve Program (CRP) lands. Some of these threats may be localized and of short duration, but may be significant at the population level, particularly for small populations. An example of this local effect is the 2008 outbreak of West Nile virus in the sage-grouse population southwestern North Dakota. This small population is on the periphery of the current sage-grouse distribution and numbers dropped dramatically following the WNv outbreak. Four years later (2012), the population has improved but not fully recovered to levels seen before the outbreak (NDGF unpublished data).

Predation is often identified as a potential factor affecting sage-grouse populations, and is understandable given the suite of predators that prey on sage-grouse from egg to adulthood (though no predators specialize on sage-grouse). Predator management has been effective on local scales for short periods, but the efficacy over broad ranges or over a long time spans have not been demonstrated (Hagen 2011). In areas of compromised habitats and high populations of synathropic predators, predator control may be effective to ensure sage-grouse persistence until habitat conditions improve. However, the most effective method to mitigate the effects of predation is to maintain quality habitat with good connectivity (Schroeder and Baydack 2001).

Though threats such as infectious diseases and predation may be significant at a localized level, particularly if habitat quantity and quality is compromised, they were not identified by FWS as significant range-wide impacts (75 FR 13910).

Challenges with Sagebrush Habitat Restoration

Very little sagebrush within its extant range remains undisturbed or unaltered from its condition prior to EuroAmerican settlement in the late 1800s (Knick *et al.* 2003, and references therein).

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Due to the disruption of primary patterns, processes and components of sagebrush ecosystems since EuroAmerican settlement (Knick *et al.* 2003; Miller *et al.* 2011), the large range of abiotic variation, the minimal short-lived seed banks, and the long generation time of sagebrush, restoration of disturbed areas is very difficult. Not all areas previously dominated by sagebrush can be restored because alteration of vegetation, nutrient cycles, topsoil, and living (cryptobiotic) soil crusts has exceeded recovery thresholds (Knick *et al.* 2003; Pyke 2011). Additionally, processes to restore sagebrush ecology are relatively unknown (Knick *et al.* 2003). Active restoration activities are often limited by financial and logistic resources (Knick *et al.* 2003; Miller *et al.* 2011) and may require decades or centuries (Knick *et al.* 2003, and references therein). Landscape restoration efforts require a broad range of partnerships (private, State, and Federal) due to landownership patterns (Knick *et al.* 2003). Except for areas where active restoration is attempted following disturbance (e.g., mining, wildfire), management efforts in sagebrush ecosystems are usually focused on maintaining the remaining sagebrush (Miller *et al.* 2011; Wisdom *et al.* 2011).

Framework for the COT's Threats Analysis

Recognizing the variability to which threats impact sage-grouse populations across the species' range, the COT assessed threats based on the populations defined by Garton *et al.* 2011, with the exception of the State of Utah. The Utah sage-grouse state mapping effort delineated management areas for sage-grouse, which redefined the Garton *et al.* 2011 populations using local population data. The threat analyses follows a template used in assessing core area conservation for the bull trout (*Salvelinus confluentus*; USFWS 2005), with appropriate time-frame adjustments for sage-grouse and sagebrush. Range-wide PACs were assigned the same threat risk as the population or management area in which it occurs. The COT reviewed each population (or in the case of Utah, state management areas) to identify primary threats for that area. The COT considered both existing and foreseeable threats (those likely to occur within 100 years, consistent with the longer timeframe provide in the Garton *et al.* 2011 analysis). Existing and foreseeable threats were categorically ranked for each population or management area, by evaluating whether the magnitude (i.e., severity and scope) and immediacy of the threat was High, Moderate, Low, Insignificant, or Unknown, as briefly defined below:

1. Severity

a. High: Loss of species population (all individuals) or destruction of species habitat in area affected, with effects essentially irreversible or requiring long-term recovery (>100 years).

b. Moderate: Major reduction of species population or long-term degradation or reduction of habitat in the PAC, requiring 50-100 years for recovery.

c. Low: Low but nontrivial reduction of species population or reversible degradation or reduction of habitat in area affected, with recovery expected in 10-50 years.

d. Insignificant: No measurable reduction of population or degradation of habitat or ecological community due to threats, or populations, habitats. Note that effects of locally sustainable levels of hunting and scientific collection are generally considered insignificant as defined here.

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2. *Scope*
   a. <u>High</u>: > 60 percent of total population or area affected.
   b. <u>Moderate</u>: 20-60 percent of total population or area affected.
   c. <u>Low</u>: 5-20 percent of total population or area affected.
   d. <u>Insignificant</u>: < 5 percent of total population or area affected.

3. *Immediacy*
   a. <u>High</u>: Threat is operational (happening now) or imminent (within 2-5 years).
   b. <u>Moderate</u>: Threat is likely to be operational within 5-10 years.
   c. <u>Low</u>: Threat is likely to be operational within 10-20 years.
   d. <u>Insignificant</u>: Threat is not likely to be operational within 20 years.

Using the building blocks of Severity, Scope, and Immediacy population or management area threats were assigned a rank value of A, B, C, D, E, F, G, H, or U where:

A = Substantial, imminent threat. Threat is moderate to severe and imminent for most (> 60 percent) of the population or area.

B = Moderate and imminent threat. Threat is moderate to severe and imminent for a significant proportion (20-60 percent) of the population or area.

C = Substantial, non- imminent threat. Threat is moderate to severe but not imminent (> 10 years) for most of the population or area.

D = Moderate, non- imminent threat. Threat is moderate to severe but not imminent for a significant portion of the population or area.

E = Localized substantial threat. Threat is moderate to severe for a small but significant proportion of the population or area.

F = Widespread, low-severity threat. Threat is of low severity but affects (or would affect) most or a significant portion of the population or area.

G = Slightly threatened. Threats, while recognizable, are of low severity, or affecting only a small portion of the population or area.

H = Unthreatened. Threats if any, when considered in comparison with natural fluctuation and change, are minimal or very localized, not leading to significant loss or degradation of populations or area even over a few decades' time. (Severity, scope, and/or immediacy of threat considered Insignificant.)

U = Unknown. The available information is not sufficient to assign degree of threat as above. (Severity, scope, and immediacy are all unknown, mostly [two of three] unknown, or not assessed.)

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Once individual threats by population were ranked using the criteria described above, the COT assessed the condition of each population or management area based on the effects of existing threats and the ecological status of the species and its habitat (e.g., population number, habitat condition). Based on this assessment, each population or management area was assigned an overall level of risk to that specific area. The risk level assigned to an individual population or management area was restricted to one of four categories as follows:

C1 = HIGH RISK. The population is at high risk because of extremely limited and/or rapidly declining numbers, range, and/or habitat, making sage-grouse in this area highly vulnerable to extirpation.

C2 = AT RISK. The population is at risk because of very limited and/or declining numbers, range, and/or habitat, making sage-grouse in this area vulnerable to extirpation.

C3 = POTENTIAL RISK. The population is potentially at risk because of limited and/or declining numbers, range, and/or habitat even though sage-grouse may be locally abundant in some portions of the area.

C4 = LOW RISK. Sage-grouse are common or uncommon, but not rare, and usually widespread through the area. They are apparently not vulnerable at this time, but there may be cause for long-term concern.

Additionally, the COT determined that populations and management areas containing fewer than 200 males or 500 breeding birds could not be ranked higher than a C2. This is because small populations are inherently more vulnerable to extinction from unpredictable environmental events (e.g., fires, drought) and because this is generally accepted for adequate effective population size to avoid negative genetic effects from inbreeding (Garton *et al.* 2011).

Individual threat ranking and risk level assignment was accomplished through a process of open forum deliberation. Initially, COT members discussed the concepts of Severity, Scope, and Immediacy in the context of the members' collective knowledge pertaining to individual threats and understood level of risk to sage-grouse populations in order to establish a relative level of consistency among members. Following these discussions, local and regional expertise was applied to individual populations to assign a population risk category. These assignments were conducted as a group exercise and iteratively with the intent to minimize inconsistency among COT members and risk level assignments among populations. The results of the individual threat and risk assessments by population or state management area are summarized in Figure 2 and Table 2. Supporting information for these assignments and a detailed description of each population are presented in Appendix B.

Results of Threats Analysis and Risk Ranking

The COT reviewed each state's PAC maps to determine whether the redundancy and representation were captured at the Management Zone and range-wide scales. We did not

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identify additional habitats, beyond what was mapped in the PAC habitat maps that would be needed to maintain representation, redundancy, and resiliency of sage-grouse on the landscape at these broader scales. While working through this process, the COT concluded that some non-PAC sage-grouse habitat should be managed to the extent practicable to retain connectivity (ability of individuals to disperse to other populations) among populations and Management Zones, to afford managers a buffer to offset habitat loss due to uncontrollable events such as wildfire, and to retain management flexibility.

To address resiliency the COT reviewed the key threats, habitat condition, connectivity, and status of populations and management areas within management zones individually, rather than providing an overall threat and risk ranking of the management zone (Table 2). We also considered existing management zone level analyses provided in Garton *et al.* 2011 (i.e., population lambda and likelihood of persistence), Knick and Hanser 2011 (i.e., connectivity analysis), and the National Sage-Grouse Conservation Planning Framework Team (Stiver *et al.* 2006). The majority of remaining sage-grouse habitat occurs Management Zones I, II, III, IV, and V in populations ranked as C3 or C4 (i.e., Northern Montana, Yellowstone Watershed, Northern, Southern, and Western Great Basins, Snake Salmon Beaverhead, and the Wyoming Basin). This suggests that these areas are strongholds for sage-grouse that are important to retain on the landscape in the long term for that reason. This is consistent with, although more expansive than, the conclusions reached by Knick and Hanser (2011).

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Figure 2. Sage-grouse population risk levels. All PACs within each population was assigned the same risk level as the population.

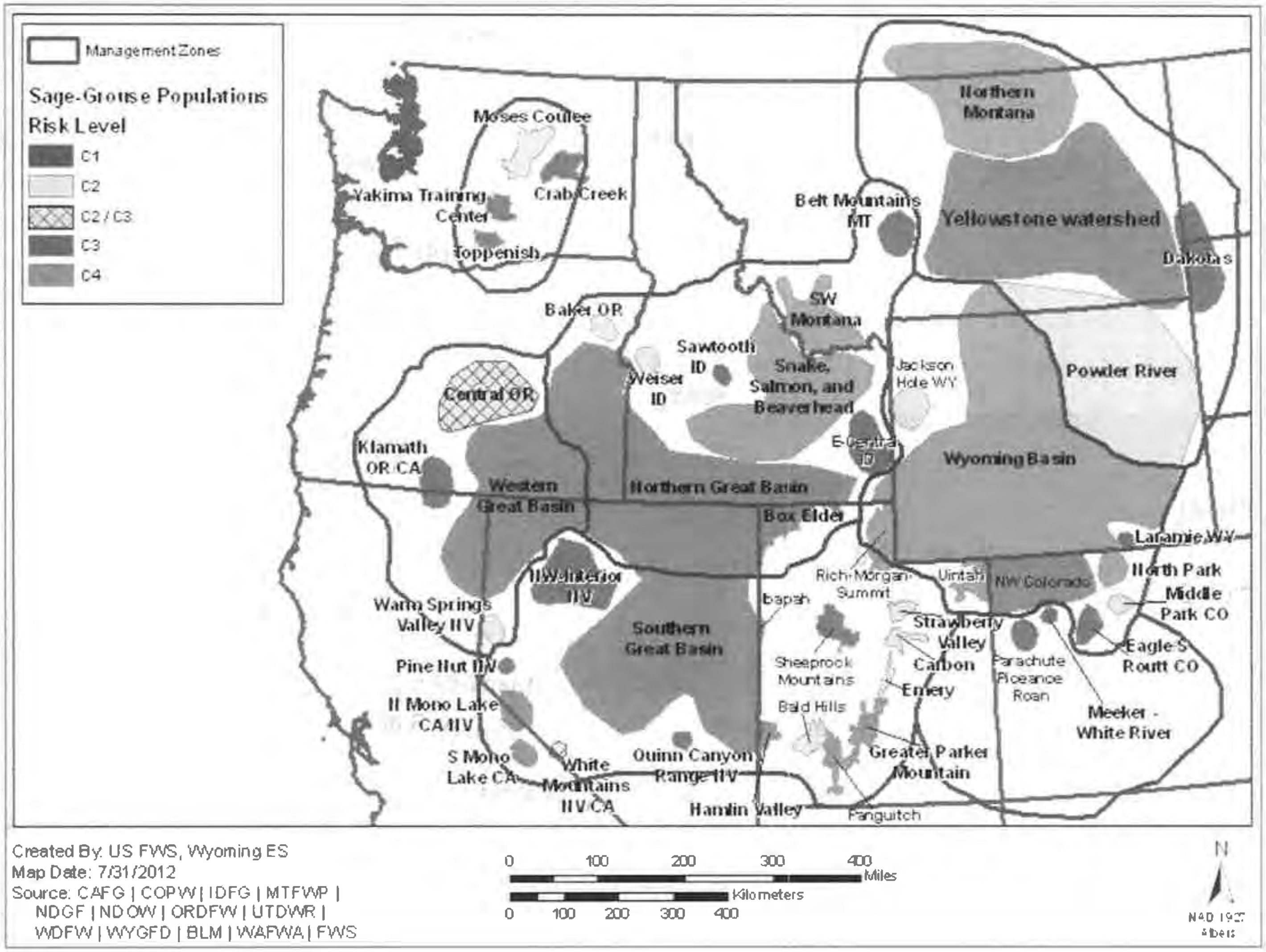

Table 2. Information on threats to sage-grouse and their habitats used in the resiliency analyses of populations and management zones. The populations described here were taken from Garton *et al.* (2011), including some sub-population designations to help focus threat identification. The population parameters (designated in tan) are defined by Garton *et al.* (2011).

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent B: Moderate, Imminent C: Substantial, Non-Imminent						D: Moderate, Non-Imminent E: Localized, Substantial F: Widespread, Low severity						G: Slight Threat H: Unthreatened U: Unknown				
Management Zone I: Great Plains		***9.5 (5.9)***	***11.1 (5.8)***	***22.8 (8.4)***	***24 (8.3)***																		
Dakotas (*ND, SD*)	N	4.6	39.5	44.6	66.3	C1	C	E	E	G	C	F	U	H	A	D	B	E	H	H	H	U	U
Northern Montana (*MT*)	N	0	0	0.2	2.0	C4	H	E	E	E	D	F	H	E	D	H	F	F	H	E	H	U	U
Powder River Basin (*WY*)	N	2.9	16.5	85.7	86.2	C2	H	E	E	E	C	D	E	D	A	B	A	E / F	H	F	E	U	U
Yellowstone Watershed (*MT*)	N	0	8.1	55.6	59.8	C3	H	E	B	E	D	F	E	D	B	H	F	F	H	E	H	U	U

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent; B: Moderate, Imminent; C: Substantial, Non-Imminent; D: Moderate, Non-Imminent; E: Localized, Substantial; F: Widespread, Low severity; G: Slight Threat; H: Unthreatened; U: Unknown																
Management Zone II: Wyoming Basin		*0.1 (0.3)*	*0.3 (1.1)*	*16.1 (7.4)*	*16.2 (7.4)*																		
Eagle-South Routt (*CO*)	Y	ND	ND	ND	ND	C1	B	E	G	E	G	E	E	G	G	H	B	F	H	E	B	U	U
Middle Park (*CO*)	N	2.5	100	7.1	100	C2	B	G	G	G	U	U	H	G	G	G	D	F	H	G	A	U	U
Laramie (*WY, CO*)	N	ND	ND	ND	ND	C1	A	H	H	D	U	D	G	F	A	U	A	F	H	G	G	U	U
Jackson Hole (*WY*)	Y	11.2	100	27.3	100	C2	A	E	H	E	H	U	E	G	H	H	H	H	H	D	E	U	U

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent B: Moderate, Imminent C: Substantial, Non-Imminent					D: Moderate, Non-Imminent E: Localized, Substantial F: Widespread, Low severity						G: Slight Threat H: Unthreatened U: Unknown					
Wyoming Basin (*WY & MT portion*)	N					C4	H	E	H	E	E	U	H	E	B	H	B	E / F	E	E / F	E	U	U
Rich-Summit-Morgan (*WY Basin in UT*)[2]	N					C4	H	H	H	G	H	B	B	B	G	H	G	H	H	B	C	U	U
Uintah (*WY Basin in UT*)	N	0.0	0.0	9.9	10.7	C4	H	H	H	B	E	B	B	B	E	G	G	H	H	G	G	U	U
N. Park (*WY Basin in CO*)	N					C4	H	F	G	G	G	G	H	G	B	G	B	F	H	G	B	U	U
NWCO (*WY Basin in CO*)	N					C3	H	E	F / G	D	G	G	E	C	B / C	B	A	F	E	F	E	U	U

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent B: Moderate, Imminent C: Substantial, Non-Imminent					D: Moderate, Non-Imminent E: Localized, Substantial F: Widespread, Low severity					G: Slight Threat H: Unthreatened U: Unknown						
Management Zone III: Southern Great Basin[3]		*0.0 (0.0)*	*0.0 (0.1)*	*6.5 (4.9)*	*7.8 (5.3)*																		
Strawberry Valley (*Part of NE Interior UT*)	Y	0.8	51.8	8.8	78.6	C2	B	H	H	F	G	B	G	G	D	H	G	H	H	G	H	U	U
Carbon (*Part of NE interior UT*)	Y					C2	B	H	H	B	E	E	H	G	G	G	G	H	H	G	H	U	U
Emery (*UT, aka Sanpete-Emery Counties*)	Y	77.7	100	99.2	100	C2	B	H	H	B	H	E	B	B	G	G	G	H	H	G	H	U	U
Sheeprock (*UT,* aka *Toole-Juab Counties*)	Y	56.5	100	100	100	C1	B	H	H	B	H	E	E	E	G	G	E	H	G	E	H	U	U

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent B: Moderate, Imminent C: Substantial, Non-Imminent						D: Moderate, Non-Imminent E: Localized, Substantial F: Widespread, Low severity						G: Slight Threat H: Unthreatened U: Unknown				
Greater Parker Mt. (*Part of South Central UT*)	N					C3	H	H	H	G	H	E	B	B	H	H	G	H	H	G	H	U	U
Panguitch (*Part of South Central UT*)	N	0.0	3.2	1.1	21.0	C3	H	H	G	G	H	E	B	B	G	E	G	H	H	G	E	U	U
Bald Hills (*Part of South Central UT*)	Y					C2	B	H	G	B	H	E	G	B	C	G	G	H	G	G	G	U	U
Northwest Interior (*NV*)	N	ND	ND	ND	ND	C1	A	H	F	A	U	F	F	A	U	G	F	B	B	F	H	H	U

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent B: Moderate, Imminent C: Substantial, Non-Imminent D: Moderate, Non-Imminent E: Localized, Substantial F: Widespread, Low severity G: Slight Threat H: Unthreatened U: Unknown																
Ibapah (*UT part of Southern Great Basin*)	Y	0.0	3.2	1.1	21.0	C3	B	H	H	B	H	E	G	B	G	G	G	H	G	B	H	U	U
Hamlin Valley (*UT part of Southern Great Basin*)	Y					C3	B	H	H	B	H	E	G	B	G	G	G	H	B	G	H	U	U
Southern Great Basin (*NV portion*)	N					C3	G	E	F	B	U	G	A	A	E	E	E	E	E	F	H	U	U
Quinn Canyon Range (*NV*)	Y	ND	ND	ND	ND	C1	U	H	F	D	U	F	B	B	U	H	B	B	B	F	H	U	U

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent; B: Moderate, Imminent; C: Substantial, Non-Imminent; D: Moderate, Non-Imminent; E: Localized, Substantial; F: Widespread, Low severity; G: Slight Threat; H: Unthreatened; U: Unknown																
Management Zone IV: Snake River Plains		*2.3 (1.4)*	*10.5 (6.1)*	*19.4 (7.9)*	*39.7 (9.6)*																		
Baker (*OR*)	N	61.9	100	66.8	100	C2	D	G	G	G	G / U	U	E	D	E	G	E	U	H	E	E	U	U
East Central (*ID*)	Y	ND	ND	ND	ND	C1	A	E	G	E	D	F	G	E	D	H	F	F	H	E	H	U	U
Southwest Montana (*Bannack, Red Rocks, Wisdom, and Bridges*)	N	Bannack: 6.4 Red Rock: 0.1	Bannack: 70.2 Red Rock: 55.3	Bannack: 32.7 Red Rock: 2.5	Bannack: 97.7 Red Rock: 91.9	C4	H	E	H	E	H	F	E	D	E	E	E	F	H	E	E	U	U
Snake-Salmon-Beaverhead (*ID*)	N	4.2	10.2	19.3	26.8	C4	H	E	E	A	E	F	E	B	D	H	E	F	F	E	H	C	U

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent B: Moderate, Imminent C: Substantial, Non-Imminent D: Moderate, Non-Imminent E: Localized, Substantial F: Widespread, Low severity G: Slight Threat H: Unthreatened U: Unknown																
Belt Mountains (*MT*)	Y	ND	ND	ND	ND	C1	A	E	B	E	H	F	E	D	E	H	E	F	H	E	E	U	U
Weiser (*ID*)	N	ND	ND	ND	ND	C2	B	E	E	E	D	F	E	D	D	H	E	F		E	E	U	U
Northern Great Basin (*OR, ID, NV portion*)	N	2.1	2.5	2.5	99.7	C3	H	E	E	A	E	F	B	A	E	E	B	F	E	F	G	U	U
Box Elder (*UT portion of Northern Great Basin*)	N					C3	H	H	G	A	H	G	B	B	E	G	G	H	H	G	H	U	U
Sawtooth (*ID*)	Y	ND	ND	ND	ND	C1	A	E	H	E	D	U	U	E	H	H	F	F	H	E	H	U	U

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent; B: Moderate, Imminent; C: Substantial, Non-Imminent; D: Moderate, Non-Imminent; E: Localized, Substantial; F: Widespread, Low severity; G: Slight Threat; H: Unthreatened; U: Unknown																
Management Zone V: Northern Great Basin		*1.0 (2.0)*	*2.1 (2.3)*	*7.2 (5.0)*	*29 (8.1)*																		
Central Oregon (*OR*)	N	4.2	15.2	74.9	91.3	C2 / C3	H	E	E	C	U	U	B	D	E	G	E	D	U	E	E	U	U
Klamath (*OR, CA*	Y	ND	ND	100	100	C1	A	U	U	D	U	U	A	D	E	H	G / U	U	U	U	U	U	U
Warm Springs Valley (*NV*)	Y	ND	ND	ND	ND	C2	D	G	G	A	U	B	F	B	D	G	B	G	E	F	C	U	U
Western Great Basin (*OR, CA, NV*)	N	5.5	6.4	6.4	99.1	C3	H	G	G	B	G	U	B	B	E	E	E	B / C	B	U	H	U	U

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent B: Moderate, Imminent C: Substantial, Non-Imminent						D: Moderate, Non-Imminent E: Localized, Substantial F: Widespread, Low severity						G: Slight Threat H: Unthreatened U: Unknown				
Management Zone VI: Columbia Basin		*12.4 (6.0)*	*76.2 (6.5)*	*62.1 (9.1)*	*86.3 (5.8)*																		
Moses Coulee (*WA*)	N	9.8	87.6	52.4	99.8	C2	B	F	A	E	U	F	H	D	D	H	D	F	H	G	F	U	G
Yakama Indian Nation (*WA*)	Y	ND	ND	ND	ND	C1	A	H	H	C	U	F	H	B	D	H	B	G	A	G	G	U	G
Crab Creek (*WA*)	Y	ND	ND	ND	ND	C1	A	F	B	E	U	F	H	D	F	H	D	D	H	G	F	U	G
Yakima Training Center (*WA*)	Y	26.1	100	50.4	100	C1	A	H	E	B	U	F	H	B	H	H	F	G	H	G	H	U	G

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent B: Moderate, Imminent C: Substantial, Non-Imminent						D: Moderate, Non-Imminent E: Localized, Substantial F: Widespread, Low severity						G: Slight Threat H: Unthreatened U: Unknown				
Management Zone VII: Colorado Plateau		***0.0 (0.0)***	***95.6 (3.7)***	***5.1 (2.3)***	***98.4 (3.7)***																		
Parachute-Piceance-Roan Basin (CO)	Y	ND	ND	ND	ND	C1	A	E	H	D	U	F	A	E	A	C	A	F	G	H	H	U	U
Meeker-White River (*CO*)	Y	ND	ND	ND	ND	C1	A	G	G	C	U	E	H	E	D	D	D	F	H	H	A	U	U
Bi-State Distinct Population Segment																							
North Mono Lake (*CA, NV*)	N	15.4	100	37.9	100	C3	C	G	G	C	D	F	B	F	D	D	B	F	B	G	E	U	U
South Mono Lake (*CA*)	N	0.1	81.5	0.6	99.9	C3	C	G	G	C	D	E	F	F	H	H	A	F	G	B	B	U	U

Unit Name	<200 Males/500 Birds?	% Chance of <50 birds/ 20 males in 2037	% Chance of <50 birds/ 20 males in 2107	% Chance of <500 birds/ 200 males in 2037	% Chance of <500 birds/ 200 males in 2107	Risk Level[1]	Isolated/Small Size	Sagebrush Elimination	Agriculture Conversion	Fire	Disease	Predation	Conifers	Weeds/Annual Grasses	Energy	Mining	Infrastructure	Livestock	Feral Horses	Recreation	Urbanization	Drought	Climate Change
							A: Substantial, Imminent B: Moderate, Imminent C: Substantial, Non-Imminent D: Moderate, Non-Imminent E: Localized, Substantial F: Widespread, Low severity G: Slight Threat H: Unthreatened U: Unknown																
Pine Nut (*NV*)	Y	ND	ND	ND	ND	C1	A	B	U	A	C	B	A	A	C	G	A	F	B	B	A	B	U
White Mountains (*CA, NV*)	Y	ND	ND	ND	ND	C2 / C3	C	G	G	C	D	F	F	F	H	H	G	F	B	H	G	U	U

[1] Where C1 = high risk, C2 = at risk, C3 = potential risk, and C4 = low risk.

[2] This UT management area also includes Summit-Morgan Counties. Numbers for columns 3-6 for this population are 20.6, 100, 41.8, and 100, respectively (Garton et al. 2011).

[3] Percentages reported in this zone include information for North and South Mono Lake, which are separately described in the Bi-State section of this table

The COT's analyses of threats, as well as redundancy and resistance are consistent with previous analyses (e.g. Knick *et al.* 2003; Stiver *et al.* 2006). Listing analyses conducted by the FWS are primarily based on threats to the species, and not population numbers and distribution (although those are considered). The 2010 listing determination by FWS (75 FR 13910) concluded that sage-grouse range-wide are at risk due to the current and reasonably foreseeable threats to the species, primarily habitat loss and fragmentation. While sage-grouse are still widely distributed, the threats to this species must be ameliorated as described in the Conservation Strategy below to ensure continued species' persistence. Connectivity between breeding populations (based on habitat analyses) is already compromised across the species' range (Knick and Hanser 2011).

Only a few populations are in a low risk category (C4) and retention of only these areas will not maintain the redundancy and representation of the species essential for long-term conservation. C4 areas are also not without threats (Table 2). Populations within the C3 category are already potentially at risk because of limited and/or declining numbers, range, and/or habitat even though sage-grouse may be locally abundant in some areas. Continued threats to these populations in this risk category could result in their re-classification to C2 or C1, thereby compromising the management flexibility for range-wide sage-grouse conservation as well as requiring an increase in the need for active management and restoration to ensure species persistence. Populations in the C2 and C1 categories already require intensive management, and in some cases, restoration to ensure they do not continue to decline to the point that recovery is no longer possible. Loss of these areas will affect redundancy and representation (Figure 2), and their loss is likely to negatively affect the resiliency of remaining C3 and C4 populations through loss of management options.

During the analyses of threats the COT identified several uncertainties that may potentially affect sage-grouse conservation, including the unknown effects of climate change and renewable energy development, the current lack of a robust range-wide genetics-based connectivity analyses, low adaptability of the species resulting from high seasonal habitat fidelity, and the lack of understanding of the processes necessary to restore sagebrush ecology (Knick *et al.* 2003). Additionally, sagebrush ecosystem restoration activities are often limited by financial and logistic resources (Knick *et al.* 2003; Miller *et al.* 2011) and may require decades or centuries (Knick *et al.* 2003, and references therein). Based on the threat analyses and the uncertainties of successful restoration, the COT has concluded that all PACs managed for conservation to the maximum extent practicable in order to enhance management flexibility and adaptive management principles for the long-term conservation of the sage-grouse.

6. Conservation Goal, Objectives and Strategies and Recommendations

The overall conservation objective identified in the Western Association of Fish and Wildlife Agencies' (WAFWA) 2006 Greater Sage-grouse Comprehensive Conservation Strategy (Stiver *et al.* 2006) was "...to produce and maintain neutral or positive trends in populations and maintain or increase the distribution of sage-grouse in each Management Zone." Analyses conducted by Knick and Hanser (2011) concluded that the WAFWA conservation objective may no longer be possible due to natural and anthropogenic threats that are degrading remaining

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sagebrush habitats. They recommended focusing conservation on areas critical to range-wide persistence of this species (Knick and Hanser 2011). Other areas within the range of sage-grouse have a high uncertainty for continued population persistence (Wisdom *et al.* 2011) due to fragmentation from anthropogenic impacts.

The conservation strategies identified below are targeted at threat amelioration through adequate regulatory mechanisms and proactive conservation actions, thereby addressing the conservation parameters of resistance and resiliency. The intent was to reduce or remove to the maximum extent practicable anthropogenic impacts affecting sage-grouse habitat loss and fragmentation. If this is not achieved, the long-term persistence of this species will be compromised. Due to the variability in ecological conditions, species' and threat status, and differing cultural perspectives across the sage-grouse range, developing detailed, prescriptive species or habitat actions is biologically untenable and inappropriate at the range-wide scale. The COT recognizes the specific strategies or actions deemed necessary for a successful threat amelioration plan must be developed and implemented at the state level, with involvement of all stakeholders.

The COT was tasked with identifying steps necessary to ensure the long-term conservation of the species through threat amelioration, and not simply species persistence. The approach included retention to the maximum extent practicable populations and habitats necessary to provide essential conservation parameters – redundancy, representation, and resiliency – for this species. Additionally, the COT wanted to identify ways to incorporate a fourth parameter, resistance, which would indicate that populations and habitats are healthy and robust even in the presence of threats. As previously discussed, the state mapping efforts have identified the PACs that provide redundancy and representation for this species. Resistance and resiliency are influenced by threats (see discussion under Part 5). While some populations within the range of sage-grouse are at significant threat risk, none are immune to the threat of habitat loss and fragmentation.

The COT acknowledges that many stakeholders within the sagebrush ecosystem have worked diligently to pro-actively minimize the impacts of their projects on the species. Voluntary efforts can be very effective in successful threat amelioration to the level that a listing determination is not warranted (e.g. the recent decision on the dunes sagebrush lizard, 77 FR 36872). Currently, proactive voluntary conservation efforts for sage-grouse are being implemented in portions of the species' range. The COT recommends that agencies engaged in voluntary conservation actions collect information on the geographic scope of these efforts, the sustained benefits from their implementation, and the likelihood that they will continue to be implemented in the future. In addition to voluntary approaches, the COT believes that regulatory mechanisms developed through other approaches, as identified in the FWS 2010 listing determination, are necessary. For maximum effectiveness, these mechanism need to apply to the activities causing habitat fragmentation and loss. Not all sage-grouse habitat is contained within the PACs identified in this report. Although the COT acknowledges that the PACs provide key conservation parameters necessary for the long-term persistence of the sage-grouse, we also agree that sage-grouse habitat outside the PACs has value in sage-grouse conservation. These areas may provide connectivity between PACs, maintain flexibility for restoration, and potentially provide key habitat components that have not yet been identified. Nevertheless, we also recognize that development in sagebrush ecosystems is important to securing energy and other resources critical to our nation. The COT encourages, however, voluntary management of non-PAC areas to retain management flexibility.

In species conservation, the intent of providing redundancy is to ensure a species will persist even if habitat and some populations are lost due to a catastrophic event. The COT acknowledges that some of the PACs could be lost, wholly or in part, to catastrophic events, particularly in areas where wildfires are prevalent. The redundancy built into the state planning efforts will allow for some of these losses and still permit long-term species conservation; however, losses of PACs from controllable anthropogenic activities must be avoided. Whether catastrophic or anthropogenic in origin, these losses will reduce redundancy and representation across the sage-grouse range, greatly increasing the risk of local extirpation and reducing management options, including restoration. If PACs are lost, the COT recommends that appropriate restoration efforts be implemented. If restoration is not possible, then efforts should be made to restore the components lost within the PAC (e.g., redundancy or representation) in other PACs or non-PAC habitats such that there is no net loss of sage-grouse or their habitats. However retention of PACs should be priority over replacement.

Some areas that were not included as PACs may still have great potential for providing important habitat if some active management is implemented. For example, removal of early stage juniper stands may render currently unsuitable habitat into effective habitat for sage-grouse. The COT encourages each state to consider actively pursuing these opportunities, if they exist. This will increase connectivity between PACS and management flexibility in conserving the species.

The COT recommends that the maps developed by each state for the purpose of sage-grouse conservation be re-evaluated on a regular basis so that new information can be incorporated as soon as it becomes available. PACs should be adjusted based on new information regarding habitat suitability and refined mapping techniques, new genetic connectivity information, and new or updated information on seasonal range delineation. By maintaining "living" maps of the habitat areas necessary to provide redundancy and representation, threat amelioration plans can be more accurately implemented, or modified if appropriate. Additionally, new restoration opportunities may be identified, thereby increasing management flexibility. Basing management decisions on out-of-date data may threaten the success of long-term conservation actions and threat amelioration plans.

Conservation Goal:

Long-term conservation of sage-grouse and their habitat, by maintaining viable, connected, and well-distributed populations across their range, through threat amelioration and restoration activities.

Overall Conservation Objectives:

- *Stop the decline.* The COT recognizes the need to "stop the bleeding" of continuing habitat and population losses by acting immediately to establish the necessary regulator mechanisms in order to ameliorate the impacts of stressors contributing to population

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declines and range erosion. This is essential to maintaining long-term conservation options, and it provides the best chance for retaining well-distributed, connected, and viable sage-grouse populations.

- *Target management and restoration*. Some sage-grouse populations may warrant more than the amelioration of the impacts to maintain birds on the landscape. In these instances, and particularly with impacts resulting from wildfire, it may be critical to not only remove or reduce anthropogenic threats to these populations but additionally to improve population health through active management (e.g. habitat restoration). This is particularly important for those populations that are essential to maintain range-wide resiliency, redundancy, and /or representation.
- *Engage all stakeholders in conservation through threat amelioration*. Successful implementation of regulatory and voluntary mechanisms to conserve sage-grouse requires that all stakeholders participate in threat amelioration, regardless of the size, type, ownership, or location of the threat impact. Continued losses by controllable individual activities of any size can result in significant impacts to the conservation of the species when considered cumulatively, and these losses also reduce management options.

General Conservation Strategies:

1) The COT acknowledges the following uncertainties as limiting our ability to prescribe a precise level of threat amelioration to ensure the long-term conservation of sage-grouse, especially on a range-wide level:
    a. We lack robust, range-wide genetics-based connectivity analyses;
    b. The specific number of populations required for long-term conservation is unknown;
    c. Successful restoration of lower-elevation and weed-infested habitats is currently limited by a lack of complete understanding of the underlying ecological processes, and in some areas because alteration of vegetation, nutrient cycles, topsoil, and living (cryptobiotic) soil crusts has exceeded recovery thresholds (Knick *et al*. 2003; Pyke 2011). Additionally, resources for restoration activities are often limited; and
    d. There is uncertainty as to the degree climate change will affect the amount and distribution of habitat in the future.

As a consequence, the COT recommends that impacts be avoided to the maximum extent possible. When avoidance is not possible, minimization and mitigation of the impacts should be implemented to sustain the functional value of the PAC impacted. This approach will ensure that potentially unidentified key components to long-term persistence of sage-grouse are not lost, and that management flexibility and the ability to implement adaptive management principles will be retained as current information gaps are filled. As described in the FWS 2010 listing determination (75 FR 13910, and references therein), local sage-grouse extirpations and habitat losses have already reduced management (and therefore recovery) options in some portions of the species' range (e.g.

the Columbia Basin, Washington). Further, many populations are in decline (WAFWA 2008; Garton *et al.* 2011) due to historic habitat loss and fragmentation, face significant threats (Table 2), or are inherently challenged by current population size. Implementing an avoidance first strategy will minimize or potentially preclude continuing declines in the species and its habitats, as well as limit further reduction in management and restoration options.

2) The COT recommends the appropriate level of continued management to effectively conserve all current PACs, as dictated by local ecological conditions and species status. State-developed PAC maps, along with the population threat status identified in Part 5 above, should inform these management actions; however, management actions should be specific to site condition and actual threats. To maximize resilience and move towards resistance, the COT recommends that threat amelioration plans should have the objective of maintaining C4 populations and their associated PACs, and of moving all other populations and associated PACs (C1 – C3) minimally to the next threat level (e.g., C1 to C2), and optimally to a C4 status. Additionally, the COT recommends conservation and restoration of C1 and C2 populations within the PACs, as appropriate, particularly those that are most beneficial in affecting population connectivity, or are important in maintaining the conservation parameters; and those that will prevent further range erosion.

   The COT recognizes that threat amelioration, even if all threats are removed, may not be sufficient to change the threat status of some C1 and C2 populations, as some of these populations (and associated PACs) are subject to non-anthropogenic threats (e.g., wildfire) or may have already declined to a point where active management is required for their long-term persistence. In these cases, the COT encourages pro-active management for non-anthropogenic threats (e.g. strategic placement of fire-fighting resources) and restoration efforts where the potential for successful long-term restoration is good. Management of C1 and C2 areas should not however preclude conservation actions necessary for maintaining C4 areas or improving C3 areas to a C4 status.

3) The COT recommends all stakeholders be enlisted to work cooperatively to develop threat amelioration plans for PACs based on local ecological conditions and local identified or potential threats.

4) The COT recommends the development and implementation of a robust, range-wide monitoring program for threat amelioration plans, which recognizes and incorporates individual state approaches. A monitoring program is necessary to track the success of threat amelioration plans and pro-active conservation activities. Without this information, the actual benefit of conservation activities cannot be measured and there is no capacity for adaptive management. Adequate funding must be secured for development and implementation of regulatory mechanisms, other conservation strategies, and monitoring programs.

5) The COT recommends increased funding and support for key research projects that will remove uncertainties for sage-grouse management. Effective amelioration of threats can only be accomplished if the mechanisms of those threats are understood.

6) The COT fully supports the development and implementation of pro-active, voluntary conservation activities for sage-grouse, (e.g. Candidate Conservation Agreements with Assurances, Natural Resources Conservation Service programs) and recommends they be closely coordinated across the range to ensure they are complimentary and address real, not perceived threats. These efforts need to receive full funding, including funding for personnel support if needed. The COT recommends that agencies engaged in voluntary conservation actions collect information on the geographic scope of these efforts, the sustained benefits from their implementation and the likelihood that they will continue to be implemented in the future.

Specific Conservation Strategies:

Short-term Recommendations (Greater sage-grouse by January, 2015; Bi-State DPS by June 2013)

The COT recommends that:

1) Each federal agency with land management responsibility and each state government within the geographic area included in the COT report develop a plan (or use an existing plan, if available) that includes clear mechanisms for ameliorating the threats to the sage-grouse within PACs. The COT recognizes that the threats can be ameliorated through a variety of mechanisms within the purview of states and federal agencies, including regulatory mechanisms.

2) Regulatory mechanisms be completed and implemented. The effectiveness of regulatory mechanisms and pro-active conservation activities will be assessed on whether such efforts will successfully ameliorate the specific threats associated with each population and its associated PACs (Table 2 in Part 5). Regulatory mechanisms and pro-active conservation actions should address all threats to a PAC to the maximum extent practicable.

3) Stakeholders consider the criteria used in the FWS *Policy for Evaluation of Conservation Efforts (PECE) when Making Listing Decisions* (Federal Register/Vol. 68, No. 60/Friday, March 28, 2003; Appendix C) as a measure by which the potential success of a threat amelioration plan for PACs can be assessed.

Threat amelioration plans should:

- Use local data on threats and ecological conditions (including status of local sage-grouse populations and their associated habitats);
- Maintain the diversity of sagebrush habitats essential to provide for all sage-grouse seasonal and life history stages;

- Maintain genetic and physical connectivity;
- Maintain all populations currently ranked as C4 in their current status to the maximum degree practicable;
- Manage populations identified as C3 to maintain such a level;
- Implement actions that will result in changing C3 populations to C4 status or demonstrate progress toward achieving that value when practicable. In addition to threat amelioration, restoration activities may be necessary to achieve this objective. Anthropogenic disturbances should be avoided to the maximum extent practicable. Restoration activities should be effective, and their effectiveness needs to be demonstrated prior to receiving any credit for mitigating losses. Restoration activities should be monitored to allow for adaptive management; and
- Manage PACs with a ranking of C1 or C2 for minimal anthropogenic disturbance, including managing for indirect effects such as noise. Any additional perturbations could lead to a population being reclassified from C2 to C1, or the extirpation of a C1 PAC, furthering population decline across the range of the species. When practicable, threat amelioration plans should also provide restoration opportunities that will change C1 and C2 populations and their associated PACs to minimally a C3 status and optimally, a C4 status.

4) All regulatory mechanisms and pro-active conservation plans should have a monitoring plan that will provide meaningful data regarding the effectiveness of each effort and the resources to support the mechanisms, plans and monitoring efforts. Adaptive management should be implemented if the regulatory mechanisms or pro-active conservation plans are determined to be ineffective.
5) If adequate regulatory mechanisms cannot be implemented in the short-term, then enforceable temporary measures should be considered in order to ensure threats will be at least temporarily ameliorate threats until such a time that an effective regulatory mechanism can be implemented.
6) Effective habitat conservation and, as appropriate, restoration activities, especially those for which with supporting mechanisms have already been developed, should be implemented. The typically long response times of sagebrush ecosystems to most management activities necessitates that these activities be initiated so that their results can be considered for long-term conservation strategies. A monitoring plan for these activities is an essential component of these efforts.
7) Develop effective strategies for ameliorating the impacts of wildfire in sage-grouse habitats. This can include development of preventative strategies (e.g. strategic placement of fire-fighting resources) as well as effective habitat restoration. Funding for necessary restoration material, including personnel costs should be secured.
8) Provide support and funding for scientifically designed research on uncertainties limiting effective sage-grouse and sagebrush management.

9) Provide funding and support for implementation of pro-active conservation actions. Continue funding and support for existing efforts.

Long-term Recommendations (beyond 2015 for Greater sage-grouse and 2013 for the Bi-state DPS)

The COT recommends:

1) Continued implementing of threat amelioration plans and restoration activities, as appropriate, to achieve the conservation goals outlined in the 2006 WAFWA Conservation Strategy (Stiver et al. 2006): "… *Produce and maintain neutral or positive trends in populations and maintain or increase the distribution of sage-grouse in each Management Zone.*"
2) Continued monitoring and adaptive management of regulatory mechanisms and pro-active conservation activities that ameliorate threats within each population and their associated PACs.
3) Continued support and funding of key research for determined necessary for effecting sage-grouse and sagebrush persistence.
4) Continued support and funding of pro-active conservation efforts.

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Appendix B. Management Zone and Population Risk Assessments. This information was used to inform the COT threat analyses. The management zones and populations are referenced in Figure 2.

Management Zone I: Great Plains

This management zone consists of four sage-grouse populations as identified by Garton *et al.* (2011), including the Dakotas, Northern Montana, Powder River Basin, and Yellowstone Watershed populations. All of these populations cross state or provincial boundaries. Garton *et al.* (2011) predicted an 11.1 percent chance this Management Zone will fall below 200 males by 2037, and a 24.0 percent chance it would fall below 200 males by 2107. Privately-owned lands are a major constituent of sagebrush landscapes in the Great Plains (66 percent), followed by BLM (17 percent), and then other ownerships (Knick 2011). After Management Zones II and IV, this zone contains some of the highest connected network of sage-grouse leks in the range (Knick and Hanser 2011). On the other hand, sagebrush habitat in 37 percent of this zone is 75-100 percent similar to sagebrush habitat in areas where extirpation has occurred (Wisdom *et al.* 2011). Generally, areas in this zone that are least similar to extirpation parts of the range include the western portions of Northern Montana and Powder River populations and the southeast corner of the Yellowstone Watershed population (Wisdom *et al.* 2011, Figure 18.5).

Dakotas

The Dakotas's population occurs on the far eastern edge of the range of sage-grouse. Much of the population occurs in the Cedar Creek Anticline. Garton *et al.* (2011) reported the minimum male count for this population at 587 and predicted a 66 percent chance that this population would dip below 200 males in the next 100 years. Population counts in 2012 for North and South Dakota were approximately 300, so this population as a whole very likely still exceeds 500 birds. Priority areas for conservation (PACs) in North and South Dakota are connected by general habitat consisting of limited sagebrush habitat. Sage-grouse movements generally occur east and west between the Dakotas's population and Montana. Connectivity between the sub-populations occurs through Montana's portion of the population (Knick and Hanser 2011). This area was identified as a PAC in Montana due to historically high density of sage-grouse and for the seasonal habitat it provides for birds from North Dakota, a likely conduit for *genetic connectivity*. The area is heavily influenced by oil and gas development and conversion of native rangeland to cropland is a major threat to the persistence of sage-grouse. Over-grazing in localized areas has degraded the sagebrush habitat and can reduce nesting success. Nesting success was positively correlated to grass cover in North Dakota (Herman-Brunson 2007). Overall, this population is small and at high risk (C1).

Northern Montana

The Northern Montana Population is predominantly in northeast Montana but extends north into southern Saskatchewan and Alberta, making up these provinces' entire sage-grouse populations. Garton *et al.* (2011) reported a minimum male count for this population at over 2,700 males and

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projected a very low probability (i.e., two percent) of the population dipping below 200 males in the next 100 years. The southern portion of this area, south of the Milk River, has a high abundance of sage-grouse, has been designated as a PAC, and is predominately comprised of public land. Land use in this area is livestock grazing with limited dryland farming and irrigated hay production adjacent to creeks and rivers. In general, habitat in this PAC is expansive and intact and faces few if any significant threats, particularly on the public lands. Grouse in this PAC make up the majority of birds in this population. North of the Milk River, habitats comprise a relatively low density of silver sagebrush and a correspondingly low density of sage-grouse. The sage-grouse habitats in this area include more private lands and, in some portions of this area, have a long history of grain farming and low to moderate densities of natural gas production. A PAC was designated in northern Valley County where relatively intact habitats provide for resident grouse as well as a conduit for spring and fall migrating sage-grouse between Saskatchewan and southern Valley County. This PAC is adjacent to considerable farming to the east but is itself relatively stable and lacks significant threats. One or more large conservation easements are in place to protect habitat values on key private lands in northern Valley County. Given the extent and limited threats associated with this population, it is considered to be at low risk (C4).

Powder River Basin

The Powder River Basin occurs mostly in Northeast Wyoming, but Montana includes the extreme northern tip of this population. A recent sagebrush cover assessment estimated average cover of sagebrush in the Powder River Basin to be 35 percent, with an average sagebrush patch size less than 300 acres (Rowland *et al.* 2005). Sagebrush patch size in the Powder River Basin has decreased by more than 63 percent in forty years, down from 820 acre patches and an overall coverage of 41 percent in 1964. Most of the occupied sage-grouse habitat in northeast Wyoming is privately owned. Approximately 70 percent of known leks, or strutting grounds used during the breeding season, are found on private land; the remaining 30 percent are found on FS, BLM, and State lands (Northeast Wyoming Sage-grouse Working Group 2006).

Garton *et al.* (2011) reported a minimum male count for this population at 3,042 and projected a high probability (86.2 percent) probability of falling below 200 males by 2107. A recent viability study done for BLM (Taylor *et al.* 2012) indicates that sage-grouse viability in the Powder River Basin is being impacted by multiple stressors including West Nile virus and energy development. Their results suggest that if development continues, future viability of the already small sage-grouse populations in northeast Wyoming will be compromised. The Powder River Basin holds vast energy resources including oil, natural gas, and coal bed natural gas (Northeast Wyoming Sage-grouse Working Group 2006). The state has a core area management strategy to help balance the priorities of retaining healthy sage-grouse population on the landscape and energy development.

Although the Montana piece of the Powder River Basin makes up a relatively small portion of the population, it may provide genetic connectivity with other Montana populations. Land use in Montana's portion of this population includes a mix of livestock grazing, coal mining, and shallow coal bed natural gas production. Montana identified relatively small but intact habitats that have limited energy development and may serve as remnant habitat for supporting small numbers of sage-grouse into the future. The expanding threat of energy development across the Powder River Basin and corresponding downward population index trends makes this overall an at risk (C2) population.

Yellowstone watershed

The Yellowstone Watershed Population is a large population covering an expansive area south of the Missouri River, making up the majority of sage-grouse habitats in southeast and south central Montana. Garton *et al.* (2011) reported a minimum male count of over 2,900 males. They further projected a 60 percent chance of this population dipping below 200 males in the next 100 years. Landownership is predominantly private with scattered tracts and blocks of public land. Livestock grazing and small grain farming are common in this area. Oil and gas developments are scattered across portions of this area. Extensive private lands have the potential for conversion of additional sagebrush habitats to farming and various forms of sagebrush eradication. Cropland conversion continues to take place in this area. Priority areas for conservation have been identified both in the western and southeastern portions of this population, where sage-grouse densities are greatest and habitats remain relatively intact. The western and southeastern PACs are separated by about 70 miles of a mix of habitats, including an interstate highway, the Yellowstone river corridor, and a patchwork of cropland intermingled with occupied sage-grouse habitat. Some portion of this space between PACs may be identified as PACs in the future as connectivity habitats become better understood and defined. Overall this is population is only potentially at risk (C3).

Management Zone II: Wyoming Basin

This management zone is made up of five sage-grouse populations as identified by Garton *et al.* (2011), including Jackson Hole, Laramie, Eagle-South Routt, Middle Park, and the Wyoming Basin. Colorado and Utah's portions of the Wyoming Basin are described separately as the NWCO and North Park subpopulations in Colorado, and the Rich-Summit-Morgan and Uintah Management Areas in Utah. This management zone represents the highest abundance of sage-grouse relative to other management zones across the sage-grouse's range. Garton *et al.* (2011) predicted a small, 0.3 percent chance, that this zone will fall below 200 males by 2037, and a 16.2 percent chance it would fall below 200 males by 2107. The majority of this management zone is represented by the Wyoming Basin population. Montana's portion of the zone is very small, only including the northern tip of the Wyoming Basin population in a portion of Carbon County. BLM and privately-owned lands are major constituents of sagebrush landscapes in this zone, representing 49 percent and 35 percent of the ownership, respectively (Knick 2011). Management Zone II contains the most highly connected network of sage-grouse leks in the range (Knick and Hanser 2011). This zone is also a stronghold for sage-grouse because it contains the second largest area of habitat range-wide (and the largest in the eastern range) with low similarity to extirpated portions of the range (Wisdom *et al.* 2011).

The Colorado portion of this management zone appears to capture redundancy and representation in the PACs. Priority areas for conservation represent 61 percent of the occupied range in

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Colorado and 84 percent of the breeding birds in the state. Being on the edge of the species range, the Colorado populations within this management zone are somewhat isolated. Linkage zones have been mapped among the Colorado populations and subpopulations (i.e., Eagle-South Routt, Middle Park, North Park, and NWCO. It is assumed the habitat linkages will allow for movement between populations and will decrease the probability of extinction of the subpopulations by stabilizing population dynamics. Connectivity between Wyoming's and Colorado's PACs may be adequate in most areas, but there may be some areas to address in the northwest Colorado area.

Eagle-South Routt

This population occurs in north-central Colorado and is separated from nearby populations by distance and mountainous terrain (Garton *et al.* 2011). Representation appears to be captured adequately in this population. Priority areas for conservation capture 68 percent of the occupied range in this population and include 100 percent of all known active leks. These areas also contain all habitats that were modeled "high probability of use" within four miles of leks that have been active in the last 10 years. Redundancy is not captured within this population because it is a fairly isolated population that is also fairly small (the three year average number of males from 2010-2012 is 108). The greatest threat to this population is loss of habitat from subdivision and housing development as well as the associated infrastructure and roads. Pinyon-juniper encroachment has been, and continues to be, a significant threat to the population as well. This population is mostly resilient but, due to its fairly small population size and isolation, it has little resiliency. Populations (in terms of males only) in the late 1960s were likely in the high 200s. This population is high risk (C1) because, given its smaller population size and isolation, a stochastic event could greatly negatively affect this population.

Middle Park

The Middle Park population occurs east of Eagle-South Routt in north-central Colorado and is separated from adjacent populations by distance and mountainous terrain (Garton *et al.* 2011). Representation and redundancy appear to be captured adequately in Middle Park. Priority areas for conservation capture 79 percent of the occupied range in this population and also include 95 percent of all known active leks. Furthermore, PACs contain 95 percent of all habitats that were modeled "high probability of use." Redundancy is captured reasonably well within this population because, although it currently has a three year running average of 210 males, the PACs include most of the known distribution of birds. Connectivity to the North Park population has been documented. Housing development has the most current and foreseeable threat. Grand County has experienced a high rate of human population growth in recent years. This high growth rate is projected to continue primarily due to its' proximity to major ski resorts and summer recreational activities. Although this is a relatively small population, Colorado Parks and Wildlife (CPW) does not believe the population has ever been very large. Since the 1970's, the population counts have been roughly between 200 and 325 males. Connectivity to the North Park population has always been somewhat naturally limited over Muddy Pass although CPW has documented birds moving over the pass. Overall this population is considered at risk (C2).

Laramie

This population consists of five leks located southwest of Laramie, Wyoming. Few birds are seen on these leks although one is routinely occupied by a small number of birds, despite the running average number of males per lek was zero from 2004 to 2007 (WAFWA 2008). None of these leks are contained in a PCA and four of these leks are threatened by proposed wind energy development. Overall this population is considered high risk (C1).

Jackson Hole

The Jackson Hole population is a small population located near Jackson Hole, Wyoming. This population is geographically isolated due to surrounding topography and limited habitat. This population consists of 16 leks (13 active in past 10 years and three inactive), of which only one is considered large (averaging over 40 birds). Population trend information indicates that this population is decreasing slightly, declining from an average of 20.5 males per active lek in 2005 to 14.9 males per active lek in 2011. Most of the breeding habitat in this population is contained within a single PAC. However there are three small subpopulations that are isolated from the main Jackson Hole PAC: Gros Ventre (two leks); Star Valley/State Line (two leks in Idaho) and Hoback Basin (one lek). Threats to this population consist of internal habitat fragmentation resulting from wildfires, prescribed burns, herbivory of sagebrush by elk and bison winter feeding operations, urban development and recreational activities. Grand Teton National Park and the National Elk Refuge encompass most of the PACs and protect much of the crucial habitat. This population exists in high mountain valleys with deep snowpack and the amount of available winter habitat is a limiting factor based on studies by Holloran and Anderson (2004) and Bedrosian and Craighead (2010). This population is on the western edge of this population, and Yellowstone National Park is just to the north, making Jackson Hole a popular tourist destination. Skiing and snowmobiling are prime recreational activities during winter. Urban development is limited as a result of limited private lands within this population, but includes some of the crucial winter habitat. Recently, energy development has begun on in the southern edge of this population (Hoback Basin). Population estimates, based on male lek counts, indicate that the total population numbers fluctuate, with a high of approximately 500 birds. Modeled population forecasts suggest that populations will decline, and long-term persistence is unlikely (Garton *et al.* 2011). Due to low population numbers, population isolation and a high degree of threats, this population is considered high risk (C1).

Wyoming Basin

This large population extends into Montana, Idaho, Utah, and Colorado. The population is separated from adjacent populations by distance and topography (Garton *et al.* 2011). This population is the largest population within the species' range (> 20,000 males attending leks annually), and is very robust. However, long-term population trends are slightly downward, although recent counts suggest an increase. Even so, population modeling suggest that declines will continue over the long term (Garton *et al.* 2011). This population is described in several smaller pieces, including the Wyoming portion (including the small piece that extends into Montana) of the population, Uintah and Rich-Morgan-Summit Management Areas in Utah, and North Park and NWCO subpopulations in Colorado.

Wyoming Portion

This large population covers approximately two-thirds of the State of Wyoming. It extends into Montana, Idaho, Utah and Colorado (Utah and Colorado portions are described separately). The population is separated from adjacent populations by distance and topography (Garton *et al.* 2011). Sage-grouse habitats are expansive and relatively intact outside of energy development areas. Despite the long-term declines in populations, implementation of the Wyoming Governor's Executive Order for sage-grouse may help alleviate these declines. The primary threats to this portion of the population are energy development and transfer, including both renewable and non-renewable resources, long-term drought, and brush eradication programs. Declines of sage-grouse near oil and gas fields in this area have been well documented (Lyon 2000; Holloran 2005; Holloran and Anderson; Kaiser 2006). Residential development has also been identified as a threat. Recent conservation actions, including the Wyoming Governor's Executive Order designating protective stipulations for core areas (PCAs) and the implementation of conservation easements within these areas have reduced the threat risk to this area. Designated state core areas (PCAs) adequately capture redundancy and representation for the Wyoming portion of this population. Due to the large size of this population, the presence of large, contiguous habitats, and regulatory measures providing habitat protection, this population is considered low risk (C4).

The majority of habitat that supports the Montana portion of the Wyoming Basin population is identified as a PAC, both because of the relatively high density of sage-grouse in the area and the likely role this area plays connecting Montana's sage-grouse to Wyoming's birds. In Montana, this area is among the driest of sage-grouse habitats and has a higher prevalence of cheat-grass relative to other parts of Montana. Land use includes livestock grazing and a long history of oil limited production. This portion of the Wyoming Basin Population is relatively small but is within 20 miles of another core area in Wyoming.

Rich-Morgan-Summit

The Rich-Morgan-Summit Sage-grouse Management Area is located in Northeastern Utah, and is a part of the Wyoming Basin population, a significant population center for grouse in Utah, Idaho, Colorado, and Wyoming. This management area also includes part of what is mapped in Garton *et al.* 2011 as Summit-Morgan Counties in Management Zone III. The area boundary was determined by consulting with adjacent states, Utah Division of Wildlife Resources, the Morgan-Summit Adaptive Resources Management Local Sage-grouse Working Group, and the Rich County Coordinated Resource Management Sage-grouse Local Working Group and follows vegetation types usable by sage-grouse. This portion of the population is regarded as stable with potential for growth. Based on a ten year average count of males on leks, the area had an estimated 1,223 males as of 2011. Sage-grouse in this area show resiliency to known threats, and are not regarded as being in jeopardy. Key threats to sage-grouse include invasive species, loss of agricultural operations, predation, residential development, and habitat fragmentation through recreational development. In conjunction with populations in Wyoming, the management area is considered low risk (C4).

Uintah

The Uintah Sage-grouse Management Area is located in northeastern Utah. This management area had an estimated 452 males on leks as of 2011. Within the northern portion of this area is the Diamond Mountain and Browns Park population, a significant population center for sage-grouse in Utah, Colorado, and Wyoming. The central and southern portions of the management area contain fragmented populations with minimal connectivity and low potential for habitat improvement. The Management Area boundary was determined by consulting with Utah Division of Wildlife Resources and the Uinta Basin Adaptive Resource Management Local Working Group, and follows vegetation types usable by sage-grouse. This portion of the Wyoming Basin population is regarded as stable with a potential for growth and also has strong connectivity with other portions of the population. Sage-grouse in the Management Area show resiliency to known threats, and are not regarded as being in jeopardy. Key threats to sage-grouse include predation, wildfire, invasive species, noxious weeds, disease, loss of agricultural operations, and habitat fragmentation (naturally occurring, but not topographical, and from existing and future anthropogenic uses). In concert with the remaining portions of this population, the management area is considered low risk (C4).

North Park

This portion of the Wyoming Basin population is located north of North Park in Jackson County, Colorado. In North Park (NP), representation and redundancy appear to be captured well. Priority areas for conservation capture 91 percent of the occupied range in this population and include 100 percent of all known active leks and 100 percent of habitat that was modeled "high probability of use" within 4 miles of a lek that has been active within the last 10 years. Historically no significant threats were apparent to this population. However, there is renewed interest in oil development in the area. In addition, a large portion (29 percent) of public land in PACs has been leased for energy development. North Park has overlapping energy and mineral resources and thus could experience natural gas, coal bed methane, and oil extraction. Although present, the other identified threats are less than other portions of the population. The habitat within PACs is in fairly good condition, and a large portion is on public lands. This is likely Colorado's most resilient area of occupied sage-grouse habitat. Long -term data trends (since the early 1970's) indicate this population has fluctuated roughly between 500 and 1,500 males. This subpopulation is considered low risk (C4).

Northwest Colorado (NWC)

NOTE: This draft document has been submitted for scientific peer review. It should therefore be considered incomplete as future revisions are possible.

In the northwest Colorado portion of this population, representation and redundancy appear to be captured adequately. Priority areas for conservation capture 56 percent of the occupied range and also include 95 percent of all known active leks and 95 percent of habitat that was modeled "high probability of use" within 4 miles of a lek that has been active within the last 10 years. Most of the sub-management zones within this portion of the population have some connectivity with other portions of this population. This is Colorado's largest area of sage-grouse occupancy and is considered to be at low risk of extirpation (C4). The northern portion is likely to be more resilient than the south eastern portions of this population because of habitat condition and connectivity. There is more habitat fragmentation in the south-eastern portion of this population. According to lek count data, the long-term trend appears to be stable, despite substantial fluctuations. Population peaks have occurred in 1960-70, 1978-80, and in the mid-2000s.

Management Zone III: Southern Great Basin

This management zone includes populations in California, Nevada, and Utah. The California populations are described separately in the Bi-State DPS section and the Summit Morgan Counties population is described in Management Zone II. The populations in this management zone include Southern Great Basin, Northeast Interior, Sheeprock, Quinn Canyon Range, South Central Utah, Northeast Interior Utah, Emery, and Northwest Interior. Garton *et al.* (2011) predicted a 0.0 percent chance this Management Zone will fall below 200 males by 2037, and a 7.8 percent chance it would fall below 200 males by 2107. Landownership in this zone is predominately BLM (71 percent), followed by private (13 percent) and others (Knick 2011). This zone is part of a stronghold for sage-grouse (that includes Management Zones III, IV, and V) because the three zones contain the largest area of habitat range-wide with low similarity to extirpated portions of the range (Wisdom *et al.* 2011). Despite the fact this zone has large areas of sagebrush habitat in Nevada this area faces large risks due to wildfire. Since it is difficult to restore burned habitat (Pyke 2011), the management approach for this area should provide a cushion to deal with fire events that are expected to occur but are not predictable in their location, extent, and outcome.

Northeast interior Utah

This population is located entirely in Utah and has been divided into the Strawberry Valley and Carbon Management Areas.

Strawberry Valley

The Strawberry Valley Sage-grouse Management Area is located in central Utah, and is a significant population center for sage-grouse in Utah. This management area had an estimated 82 males on leks as of 2011. The area boundary was determined by consulting with DWR and the Strawberry Valley Adaptive Resource Management Local Working Group, and follows vegetation types usable by sage-grouse. Significant restoration efforts have been conducted on this population and it is the most intensively managed in Utah. This population is regarded as stable with a high potential for growth. Sage-grouse in this area had_suffered significant reductions in populations, but these concentrated restoration efforts have significantly increased this population. Due to its smaller size, Strawberry Valley is considered at risk (C2).

Carbon

The Carbon Sage-grouse Management Area is located in the northern portion of the Colorado Plateau in central Utah. This management area had an estimated 119 males on leks as of 2011. The area is characterized by highly broken terrain, with deep canyons and mid-elevation plateaus. Telemetry studies in the area suggest that occasionally sage-grouse migrate to and from the adjoining Strawberry Valley portion of this population. The area boundary was determined by buffering active leks with topographic imagery, and adding areas of known winter use. Key threats include habitat loss and fragmentation due to a variety of factors including energy development, wildfire, invasive species, and predation. West Nile Virus has been reported in Carbon in the last 10 years. The management area is at risk (C2).

Emery

The Emery population in Utah is considered the Emery Sage-grouse Management Area and is also known as the Sanpete-Emery Counties population in Garton *et al.* (2011). This population had an estimated 30 males on leks as of 2011. Small, mostly isolated sage-grouse populations occupy high elevation sagebrush steppe on the eastern slope of the Wastach Plateau. Although no direct movement between these areas has been documented, this population is relatively close to the South Central Utah population (Parker Mountain portion). This populatin includes all currently used habitat and corridors connecting this habitat. Key threats to the population include woody species encroachment, wildfire, invasive species, predation, and habitat fragmentation. Due to its smaller size, Emery is considered at risk (C2).

Sheeprock

The Sheeprock population in Utah is a relatively isolated population center also known as the Sheeprock Mountains Management. Garton *et al.* (2011) refers to this as the Toole-Juab Counties population. This population had an estimated 102 males on leks as of 2011. The area boundary was determined by consulting with the West Desert Adaptive Resource Management local working group and Utah Division of Wildlife Resources, and follows vegetation types usable by sage-grouse. This population is regarded as stable with a potential for growth. Sage-grouse in this area show resiliency to known threats. Key threats to sage-grouse include wildfire, invasive species (cheatgrass and knapweeds), potential loss of riparian areas due to water piping, predation, and habitat fragmentation (dispersed recreation and pinyon-juniper encroachment). The management area has a risk ranking of C1 (high risk).

South Central Utah

The population is located entirely within Utah and is one of its largest. It has been divided into three portions for management purposes including the Greater Parker Mountain, Panguitch, and Bald Hills.

Greater Parker Mountain

The Greater Parker Mountain Sage-grouse Management Area portion of the South Central Utah population is located on the Awapa Plateau and nearby environments. The Greater Parker Mountain Local Area Working Group was established in 1996 and is the longest operational working group in Utah. The boundaries of this portion of the population were refined based on 15 years of greater sage-grouse radio telemetry studies which included research on species vital rates, survival, and seasonal movements. Boundary refinements included consultations with the working groups and the Utah Division of Wildlife Resources. This area had an estimated 821 males on leks in 2011. Because of these long term research studies in this area, more is known about the sage-grouse population dynamics, seasonal habitat use, population threats, and abatement strategies in this area than in other areas of Utah. This portion of the population includes all connected currently used habitats and the corridors connecting these habitats. Key sage-grouse threats identified include; 1) loss or degradation of habitat (primarily due to vegetation succession), 2) conversion of habitat (sagebrush to pinyon-juniper or cheat grass at the lower elevations), 3) increased risk of predation because of expanding or changes in the native predator community in response to anthropogenic factors, and 4) habitat fragmentation from loss or degradation of habitat that results in a loss of habitat connectivity in sage-grouse habitat areas. The population has a risk ranking of C3 (potential risk).

Panguitch

The Panguitch portion of the South Central Utah population is referred to as the Panguitch Management Area. It incorporates more than a dozen leks, often inter-connected. This area had an estimated 304 males on leks in 2011. This portion of the population is distributed north-south in a series of linked valleys and benches, and constrained by mountains and canyons. There is a large range in the number of males in attendance among these leks. Movement of sage-grouse from one valley or bench to another among seasons is necessary to meet their seasonal habitat requirements in the highly variable annual weather conditions of this region. This area has the highest potential for increase in Utah due to habitat treatments to remove pinyon-juniper. Key threats to sage-grouse in this area are enhanced native predator populations, vegetation management (conflicting or lack of), energy development, and residential/commercial development. The management area has a risk ranking of C3 (potential risk).

Bald Hills

The Bald Hills portion of the South Central Utah population is referred to as the Bald Hills Management Area. This area had an estimated 68 males on leks in 2011. Currently, sage-grouse in the area are constrained by vegetation fragmentation and human development. However future improvements could connect this population to the Southern Great Basin population (Hamlin Valley portion) to the west. This portion of the South Central Utah population is regarded as stable with a high potential for growth. Sage-grouse in this area show resiliency to known threats and are not considered as being in jeopardy. Key threats include wildfire, enhanced native predator populations, vegetation management (conflicting or lack of), and energy development. Although the area has a risk ranking of C2, connectivity with other portions of the population (Greater Parker Mountain and Panguitch) might support a higher ranking of C3

Northwest Interior

This population is largely within Pershing County, Nevada, but also incorporates a portion of western Lander County and southeastern Humboldt County. Little PACs are mapped within this population other than some habitats within the Sonoma Range in southeastern Humboldt County, the Tobin Range in eastern Pershing County, and the Fish Creek Range in western Lander County. Priority areas for conservation identified within these ranges largely cover all remaining suitable habitat for sage-grouse. There were not enough data for Garton *et al.* (2011) to conduct an analysis on population trends or persistence estimates. The largest sub-populations within this area are within the Sonoma-Tobin complex and the Fish Creek Range. Lek count information from both of these areas suggest that there is less than 500 birds in each one of these populations and the potential for connectivity appears low, but possible. Other sub-populations within this area (e.g., Eugene Mountains, East Range, Humboldt Range, Majuba Mountain, and Trinity Ranges) have extremely low populations (<50 birds) with some of these ranges having populations that are extirpated due to severe wildfire and inability of the habitat to recover. Much of these areas are now monotypic stands of cheatgrass and tansy mustard. Overall, this population is high risk (C1).

Southern Great Basin

This population contains the largest number of sage-grouse within Management Zone 3. It is relatively expansive and divided into a Nevada portion and Ibapah and Hamlin Valley portions within Utah.

<u>Nevada</u>

The Nevada portion of this population contains the largest number of sage-grouse this population. Suitable habitats are somewhat uncharacteristic of sage-grouse habitats in that use areas are disjunct, but connected. This is due to the "basin and range" topography that is characteristic of this region. Lower elevation valley bottoms often are dominated by playas and salt desert shrub vegetation, but transcend quickly into sagebrush dominated benches, which often comprises the breeding and winter habitat. Moving up in elevation, pinyon-juniper woodlands dominate the mid-elevation and gives way to little sagebrush, mountain big sagebrush and mountain shrub communities utilized by sage-grouse as nesting and brood rearing habitat.

Priority areas for conservation adequately capture important use areas for this population as all use areas were mapped to the greatest extent practical under the time constraints given to complete a map for the BLM's interim guidance. Redundancy and representation exist within this population, largely because it covers a large geographic area. Most populations appear to be connected as indicated through recent telemetry investigations and the availability of suitable habitat available between sub-populations within this region. Resiliency of the habitat is in question due to threats, either projected or realized, in the lower elevation habitats as explained below.

Garton *et al.* (2011) determined that this population has declined by 19 percent from the period 1965-69 through 2000-2007 and that average rates of change were <1.0 for three of the eight analysis periods from 1965-2007. In addition, Garton *et al.* (2011) determined that this population has a two percent chance of declining below 200 males within the next 30 years and a 78 percent chance of declining below 200 males within 100 years (by 2107).

Some of the historic habitat available to sage-grouse within this population has transitioned to pinyon-juniper woodlands. Wisdom *et al.* (2005) determined that 35 percent of the sagebrush area in the eastern Great Basin is at high risk to displacement by pinyon-juniper woodlands and that mountain big sagebrush appeared to be most at risk which could have meaningful impacts to sage-grouse brood rearing habitats within the upper elevations of mountain ranges within this region. In addition to this threat, much of the Great Basin is also susceptible to displacement by cheatgrass. The most at risk vegetative community in this region is Wyoming-basin big sagebrush (Wisdom *et al.* 2005) located predominately within the lower elevation benches of mountain ranges. In some areas, this has been realized and the future risk for existing sagebrush habitats is moderate to high. This threatens both breeding and winter habitats for sage-grouse. Overall, the Southern Great Basin in Nevada is potentially at risk (C3).

Ibapah

The Ibapah portion of the Southern Great Basin population is also referred to as the Ibapah Management Area is located in northwestern Utah. This area had an estimated 39 males on leks as of 2011, primarily on Goshute Tribal lands. The area boundary was determined by consulting with Nevada, the West Desert Adaptive Resource Management Local Area Working Group, and the Utah Division of Wildlife Resources and follows vegetation types used by sage-grouse. Sage-grouse in this area show resiliency to known threats, and are not regarded as being in jeopardy. Key threats to sage-grouse are fire, invasive species (cheatgrass and knapweeds), potential loss of riparian areas due to water piping, predation, and habitat fragmentation (dispersed recreation and pinyon-juniper encroachment). Despite this area having fewer than 200 males, when considered as a whole with the rest of the population, this area has a risk ranking of C3 (potential risk).

Hamlin Valley

The Hamlin Valley portion of the Southern Great Basin population is also referred to as the Hamlin Valley Management Area. It is located in southwestern Utah, on the border of Utah and

Nevada and is important due to its connectivity with other portions of the population. Although currently isolated from other habitat areas in Utah, habitat restoration could link this population to the South Central Utah population. This area consists of a relatively small number of birds (i.e., 89 males in 2011) that use less than 10 leks throughout the habitat area. Telemetry data has not shown that birds known to travel large distances within this areas and in the Naevada portion of this population, particularly during summer. This portion of the population is regarded as moderately stable with a high potential for growth. Key threats include wildfire, enhanced native predator populations, vegetation management (conflicting or lack of), wild horse management, and habitat fragmentation. Despite the area having fewer than 200 males, when considered as a whole with the rest of the population, this area has a risk ranking of C3 (potential risk).

Quinn Canyon Range

This is a very small and isolated population located in southeastern Nevada. There were not enough data for Garton *et al.* (2011) to conduct an analysis on population trends or persistence. Two to three leks have been identified in this area, but there is very little information associated with these sites and most of this information is anecdotal. Habitat within this area has been compromised by pinyon-juniper encroachment. No PACs were identified for this population largely because the majority of vegetative associations are either salt desert shrub communities or pinyon-juniper stands. Very little sagebrush exists within this population. Overall this is a high risk (C1) population.

Management Zone IV: Snake River Plains

This zone represents one of the largest areas of connectivity, as demonstrated by Knick *et al.* (2011), and supports the largest population of sage-grouse outside of the Wyoming Basin (Garton *et al.* 2011). The Snake River Plain management zone includes sage-grouse populations in Oregon, Idaho, Nevada, Utah and Montana. Garton *et al.* (2011) predicted a 10.5 percent chance this Management Zone will fall below 200 males by 2037, and a 39.7 percent chance it would fall below 200 males by 2107.

Baker

The Baker population has approximately the same distribution as the area covered by the Baker administrative unit identified in Oregon's Sage-grouse Conservation Strategy (Hagen 2011). The Baker spring population was estimated to be 872 -1,650 birds in 2010, the smallest extant population of sage-grouse that is exclusively in Oregon. Garton *et al.* (2011) based their Baker population assessment on minimum estimate of 137 birds in 2007 and estimated a 61.9% chance there will be fewer than 50 birds in the population by the year 2037, similarly, there is 66.8% chance of fewer than 50 birds by 2137. The Oregon Department of Fish and Wildlife lek counts indicated more than 300 males (or 750 birds if applying the Garton *et al.* (2011) 2.5 sex ratio) in Baker County in 2011. Since systematic counts began in 1989, the number of counted males/lek has remained relatively stable (Hagen 2011). Due to habitat and topography it has been assumed the Baker population has little connectivity with other sage-grouse populations. Recent telemetry information suggests that at least some birds move between the Weiser population in Idaho and the Baker population.

The Baker population is more at risk and probably less resilient since connectivity to other populations appears limited (future genetics work will help clarify this). There is no redundancy in this population as everything occurs in one general area. Also, the quality of habitat is more similar to extirpated populations than extant ones (Wisdom *et al.* 2011). Finally, much of this population occurs on private lands where there are limited regulatory mechanisms, making it uncertain as to whether state-recommended conservation measures and practices will be applied on the majority of lands within this population.

More than 80% of the historic habitat for the Baker Population remains available today but steeper habitat and rugged topography reduces the suitability for sage-grouse. Nearly 300,000 acres in this region were identified as priority areas for conservation, and includes much of the current range of the Baker population. Most (68%) of the sage-grouse habitat for the Baker population is in private ownership and 31% is administered by BLM (Hagen 2011). This is the largest proportion of privately managed sage-grouse habitat for any population in Oregon. Principal threats to this population include renewable energy development (primarily wind), transmission, invasive weeds, OHV recreation, and juniper encroachment. Recently, thousands of acres of juniper have been treated in this region to benefit sage-grouse and other sagebrush obligates. Overall, this population is considered at risk (C2). Most of the area used by this population has been mapped as priority habitat.

East-Central Idaho

Areas within the East Idaho Uplands in the Blackfoot River drainage downstream from Blackfoot Reservoir have historically provided popular sites for greater sage-grouse hunters. The area is generally characterized by a high proportion of private and state land and a local working group has been actively pursuing conservation measures. Nevertheless little information is available on sage-grouse populations other than some limited location and attendance data on a few leks. No lek routes have been established within this area that would allow consistent monitoring of sage-grouse populations. This lack of data is largely due to very difficult access in most years during winter and spring. Analysis of limited data by Garton *et al.* (2011) suggests that this population has a low probability of persistence. Although causal observation and some historic data suggest the study area provides adequate breeding and nesting habitat, sage-grouse numbers appear to be very low. Initial summer surveys in 2011 suggested sage-grouse were reasonably widespread throughout the area. However, given the apparent overall quality of the habitat, sage-grouse numbers seem surprisingly low and difficult to explain. Factors that could act to reduce sage-grouse populations in this area include sagebrush treatments in breeding habitat, West Nile virus, and loss or fragmentation of winter range. Overall this population is considered high risk (C1).

Southwest Montana

The Southwest Montana Population occurs in Beaverhead and Madison Counties, within a 60 mile radius of Dillon, MT. Segments of this population also make seasonal migrations into Idaho. Garton *et al.* (2011) analyzed the Southwest Montana population as 4 separate smaller populations (i.e., Bannack, Wisdom, Red Rock, and Bridges), which biased the results of their analysis, suggesting a high probability of each population dropping below 200 males. Telemetry data, however, has demonstrated considerable intermingling between each of these lek complexes, clarifying that these birds represent a single population (and could be more accurately described as four sub-populations). Priority areas for conservation encompass about 80 percent of the habitat associated with the Southwest Montana Population. These PACs were identified because of the relatively high density of sage-grouse and the genetic conduit this area provides with Idaho's birds. Habitat threats are generally limited to improper grazing management, isolated sagebrush control efforts, and expansion of conifers into sage-grouse habitat in localized instances. Habitat conversion on the Idaho side of this Management Zone may also affect this population, but to a lesser extent. Both the Centennial and Big Hole valleys are focus areas for native habitat conservation for grayling, sage-grouse and other wildlife, resulting in considerable acreage enrolled in long term and perpetual conservation agreements with private landowners. Given this population's size, limited habitat threats, and ties to Idaho's birds, the Southwest Montana population is characterized as being at a low level of risk (C4).

Snake-Salmon-Beaverhead

Recent data indicates this large population extends into southwestern Montana. This area contains a large amount of publicly managed land (largely BLM and USFS). Within the southern portion of this population, wildfires and invasive species have continued to reduce the quality of habitat. The mountain Valley portions of this population appear to have relatively stable habitats. A recent rate of change analysis indicates this population has been stable to increasing from 2007 to 2010. Garton *et al.* (2011) indicated that this population had virtually no chance of declining below 500 in the next 100 years. Population analysis indicates that sage-grouse have fluctuated around 5,000 males since 1992. Overall this population is considered low risk (C4).

Belt Mountains

This population occurs within a broad intermountain valley that extends roughly from White Sulfur Springs south toward Livingston, within Meagher and Park Counties. This population experienced considerable habitat conversion to small grain cropping in the late 1960s through the 1980s, involving at least one key sage-grouse wintering area (Swenson *et al.* 1987). Ironically, some of these croplands have since been enrolled into the Conservation Reserve Program (CRP) but natural sagebrush recovery appears minimal. Garton *et al.* (2011) were unable to develop any population predictions due to a lack of sufficient data. This population is at least 50 miles distant from the nearest adjacent population. Timbered and mountainous terrain and expansive non-habitat barriers further isolate this population in nearly every direction. Sagebrush control projects, primarily using herbicides, and conversion to cropland and domestic seeded pastures have continued to affect portions of the remaining habitat during the past 20 years. More recently, isolated housing developments and limited drilling for oil and/or gas resources have

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impacted a relatively small portion of remaining sagebrush grassland habitats in this area. The small population size, isolation from other populations, and a history of significant habitat perturbations, some of which continue but perhaps at a slower rate, characterizes this population as high risk (C1).

Weiser

This small population in western Idaho did not have sufficient data to allow analysis by Garton *et al.* (2011). However, 2010 data indicated the area had 14 occupied leks. Recently some connection with the Baker, OR population has been documented. The area is generally characterized by a high proportion of private land and a local working group has been actively pursuing conservation measures. This population is considered at risk (C2).

Northern Great Basin

The Northern Great Basin population is a large population in Oregon, Idaho, Nevada, and Utah. It has been divided into the large portion in Oregon, Idaho, and Nevada and a smaller portion in northwestern Utah called the Box Elder area. This area contains a large amount of publicly managed land (largely BLM). Despite efforts to manage wildfire risks, wildfires and invasive species have continued to reduce the quality of habitat in portions of this area. The Murphy fire complex recently affected roughly 600,000 acres of habitat for this population. A recent rate of change analysis indicated that at least part of this large population has been stable to increasing from 2007-2010. Garton *et al.* (2011) indicated that this population had virtually no chance of declining below 50 in 30 or 100 years. Population analysis indicated that sage-grouse will fluctuate around a carrying capacity that will decline from an estimated 6,770 males in 2007 to 1787 males in 2037 if current trends continue (Garton *et al.* 2011). Overall this part of the population is potentially at risk (C3).

<u>Oregon, Idaho, and Nevada Portion</u>

Redundancy and representation appear to be captured adequately in the PACs. In Oregon, PACs capture 95 percent of all known breeding locations, 98 percent of known wintering locations (which was expected since this was based on telemetry data), and 89 percent of known summer locations. Priority areas for conservation and low density (non-priority but managed) habitat combined capture all but three percent of known summer, one percent of known breeding, and one percent of known wintering habitat. Oregon PACs also considered the need to maintain a network of connected habitats.

The Nevada portion of the Northern Great Basin population represents the largest, most contiguous concentration of sage-grouse in Nevada and includes the Santa Rosa, Desert, Tuscarora, North Fork, O'Neil Basin, Islands, Snake and Gollaher Population Management Units. Portions of this area are well connected with Oregon, Idaho and Utah. The northern Great Basin population in Nevada is demonstrating at least some resiliency. Rehabilitation efforts and the higher elevation/higher precipitation zones for some recent wildfires have led to expedited habitat recovery that is once again being utilized by sage-grouse. Winter habitat in some areas has been compromised although recent winter snowpack has been below average, allowing birds to utilize an expanded area. Concern remains over the Gollaher and Tuscarora population management units as these areas have been prone to wildfire and are more susceptible to invasive species such as cheatgrass.

Oregon represents the western part of this large population which is shared with Southern Idaho, NE Nevada, and NW Utah. Within Oregon, this represents one of the largest populations. The delineation of the Northern Great Basin population doesn't correspond well to any existing assessment for Oregon, but does include almost all of the Vale administrative unit, as well as portions of the Burns administrative unit. In just Oregon, the spring population in the Northern Great Basin is likely several thousand birds, with 2011 spring lek counts approaching 3,000 males (or 7,500 birds if applying the Garton *et al.* (2011) 2.5 sex ratio) in the Beulah, Malheur River, Owyhee, and eastern portion of Whitehorse Wildlife Management Units. Garton *et al.* (2011) estimated for the Northern Great Basin a minimum population estimate of 9,114 birds in 2007 (includes S. ID, NE NV, NW UT). Modeling suggested there is a 2.5% chance birds will drop below 500 by the year 2037, but a 99.7% chance the population will be below 500 by 2137 (Garton *et al.* 2011). Between 1963 and 1974, 500,000 acres of sagebrush habitat was seeded to crested wheatgrass or sprayed with herbicide, and 1,600 water developments and 463 miles of pipeline were installed in the Vale District BLM's area for the Vale project. Wildfire has exacerbated the problems. In many instances, these areas were historically dominated by Wyoming big sagebrush habitat. Other threats in this region include mining development, renewable energy development, transmission, and juniper encroachment at higher elevations. West Nile virus has also been consistently detected in mosquitoes in this region and the population was subjected to the largest known West Nile virus mortality event involving sage-grouse in Oregon (2006).

Despite efforts to manage wildfire risks, wildfires and invasive species have continued to reduce the quality of habitat in portions of this area. Overall this part of the population is potentially at risk (C3).

<u>Box Elder</u>

The Box Elder portion of the Northern Great Basin population is located in northwestern Utah. This area is referred to as the Box Elder Management Area. It had an estimated 755 males on leks as of 2011. This population is regarded as stable with a potential for growth. Key threats include wildfire, invasive species, loss of agricultural operations, and habitat fragmentation. The area can likely sustain increases in sage-grouse populations with continued reclamation and restoration. Resource management in the area has contributed to large populations to date, and those populations can be enhanced by providing high quality habitat. As a result, this area should be a high priority for funding of habitat enhancement. Because this area is a portion of the large Northern Great Basin population, it has a risk ranking of C3 (potential risk).

Sawtooth

This small population in central Idaho did not have sufficient data to allow analysis by Garton *et al.* (2011). No occupied leks are known to exist at this time. This area is largely encompassed by the Sawtooth National Recreation Area and includes a high proportion of public land. This population declined to one male on one lek in 1986 and was subsequently increased by translocation during the mid-1980s. Overall this population is high risk (C1).

Management Zone V: Northern Great Basin

There are four sage-grouse populations identified in this management zone, including Central Oregon, Klamath, Warm Springs Valley, and the Western Great Basin. Garton *et al.* (2011) predicted a 2.1 percent chance this Management Zone will fall below 200 males by 2037, and a 29.0 percent chance it would fall below 200 males by 2107. Only two of the populations (Central Oregon and Western Great Basin) had sufficient information for a population assessment by Garton *et al.* (2011). BLM lands are a major constituent of sagebrush landscapes in the Northern Great Basin (62 percent), followed by private (21 percent), Forest Service (10 percent), State (8 percent), and then other ownerships (Knick 2011). This zone is part of a stronghold for sage-grouse (that includes Management Zones III, IV, and V) because the three zones contain the largest area of habitat range-wide with low similarity to extirpated portions of the range (Wisdom *et al.* 2011).

Central Oregon

The Central Oregon population has approximately the same distribution as the area covered by the Prineville administrative unit identified in Oregon's Sage-grouse Conservation Strategy. Approximately 700,000 acres of habitat for the Central Oregon population has been identified as priority areas for conservation. This is a relatively large population, with the minimum spring population estimated at 1,775-2,084 birds in 2010 (Hagen 2011). The population has declined steadily since 1980 (average, -0.004 percent/yr [Hagen 2011]). There is a 15.2 percent chance the population will decline below 500 by 2037, and a 91.3 percent chance that fewer than 500 birds will be in the population by 2137 (Garton *et al.* 2011).

This population is estimated to have only 53 percent of historic sagebrush habitat, having lost more historic habitat than any other sage-grouse administrative unit in Oregon. The area also has more privately owned sage-grouse habitat (48 percent) than most other sage-grouse management zone populations in Oregon. This population faces a wide suite of threats, including juniper encroachment, renewable energy development (both wind and geothermal), transmission, roads, OHV recreation, and residential development. Projections based on historic trends suggest this population is at risk, but in the last 2 years there have been a number of positive developments including thousands of acres of habitat improvement under the NRCS's Sage-grouse Initiative and increasing local interest sage-grouse conservation. Overall this population is considered a split between C2 (at risk) and C3 (potential risk).

Based on Garton *et al.* (2011), this population appears fairly resilient in 30 years, but not in 100 years. Redundancy and representation appear to be captured adequately. PACs capture 95 percent of all known sage-grouse breeding locations, 98 percent of known wintering locations, and 89 percent of known summer locations. Priority areas for conservation and low density (non-priority but managed) habitat combined capture all but three percent of known summer, one percent of known breeding, and one percent of known wintering habitat. Since this population's habitat/landscape appears more similar to landscapes in extirpated populations than extant populations (Wisdom et al. 2011), we suggest retaining all priority habitats for this populations. Most of the sites within this population (with the possible exception of the southwestern site) probably have some connectivity with other sites in this population, though verification from genetics is lacking. Although a lot of the known habitat is mapped, we suggest retaining all PACs in Central Oregon.

Klamath

The Klamath population is all that remains of a population that once extended throughout the Devil's Garden Area of California, which had at least 46 known leks as recently as the 1970s, and was well connected to populations in Oregon and the Western Great Basin. By the early 2000s, only one known lek remained on the Clear Lake National Wildlife Refuge, with less than 10 males. Since 2005, birds have been translocated from Oregon and Nevada to prevent extirpation. A small amount of priority habitat is mapped for the area, but not connected to the Western Great Basin or Central Oregon populations. Redundancy is not adequate and resistence is poor. This population would be at immediate risk of extinction without augmentation. There is no priority habitat mapped in this population for Oregon because we have not documented birds there recently.

There are no priority areas for conservation mapped for this population in Oregon because sage-grouse in the Oregon part of the Klamath population are thought to be extirpated. As recently as the early 1990's, a few birds attended leks in Oregon, but there have been no confirmed sightings since 1993 despite periodic survey efforts. A few birds exist on the California side, particularly in the vicinity of Clear Lake National Wildlife Refuge. Oregon has permitted the trapping of birds from the Western Great Basin population to augment the population around Clear Lake. The Klamath population lacks resiliency and is at risk of extirpation and therefore is a high risk (C1) population.

The Klamath population in Oregon likely had limited connection with sage-grouse populations to the east due to barriers of unsuitable habitat and was likely an extension of the population in northeast California. Habitat in Oregon was severely compromised by juniper encroachment. Significant juniper treatments have taken place in the former Oregon range, particularly by BLM, and there is potential of limited habitat for sage-grouse in the future. Juniper encroachment, and invasive weeds, have also compromised the habitat it in California. Large treatments of juniper have been conducted on the Clear Lake NWR and in the vicinity in hopes of expanding suitable habitat in that area.

Warm Springs Valley

This is a small population that exists in southern Washoe County within the Virginia Population Management Unit. Only two confirmed active leks comprise this population; however, lek size is relatively large (average of over 40). The identified PACs encompass the majority of use areas. Extensive research has been conducted within this particular Population Management Unit. Some individuals have dispersed to the southern portion of the western Great Basin population during the winter, so there is the possibility of genetic interchange. There is an indication of this within work conducted by Oyler-McCance *et al.* (2005) suggesting a relationship with the Lassen population in California. Representation and redundancy are at risk within this population due to its small size, proximity to urbanized setting and threats from invasive species.

The Warm Springs population in southern Washoe County may be close to a threshold if additional threats occur. This population is very near to urbanization, has experienced large wildfire and energy development in the form of a utility scale transmission line (345kV Alturas line) and water transfer pipeline (Vidler Water), and is experiencing some pinyon-juniper encroachment. However, the primary area used by sage-grouse in the population (Spanish Flat) remains intact and benefits from higher elevation precipitation regimes. Overall, this is population is at risk (C2).

Western Great Basin

The Western Great Basin population is shared among Oregon, northeastern California and northwestern Nevada. Garton *et a*l. (2011) estimated for the Western Great Basin a minimum population estimate of 5,904 birds in 2007 (includes NE CA, NW NV). Over 8 analysis periods conducted by Garton *et al.* (2011), average rates of change were <1.0 in 3 of those periods and the minimum population estimate was determined to be 5,904 males in 2007 based on counts at 393 leks. Modeling suggested there is a 6.4 percent chance birds will drop below 500 by the year 2037, but a 99.1 percent chance the population will be below 500 by 2137 (Garton *et al.* 2011). The Western Great Basin is the most resilient population in Management Zone 5, but reducing threats alone is not likely to ensure long-term persistence in some areas. Resiliency needs to be improved in the California portion of the Western Great Basin with increased habitat suitability in terms of shrub densities and native grasses and forbs.

Oregon's portion of the population has some of the best habitat and highest sage-grouse densities in the state, including Hart Mountain National Antelope Refuge and Trout Creek Mountains. The delineation of the Western Great Basin population doesn't correspond well to any existing assessment for Oregon, but does include almost all of the Lakeview administrative unit, as well as portions of the Burns and Vale administrative units. In just Oregon, the spring population in the Western Great Basin likely exceeded 10,000 birds in 2010 (interpolation from Hagen 2011). In the Oregon, >80 percent of the historical sage-grouse habitat remains intact, and most of the habitat is in public ownership (Hagen 2011). In the Lakeview administration unit, which comprises most of the Western Great Basin population in Oregon, about 78 percent of the region is administered by the BLM and the FWS manages more than 278,000 acres. Invasive weeds and juniper encroachment (particularly on the western edge) represent some of the greatest risks to this population. Renewable energy development (wind and geothermal) and fire also represent risks to the Oregon portion of the population. Feral horses have been identified as a threat to sage-grouse habitat in portions (e.g., Steens, Dry Valley/Jack Mountain Action Areas) of the Western Great Basin. Given the majority of this population occupies federal land, proper and proactive habitat management could ensure the persistence of this sage-grouse population well into the future. Redundancy and representation appear to be captured adequately in the Oregon portion of this population based on the fact that priority habitats include most of the known distribution of birds (see rationale in Central above).

The California portion of the Western Great Basin includes the majority of the Buffalo-Skedaddle Population Management Unit. Priority habitat in California includes 100 percent of known sage-grouse distribution. This population was part of a much larger population that was connected to the Klamath population into the 1970's. Habitat degradation, including juniper expansion and spread of exotic grasses have been extraordinary in this region. The extant population is well connected and adequately captures redundancy, but further losses would jeopardize the long term existence of sage-grouse in California. Recent population trends have shown consistent increases, demonstrating that the population exhibits positive growth rates during years of favorable environmental conditions. Habitat suitability is low in much of the currently occupied habitat and habitat conditions need to be improved to increase resistance of this population.

The Nevada portion of this population includes the Buffalo/Skedaddle, Massacre, Vya, Sheldon, Black Rock, Pine Forest and Lone Willow Population Management Units. Currently identified priority habitat encompasses an area greater than the 85 percent core breeding density as reconstructed by the Nevada Department of Wildlife using methods described by Doherty *et al.* (2010), but utilizing the 10-year average for lek attendance rather than the most recent peak. Redundancy and representation are adequately captured both within the Nevada portion of this population and certainly within the Western Great Basin population as identified by Garton *et al.* (2011).

The Lone Willow area (connected with Oregon) faces threats from lithium and uranium exploration and extraction. Both the Massacre and Buffalo/Skedaddle Population Management Units face high risk due to invasive species being pervasive within the understory of lower elevation sagebrush communities. Improper livestock grazing practices and wild horse utilization have caused severe habitat degradation in some instances, especially with respect to meadow, spring and riparian habitats.

The Western Great Basin is most resilient in MZ5, but reducing threats alone is not likely to ensure long-term persistence in some areas. Resiliency needs to be improved in the California portion of the Western Great Basin with increased habitat suitability in terms of shrub densities and native grasses and forbs. Overall this population is considered potentially at risk, or C3.

Management Zone VI: Columbia Basin

There are four identified populations in Management Zone VI, which exists mostly in Washington State. Two of these populations, Moses Coulee and Yakima Training Center, are extant populations that were identified and assessed by Garton *et al.* 2011. The additional populations are Crab Creek and Yakama Nation, both of which were addressed with the aid of translocated individuals. Based on information collected at Moses Coulee and Yakima Training Center, Garton *et al.* (2011) predicted a 76.2 percent chance that this population would dip below 200 males in the next 30 years and 86.3 percent chance it would dip below 200 by 2107. Along with the Colorado Plateau, leks in this management zone are the least connected (Knick and Hanser 2011). The PACs likely are large enough to support the current populations and the recovery areas encourage the expansion needed to improve the overall viability. The small size of existing populations and lack of current viability in this management zone means that current management direction (target toward recovery rather than maintenance) is different than in other management zones.

The PACs within this management zone capture redundancy and representation within the management zone, assuming that the protections and management prescriptions area adequate within these areas and they are followed. The PACs were specifically chosen to protect the identified populations. However, because the populations in this management zone are not believed to be viable at this time, the area of protection is larger and designed to include recovery areas which are needed to support a larger, more connected, and hopefully viable population in the future. Based on population viability, it is unlikely that any of the populations in this zone are resilient to threats or disturbances. The order of descending risk is Yakama Nation, Crab Creek, Yakima Training Center, and Moses Coulee.

Moses Coulee

The Moses Coulee population has been maintaining its number for the last 30 years, largely due to the support of farm programs. However, the lower risk of Moses Coulee does not mean that the population is at no risk. This population was ranked C2 (at risk). In 2007, 230 males were counted in this population (Garton *et al.* 2011); they estimated an 88 percent probability that the population would dip below 200 males by the year 2037 or close to a 100 percent probability that the population would dip below 200 males by the year 2107. The estimated a 62 percent probability that the population would dip below 20 males by 2107. Despite these dire concerns, the Moses Coulee population of males was estimated to be about 350 in 2012 (Schroeder *et al.* 2011).

Major issues in Moses Coulee are the lack of habitat stability due to the abundant private land, habitat fragmentation, and dependence on farm programs. There is public land managed by the Washington Department of Fish and Wildlife, BLM, Washington and Department of Natural Resources, but the public land is relatively sparse compared to the quantity of private land (Stinson *et al.* 2004). The abundance of private land adds to the management uncertainty. Because of relatively large amounts of enrollment in CRP and State Acres for Wildlife Enhancement (SAFE) programs, there is a great deal of support for sage-grouse in the Moses Coulee area at least for the next decade. Even so, the high degree of fragmentation and 'subsidized' predators (subsidized with road kill, orchards, and nesting and perching structures) increases the overall predation rate.

Yakama Nation

The Yakama Nation population is extremely small with extremely low viability, if any. The area was historically occupied, but the extinction of the endemic population was not precisely documented (Schroeder *et al.* 2000). During 2006-2008 sage-grouse were translocated to the Yakama Nation in an attempt to re-establish a population. Although it is still too early to evaluate success, the results are not promising at this state. The Yakama Nation faces many threats to their sage-grouse population including poor habitat quality, small population size, and lack of connectivity with existing populations, and wild horses. The wild horse population is severe in portions of the Yakama Nation. It is not clear if the Yakama will be able to aggressively deal with the horse issue. On the positive side, the land is owned by the Yakama Nation and the strictly control access. Consequently, they have a great deal of management control as well as interested in recovering a population of sage-grouse on their land. This population is considered high risk (C1).

Crab Creek

The Crab Creek was occupied by sage-grouse until the mid-1980s (Schroeder *et al.* 2000). By the mid-1990s the Washington Department of Wildlife and the BLM had acquired and/or consolidated approximately 50,000 acres in the Crab Creek area. Because sage-grouse were a priority for management on many of these acres and management direction was altered in favor of sage-grouse, it was believed that this area could once again support sage-grouse. Translocations were initiated in 2008 (Schroeder *et al.* 2011). In 2012, the number of males counted on a single lek was 13. Based on survival and productivity, the potential for this population appears promising. However, it is still too early to determine if the re-establishment effort was successful. The primary risk factors for this population include its small size, habitat fragmentation, and the risk of losing acres formerly enrolled in farm programs (CRP and SAFE). This population is considered high risk (C1).

Yakima Training Center

The second most resilient population in this zone is the Yakima Training Center population which is much smaller than Moses Coulee, but is almost entirely public land. Long-term viability is anything but certain. In 2007, 85 males were counted in this population (Garton *et al.* 2012); they estimated a 26 percent probability that the population would dip below 20 males by the year 2037 or 50 percent probability that the population would dip below 20 males by 2107. The number of males counted in 2011 was 72 (Schroeder *et al.* 2011). The use of the Yakima Training Center for military training activities and the risk of fire have reduced the overall suitability of the habitat supporting this population. A substantial amount of the sage-grouse habitat on the area has been harmed directly and indirectly military training activities, particularly due to wildfires. Despite efforts to manage wildfire risks, wildfires have continued to reduce the quality of habitat in the population. Other key factors in this population are two interstate highways (I 82 and I 90) which border the population on north and west side, powerlines which border the population on the north, west, and south sides, the Columbia River Valley which is natural but reduces movement on the east side, and wind development on the north side. The cumulative effect of these factors is that the population is constricted with little opportunity for expansion. On the positive side, the population occupies and area dominated by public land. This population is considered high risk (C1).

Management Zone VII: Colorado Plateau

This management zone contains two populations; Parachute-Piceance Basin and Meeker-White River Colorado. The designated priority areas for conservation appear to capture redundancy and representation Priority habitats are well mapped and include all high use habitat (which includes breeding, summer, and winter habitat within 4 miles of all known leks) and linkage zones to Management Zone 2 to the north. There is no known connectivity with Utah (Management Zone 3 to the west) due to natural habitat fragmentation and large areas of non-habitat.

Parachute-Piceance-Roan

The Parachute-Piceance Basin population appears to be captured within priority areas for conservation, and representation appears to be captured adequately. Priority areas for conservation capture 60 percent of the occupied range in this population and also include 100 percent of all known active leks and all habitats that were modeled "high probability of use" within four miles of a lek that has been active in the last 10 years. Redundancy is not captured within this population because it is a relatively small (three year running average number of males is 93) and somewhat isolated. This population is on the very southern edge of the species range. There is some potential for connectivity to the north to the Wyoming Basin population in Management Zone 2. Linkage habitats have been included in our mapping efforts. Representation and redundancy are at risk within this population due to its small size, energy development and the associated infrastructure, especially road development. Pinyon-juniper encroachment is also an issue. The Parachute-Piceance-Roan population appears to have some resiliency. The population has been monitored since 2005 and appears to be fluctuating similar to other larger populations in the state. A large majority of PACs are privately owned, mostly by energy companies. Energy and mineral development is the highest ranked threat to sage-grouse in this area. Advances in drilling technology and rapid natural gas demand and subsequent rising prices have led to a significant increase in natural gas drilling activity. Road and infrastructure are also ranked high as they are closely related to energy production. Historic habitat has been lost and fragmented also by pinyon-juniper encroachment. This population is considered to be at high risk (C1).

Meeker-White River Colorado

This population is located just northeast of Parachute-Piceance-Basin. There is no redundancy and little representation in the Meeker-White River population (three-year running average high male count is six birds). Priority areas for conservation capture 27 percent of the occupied range in this population and include the only known active lek. All habitats modeled "high probability of use" and within four miles of any lek (active in the last 10 years) are within priority habitat. Representation and redundancy are at risk within this population due to its small size, proximity to an urbanized setting and, thus, housing development and associated infrastructure and agriculture conversion. This is a very small population located near the town of Meeker and consists of only one active lek that was discovered in 2004, and strutting male counts have been on a steady decline since (e.g., from a high of 30 males in 2004 to six males in 2012). Most of the occupied habitat is privately owned (90 percent) and is in two disconnected patches of habitat, separated by the White River. One of the patches remains unfragmented. The other patch is located where housing development will primarily occur. Meeker-White River has lost resiliency. The population has been monitored since 2004 and the population has been in a steady decline from 30 males to the current six males. Housing development is increasing mainly due to energy development in nearby counties. A large part of the habitat was converted to agriculture in the 1960's, which was a primary reason why the population went into decline. Current issue is that some of the lands in pasture and CRP land may now be converted back to crop lands. This population is considered to be at high risk (C1).

Bi-State DPS

The Bi-State Distinct Population Segment (Bi-State DPS) is geographically and genetically isolated from other populations of greater sage-grouse (Oyler McCance *et al.* 2005, Benedict *et al.* 2003). Four populations are identified in the Bi-State DPS, including: Pine Nut, North of Mono Lake, South of Mono Lake, and the White Mountains. These populations are delineated based on a fair degree of geographic and genetic isolation within the overall Bi-State DPS. Within the Bi-State, all occupied habitat is considered PAC. Two core populations exist to the north and south of Mono Lake, with small peripheral populations in the Pine Nut Range to the north and White Mountains to the south. Garton *et al.* (2011) indicate that long-term persistence is questionable for both core populations with a high probability of dropping below effective population sizes of 50 birds in the next 100 years (100 percent for North Mono and 81.5 percent for South Mono). However, probability of dropping below effective population sizes of 50 birds is low in the next 30 years (15.4 percent for North Mono and 0.1 percent for South Mono. The Bi-State DPS has grown consistently each year from 2008–2012 to the highest population size on record, presumably in response to a trend in higher precipitation and favorable range conditions. Relatively large population increases have been seen in the core populations to the north and south of Mono Lake that have multiple well-connected leks, while peripheral populations have not seen these population increases. The Bi-State DPS is still represented in most of the known historic distribution, but threatened by small and isolated populations on the periphery of the range. Genetic diversity remains high in most of the Bi-State DPS, with emerging evidence that representation has been lost in some areas by population reduction and some loss of genetic diversity.

North Mono Lake

NOTE: This draft document has been submitted for scientific peer review. It should therefore be considered incomplete as future revisions are possible.

The population to the north of Mono Lake consists of a central stronghold located in the Bodie Hills, CA, and several additional peripheral populations in CA and NV that vary in size and degree of isolation. The Bodie Hills population has grown in recent years to be the largest and most connected population in the Bi-State, with more than 500 males counted on leks in 2012. The Bodie Hills breeding complex has about 9-11core leks , ranging from about 100-500 males counted over the past 20 years. The Bodie Hills breeding complex appears to be best connected with the Aurora, Rough Creek and Nine Mile Flat area within the Mount Grant PMU in Nevada. This area, plus Mount Grant proper in the Wassuk Range contains 8 active leks. The Fales area in California, consisting of 2 known leks at Wheeler Flat and Burcham Flat on the northwestern edge of this population, is largely isolated from Bodie, but probably has some connectivity to another small population at Jackass Spring along the border and Desert Creek/Sweetwater Flat in NV. The Fales population was much larger prior to the early 1980's and has experienced the greatest population declines in California, with less than 100 males counted on leks in 2012. The core population to the north of Mono Lake in total appears to be fairly resistant but individual subpopulations much less so. While the population remains relatively stable, the size and geographical extent is moderately small and the degree of historic impacts has not been severe. Although there is good resistance in the core of this population, additional threats should be avoided in both the core and peripheral areas. The North Mono Lake population is the largest population in the Bi-State and least isolated, but classified as C3 because of periodic fluctuations in population size, and multiple threats to the population.

South Mono Lake

The population to the south of Mono Lake consists of a central stronghold located in Long Valley, CA. The Long Valley and Bodie Hills populations are considered the two main core populations in the Bi-State DPS. Similar to Bodie, the Long Valley population has grown in recent years, with more than 400 males counted on leks in 2012. Similar to the Bodie Hills, the Long Valley breeding complex contains about 9-11 core leks, with about 150-400 males counted over the past 20 years. One additional breeding population located at Parker Creek in CA is considered isolated from Long Valley and only known to contain one lek. The Long Valley breeding complex remains relatively stable and resistance to ongoing impacts is generally good. As with the North Mono population, however, this breeding complex is not overly large. The Long Valley population is probably more vulnerable than Bodie because it is considered isolated from other Bi-State populations and seasonal habitats are limited to a relatively small area. Therefore, this population could be severely impacted by catastrophic events, and further cumulative threats should be avoided. The Parker population is probably fewer than 100 estimated birds total and lacks resistance. The South Mono Lake is currently relatively large population, but classified as C3 because of isolation, periodic fluctuations in population size, and multiple threats to the population.

Pine Nut

The Pine Nut population is the smallest and most threatened population in the Bi-State DPS. The population consists of one consistently active lek, although there is indication that additional

NOTE: This draft document has been submitted for scientific peer review. It should therefore be considered incomplete as future revisions are possible.

sites may be present and there is some connectivity to the population to the north of Mono Lake. The long-term average male attendance is approximately 14 males over the past 11 years. The population appears predisposed to environmental vagaries in the form of wildfire and drought as well as additional anthropogenic stressors that have and continue to influence the population. These conditions have resulted in a population that is largely nonresistant to additional impacts. The Pine Nut population is classified as C1 because of very low population size and relatively high level of threats.

White Mountains

The population in the White Mountains is not well understood because of difficulty in accessing the area to conduct lek surveys. However, at least one lek is known to exist at Chiatovich Flat in California and 2 recently discovered leks are known to exist in NV. As with the other Bi-State breeding populations, sage-grouse in the White Mountains are probably mostly threatened by small population size and are therefore vulnerable to catastrophic events. However, this population, located in high elevation habitats on the extreme southwest of the species range, has probably always been small and faces the fewest threats in the Bi-State DPS. The White Mountains are classified as C2/C3 because of the aforementioned uncertainty regarding population size, but has the least land use threats in the Bi-State DPS.

Appendix C: Policy for the Evaluation of Conservation Efforts When Making Listing Decisions preferred the rulemaking petition. The coordinates for Channel 287C3 at Alamo are 32–19–29 North Latitude and 82–43–23 West Longitude. This allotment has a site restriction of 20.4 kilometers (12.7 miles) north of Alamo.

DATES: Effective April 28, 2003.

FOR FURTHER INFORMATION CONTACT: R. Barthen Gorman, Media Bureau, (202) 418–2180.

SUPPLEMENTARY INFORMATION: This is a synopsis of the Commission's Report and Order, MM Docket No. 01–111, adopted March 12, 2003, and released March 14, 2003. The full text of this Commission decision is available for inspection and copying during normal business hours in the FCC's Reference Information Center at Portals II, 445 12th Street, SW., Room CY–A257, Washington, DC, 20554. The document may also be purchased from the Commission's duplicating contractor, Qualex International, Portals II, 445 12th Street, SW., Room CY–B402, Washington, DC, 20554, telephone 202 863–2893, facsimile 202 863–2898, or via e-mail *qualexint@aol.com.*

List of Subjects in 47 CFR Part 73

Radio, Radio broadcasting.

■ Part 73 of Title 47 of the Code of Federal Regulations is amended as follows:

PART 73—RADIO BROADCAST SERVICES

■ 1. The authority citation for Part 73 reads as follows:

Authority: 47 U.S.C. 154, 303, 334 and 336.

§ 73.202 [Amended]

■ 2. Section 73.202(b), the Table of FM Allotments under Georgia, is amended by adding Alamo, Channel 287C3.

Federal Communications Commission.

John A. Karousos,

Assistant Chief, Audio Division Media Bureau.

[FR Doc. 03–7470 Filed 3–27–03; 8:45 am]

BILLING CODE 6712–01–P

FEDERAL COMMUNICATIONS COMMISSION

47 CFR Part 73

[DA 03–629; MB Docket No. 02–120; RM–10442]

Radio Broadcasting Services; Owen, Wisconsin

AGENCY: Federal Communications Commission.

ACTION: Final rule.

SUMMARY: The Audio Division, at the request of Starboard Broadcasting, Inc., allots Channel 242C3 at Owen, Wisconsin, as the community's first local FM service. Channel 242C3 can be allotted to Owen, Wisconsin, in compliance with the Commission's minimum distance separation requirements with a site restriction of 12.9 km (8.0 miles) northeast of Owen. The coordinates for Channel 242C3 at Owen, Wisconsin, are 45–03–08 North Latitude and 90–29–21 West Longitude. A filing window for Channel 242C3 at Owen, WI, will not be opened at this time. Instead, the issue of opening this allotment for auction will be addressed by the Commission in a subsequent Order.

DATES: Effective April 28, 2003.

FOR FURTHER INFORMATION CONTACT: Deborah Dupont, Media Bureau, (202) 418–2180.

SUPPLEMENTARY INFORMATION: This is a synopsis of the Commission's Report and Order, MB Docket No. 02–120, adopted March 12, 2003, and released March 14, 2003. The full text of this Commission decision is available for inspection and copying during normal business hours in the FCC Information Center, Portals II, 445 12th Street, SW., Room CY–A257, Washington, DC 20554. The complete text of this decision may also be purchased from the Commission's duplicating contractor, Qualex International, Portals II, 445 12th Street, SW., Room CY–B402, Washington, DC, 20554, (202) 863–2893, facsimile (202) 863–2898, or via e-mail *qualexint@aol.com.*

List of Subjects in 47 CFR Part 73

Radio, Radio broadcasting.

■ Part 73 of title 47 of the Code of Federal Regulations is amended as follows:

PART 73—RADIO BROADCAST SERVICES

■ 1. The authority citation for part 73 continues to read as follows:

Authority: 47 U.S.C. 154, 303, 334 and 336.

§ 73.202 [Amended]

■ 2. Section 73.202(b), the Table of FM Allotments under Wisconsin, is amended by adding Owen, Channel 242C3.

Federal Communications Commission.

John A. Karousos,

Assistant Chief, Audio Division, Media Bureau.

[FR Doc. 03–7472 Filed 3–27–03; 8:45 am]

BILLING CODE 6712–01–P

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Chapter IV

[Docket No. 000214043–2227–02; I.D. 011603A]

RIN 1018–AF55, 0648–XA48

Policy for Evaluation of Conservation Efforts When Making Listing Decisions

AGENCIES: Fish and Wildlife Service, Interior; National Marine Fisheries Service, NOAA, Commerce.

ACTION: Announcement of final policy.

SUMMARY: We, the Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) (the Services), announce a final policy for the evaluation of conservation efforts when making listing decisions (PECE) under the Endangered Species Act of 1973, as amended (Act). While the Act requires us to take into account all conservation efforts being made to protect a species, the policy identifies criteria we will use in determining whether formalized conservation efforts that have yet to be implemented or to show effectiveness contribute to making listing a species as threatened or endangered unnecessary. The policy applies to conservation efforts identified in conservation agreements, conservation plans, management plans, or similar documents developed by Federal agencies, State and local governments, Tribal governments, businesses, organizations, and individuals.

DATES: This policy is effective April 28, 2003.

ADDRESSES: Chief, Division of Conservation and Classification, U.S. Fish and Wildlife Service, 4401 North Fairfax Drive, Arlington, VA 22203 (Telephone 703/358–2171, Facsimile 703/358–1735); or Chief, Endangered Species Division, National Marine Fisheries Service, Office of Protected Resources, 1315 East-West Highway, Silver Spring, MD 20910 (Telephone 301/713–1401, Facsimile 301/713–0376).

FOR FURTHER INFORMATION CONTACT: Chris Nolin, Chief, Division of Conservation and Classification, U.S. Fish and Wildlife Service at the above address, telephone 703/358–2171 or facsimile 703/358–1735, or Margaret Lorenz, Endangered Species Division, National Marine Fisheries Service at the above address, telephone 301/713–1401 or facsimile 301/713–0376.

SUPPLEMENTARY INFORMATION:

Background

This policy provides direction to Service personnel in determining how to consider a conservation agreement when making a decision on whether a species warrants listing under the Act. It also provides information to the groups interested in developing agreements or plans that would contribute to making it unnecessary for the Services to list a species under the Act.

On June 13, 2000, we published in the **Federal Register** (65 FR 37102) a draft policy for evaluating conservation efforts that have not yet been implemented or have not yet demonstrated effectiveness when making listing decisions under the Act. The policy establishes two basic criteria: (1) The certainty that the conservation efforts will be implemented and (2) the certainty that the efforts will be effective. The policy provides specific factors under these two basic criteria that we will use to direct our analysis of the conservation effort. At the time of making listing determinations, we will evaluate formalized conservation efforts (i.e., conservation efforts identified in a conservation agreement, conservation plan, management plan, or similar document) to determine if the conservation effort provides certainty of implementation and effectiveness and, thereby, improves the status, as defined by the Act, of the species such that it does not meet the Act's definition of a threatened or endangered species.

When we evaluate the certainty of whether the formalized conservation effort will be implemented, we will consider the following: Do we have a high level of certainty that the resources necessary to carry out the conservation effort are available? Do the parties to the conservation effort have the authority to carry it out? Are the regulatory or procedural mechanisms in place to carry out the efforts? And is there a schedule for completing and evaluating the efforts? If the conservation effort relies on voluntary participation, we will evaluate whether the incentives that are included in the conservation effort will ensure the level of participation necessary to carry out the conservation effort. We will also evaluate the certainty that the conservation effort will be effective. In making this evaluation, we will consider the following: Does the effort describe the nature and extent of the threats to the species to be addressed and how these threats are reduced by the conservation effort? Does the effort establish specific conservation objectives? Does the effort identify the appropriate steps to reduce threats to the species? And does the effort include quantifiable performance measures to monitor for both compliance and effectiveness? Overall, we need to be certain that the formalized conservation effort improves the status of the species at the time we make a listing determination.

This policy is important because it gives us a consistent set of criteria to evaluate formalized conservation efforts. For states and other entities that are developing agreements or plans, this policy informs them of the criteria we will use in evaluating formalized conservation efforts when making listing decisions, and thereby guides States and other entities that wish to develop formalized conservation efforts that may contribute to making listing unnecessary.

In the notice of the draft policy, we specifically requested comments on the criteria that we would use to evaluate the certainty that a formalized conservation effort will be implemented. Also, we requested comments on the timing of the development of conservation agreements or plans. We have learned that timing is the most critical element when developing a successful conservation agreement or plan. Encouraging and facilitating early development of conservation agreements or plans is an important objective of this policy. Last-minute agreements (i.e., those that are developed just before or after a species is proposed for listing) often have little chance of affecting the outcome of a listing decision. Once a species is proposed for listing under the Act, we may have insufficient time to include consideration of a newly developed conservation plan in the public notice and comment process and still meet our statutory deadlines. Last-minute efforts are also less likely to be able to demonstrate that they will be implemented and effective in reducing or removing threats to the species. In addition, there are circumstances in which the threats to a species are so imminent and/or complex that it will be almost impossible to develop an agreement or plan that includes conservation efforts that will result in making the listing unnecessary. Accordingly, we encourage the early development of formalized conservation efforts before the threats become too extreme and imminent and when there is greater flexibility in sufficiently improving a species' status to the point where listing the species as threatened or endangered is unnecessary.

Summary of Comments and Recommendations

In response to our request for comments on the draft policy, we received letters from 44 entities. Thirty-five were in support of the policy and nine were against. We reviewed all comments received and have incorporated accepted suggestions or clarifications into the final policy text. Because most of these letters included similar comments (several were form letters) we grouped the comments according to issues. The following is a summary of the relevant comments and our responses. We also received comments that were not relevant to the policy and, therefore, outside the policy's scope. We responded to some of these comments where doing so would clarify the process for determining whether a species is endangered or threatened (the listing process) or clarify the nature of conservation plans, agreements, and efforts.

Policy Scope Issues

Issue 1: Many commenters felt that this policy should also apply to downlisting species from endangered to threatened status and delisting actions, or else parties to an agreement where the final decision is to list the species would not have any incentives to take action on a listed species until a recovery plan is developed. In addition, one commenter suggested that the policy scope should be expanded to include the process of designating critical habitat.

Response 1: We believe that the immediate need is to develop criteria that will guide consistent and predictable evaluation of conservation efforts at the time of a listing determination. We may consider such a policy for downlisting or delisting actions in the future. However, we note that a recovery plan is the appropriate vehicle to provide guidance on actions necessary to delist a species. Also, we may consider developing a similar policy for critical habitat designations.

Issue 2: Two commenters stated that our estimates of time needed to develop, implement, monitor, and report on conservation efforts are underestimated.

Response 2: We agree that our original estimates were too low. We have increased our estimate to an average of 2,500 person-hours to complete a conservation agreement (with a range of 1,000 to 4,000 person-hours). We also increased our estimate of the average number of person-hours to conduct monitoring and to prepare a report to

320 and 80 hours, respectively. We expect the amount of time will vary depending on several factors including, but not limited to, the number of species addressed, amount of biological information available on the species, and the complexity of the threats. Therefore, we have provided an average to assist interested parties in their planning efforts.

Issue 3: One commenter questioned whether we would evaluate proposed agreements or plans using the stated criteria automatically or only upon request. The commenter also questioned whether we will consider agreements or plans that we previously determined were not sufficient to prevent the need for listing in combination with "new" proposed agreements or plans when we evaluate whether to list a species.

Response 3: If a listing proposal is under review, we will consider any conservation effort. We will evaluate the status of the species in the context of all factors that affect the species' risk of extinction, including all known conservation efforts whether planned, under way, or fully implemented. However, for formalized conservation efforts not fully implemented, or where the results have not been demonstrated, we will consider the PECE criteria in our evaluation of whether, and to what extent, the formalized conservation efforts affect the species' status under the Act.

Issue 4: One commenter asked the length of time for which a plan is approved.

Response 4: The PECE is not a plan-approval process, nor does it establish an alternative to listing. PECE outlines the criteria we will consider when evaluating formalized conservation efforts that have not yet been fully implemented or do not yet have a record of effectiveness at the time we make a listing decision. Should the status of a species decline after we make a decision not to list this species, we would need to reassess our listing decision. For example, there may be situations where the parties to a plan or agreement meet their commitments, but unexpected and/or increased threats (e.g., disease) may occur that threaten the species' status and make it necessary to list the species.

Issue 5: One commenter asked if the "new information" reopener is operative at any time.

Response 5: Yes, because section 4(b)(1) of the Act requires us to use the best available scientific and commercial data whenever making decisions during the listing process. In making a decision whether to list a species, we will take into account all available information, including new information regarding formalized conservation efforts. If we receive new information on a formalized conservation effort that has not yet been implemented or not yet demonstrated effectiveness prior to making a listing decision, we will evaluate the conservation effort in the context of the PECE criteria. If we receive new information on such an effort after we have decided to list a species, then we will consider this new information along with other measures that reduce threats to the species and may use this information in downlisting the species from endangered to threatened status or delisting. However, PECE will not control our analysis of the downlisting of the species.

Issue 6: One commenter stated that it is unrealistic and unreasonable to expect agreements to be in place at the time the conservation effort is evaluated. In addition, the commenter stated that it is particularly unrealistic and unreasonable to expect that conservation agreements or plans be submitted within 60 days of publication of a proposed rule.

Response 6: We strongly encourage parties to initiate formalized conservation efforts prior to publication of a proposal to list a species under the Act. If a formalized conservation effort is submitted during the public comment period for a proposed rule, and may be significant to the listing decision, then we may extend or reopen the comment period to allow time for comment on the new conservation effort. However, we can extend the public comment period only if doing so does not prevent us from completing the final listing action within the statutory timeframe.

Issue 7: One commenter stated that most existing conservation agreements are ineffective, and furthermore that we are unable to determine their effectiveness for several years.

Response 7: We agree that it could take several years for some conservation efforts to demonstrate results. However, the PECE criteria provide the framework for us to evaluate the likely effectiveness of such formalized conservation efforts. Some existing conservation efforts have proven to be very effective and have justifiably influenced our listing decisions.

Issue 8: Several commenters stated that funds are better spent to list species, designate critical habitat, and implement recovery efforts rather than to develop conservation agreements.

Response 8: Conservation agreements can be seen as early recovery efforts. Early conservation efforts to improve the status of a species before listing is necessary may cost less than if the species' status has already been reduced to the point where it needs to be listed. Early conservation of candidate species can reduce threats and stabilize or increase populations sufficiently to allow us to use our resources for species in greater need of the Act's protective measures.

Issue 9: Some commenters questioned the 14 conservation agreements that we cited which contributed to making listing the covered species as threatened or endangered unnecessary. Commenters requested information on each plan to better allow the public to evaluate the adequacy of the agreements.

Response 9: We referenced the 14 conservation agreements in the Paperwork Reduction Act section of the draft policy and used them solely to estimate the information collection and recordkeeping burden that would result from our draft policy if it were made final. Therefore, we do not recommend using these to comment on the new policy.

Biological Issues

Issue 10: One commenter questioned our method for evaluating a conservation plan that addresses only a portion of a species' range.

Response 10: Using the PECE criteria, we will evaluate all formalized conservation efforts that have yet to be implemented or have yet to demonstrate results at the time we make our listing decision. This is true for efforts that are applicable to all or only a portion of the species' range. The PECE does not set standards for how much conservation is needed to make listing unnecessary. The significance of plans that address only a portion of a species' range will be evaluated in the context of the species' overall status. While a formalized conservation effort may be effective in reducing or removing threats in a portion of the species' range, that may or may not be sufficient to remove the need to list the species as threatened or endangered. In some cases, the conservation effort may lead to a determination that a species warrants threatened status rather than endangered.

In addition, parties may have entered into agreements to obtain assurances that no additional commitments or restrictions will be required if the species is listed. A landowner or other non-Federal entity can enter into a Candidate Conservation Agreement with Assurances (CCAA) (64 FR 32726, June 17, 1999), which are formal agreements between us and one or more non-Federal parties that address the conservation needs of proposed or candidate species, or species likely to become candidates. These agreements provide assurances to non-Federal property owners who voluntarily agree to manage their lands or waters to remove threats to candidate or proposed species, or to species likely to become candidates. The assurances are authorized under the CCAA regulations (50 CFR 17. 22(d)(5) and 17.32(d)(5)) and provide non-Federal property owners assurances that their conservation efforts will not result in future regulatory obligations in excess of those they agree to at the time they enter into the Agreement. Should the species eventually be listed under the Act, landowners will not be subjected to increased property use restrictions as long as they conform to the terms of the agreement. While one of these agreements may not remove the need to list, several such agreements, covering a large portion of the species' range, may.

Issue 11: Several commenters suggested that the Services should consider conservation efforts developed for species other than the species for which a listing decision is being made when the species have similar biological requirements and the conservation effort addresses protection of habitat of the species for which a listing decision is being made.

Response 11: We agree. When a decision whether or not to list a species is being made, we will consider all conservation efforts that reduce or remove threats to the species under review, including conservation efforts developed for other species. However, for all formalized conservation efforts that have not yet been implemented or have yet to demonstrate results, we will use the PECE criteria to evaluate the conservation effort for certainty of implementation and effectiveness for the species subject to the listing decision.

Issue 12: One commenter stated the "biology/natural history" of the species should be adequately known and explained in order to evaluate the effectiveness of the effort.

Response 12: When we consider the elements under the effectiveness criterion, we will evaluate whether the formalized conservation effort incorporates the best available information on the species' biology and natural history. However, due to variation in the amount of information available about different species and the threats to their existence, the level of information necessary to provide a high level of certainty that the effort will be effective will vary.

We believe it is important, however, to start conservation efforts as early as possible even if complete biological information is lacking. Regardless of the extent of biological information we have about a species, there will almost always be some uncertainty about threats and the most effective mechanisms for improving the status of a species. We will include the extent of gaps in the available information in our evaluation of the level of certainty that the formalized conservation effort will be effective. One method of addressing uncertainty and accommodating new information is the use of monitoring and the application of adaptive management principles. The PECE criteria note that describing the threats and how those threats will be removed, including the use of monitoring and adaptive management principles, as appropriate, is critical to determining that a conservation effort that has yet to demonstrate results has reduced or removed a particular threat to a species.

Issue 13: Several commenters suggested that affected party(ies) should work with the Services to identify species that will be proposed for listing in the near future to help concentrate and direct efforts to those species that most warrant the protection, and help make the party(ies) aware of when and what actions should be taken to help conserve species in need.

Response 13: We do identify species in need of protection. The FWS publishes a Candidate Notice of Review (CNOR) in which the FWS identifies those species of plants and animals for which they have sufficient information on the species' biological status and threats to propose them as endangered or threatened under the Act, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. NMFS, which has jurisdiction over marine species and some anadromous species, defines candidate species more broadly to include species whose status is of concern but more information is needed before they can be proposed for listing. NMFS candidate species can be found on their web site at *http://www.nmfs.noaa.gov*. The FWS's CNOR is published in the **Federal Register** and can also be found on their web site at *http://endangered.fws.gov.*

We agree that it is important to start developing and implementing conservation efforts and coordinating those efforts with us as early as possible. Early conservation helps preserve management options, minimizes the cost of reducing threats to a species, and reduces the potential for land use restrictions in the future. Addressing the needs of species before the regulatory protections associated with listing under the Act come into play often allows greater management flexibility in the actions necessary to stabilize or restore these species and their habitats. Early implementation of conservation efforts may reduce the risk of extinction for some species, thus eliminating the need for them to be listed as threatened or endangered.

Issue 14: One commenter stated that requiring an implementation schedule/timeline for conservation objectives is not feasible when baseline data on a species is poorly understood. The policy should recognize that variation in patterns of species distribution and land ownership will cause variation in the difficulty of developing conservation efforts. Thus, some conservation efforts should be allotted more time for their completion.

Response 14: Biological uncertainty is a common feature of any conservation effort. Nevertheless, some conservation actions can proceed even when information on the species is incomplete. Implementation schedules are an important element of all formalized conservation planning efforts (e.g., recovery plans). The implementation schedule identified in PECE criterion A.8. establishes a timeframe with incremental completion dates for specific tasks. In light of the information gaps that may exist for some species or actions, schedules for completing certain tasks may require revision in response to new information, changing circumstances, and the application of adaptive management principles. Including an implementation schedule in a formalized conservation effort is critical to determining that the effort will be implemented and effective and has improved the status of the species under the Act at the time we make our listing determination.

We acknowledge that the amount of time required to develop and implement formalized conservation efforts will vary. Therefore, we encourage early development and implementation of conservation efforts for species that have not yet become candidates for listing and for those species that are already candidates. This policy does not dictate timeframes for completing conservation efforts. However, the Act mandates specific timeframes for many listing decisions, and we cannot delay final listing actions to allow for the development and signing of a conservation agreement or plan. We and participants must also acknowledge that, for species that are poorly known, or whose threats are not well understood, it is unlikely that conservation efforts that have not been implemented or that have yet to yield results will have improved the status of the species sufficiently to play a significant role in the listing decision.

Issue 15: One commenter stated that the Services, when evaluating the certainty of conservation efforts while making listing decisions, should factor into the analysis the Services' ability to open or reopen the listing process at any time, and to list the species on an emergency basis if necessary.

Response 15: We will initiate or revisit a listing decision if information indicates that doing so is warranted, and on an emergency basis if there is an imminent threat to the species' well-being. However, we do not make any listing determinations based on our ability to change our decisions. We base our listing decisions on the status of the species at that time, not on some time in the future.

Criteria Issues

Issue 16: Several commenters requested that we further explain the criteria for both implementation and effectiveness. The commenters claim that our criteria are too vague and are subject to interpretation by the Services. One commenter said that, by stating "this list should not be considered comprehensive evaluation criteria," the policy allows the Services to consider criteria not addressed in the agreement, and allows for too much leeway for the Services to reject conservation efforts of an agreement, even if all criteria listed in the draft policy are satisfied.

Response 16: PECE establishes a set of criteria for us to consider when evaluating formalized conservation efforts that have not yet been implemented or have not yet demonstrated effectiveness to determine if the efforts have improved the status of the species. At the time of the listing decision, we must find, with minimal uncertainty, that a particular formalized conservation effort will be implemented and will be effective, in order to find that the effort has positively affected the conservation status of a species. Meeting these criteria does not create an approval process. Some conservation efforts will address these criteria more thoroughly than others. Because, in part, circumstances vary greatly among species, we must evaluate all conservation efforts on a case-by-case basis at the time of listing, taking into account any and all factors relevant to whether the conservation effort will be implemented and effective.

Similarly, the list of criteria is not comprehensive because the conservation needs of species will vary greatly and depend on species-specific, habitat-specific, location-specific, and action-specific factors. Because conservation needs vary, it is not possible to state all of the factors that might determine the ultimate effectiveness of formalized conservation efforts. The species-specific circumstances will also determine the amount of information necessary to satisfy these criteria. Evaluating the certainty of the effectiveness of a formalized conservation effort necessarily includes an evaluation of the technical adequacy of the effort. For example, the effectiveness of creating a wetland for species conservation will depend on soil texture, hydrology, water chemistry, and other factors. Listing all of the factors that we would appropriately consider in evaluations of technical adequacy is not possible.

Issue 17: One commenter suggested that we consider conservation plans in the development stage rather than waiting until finalized due to the possible benefits that may result from initial efforts.

Response 17: Plans that have not been finalized and, therefore, do not conform to the PECE criteria, may have some conservation value for the species. For example, in the process of developing a plan, participants and the public may become more informed about the species and its conservation needs. We will consider any benefits to a species that have accrued prior to the completion of an agreement or plan in our listing decision, under section 4(b)(1)(A) of the Act. However, the mere existence of a planning process does not provide sufficient certainty to actually improve the status of a species. The criteria of PECE set a rigorous standard for analysis and assure a high level of certainty associated with formalized conservation efforts that have not been implemented, or have yet to yield results, in order to determine that the status of the species has improved.

We encourage parties to involve the appropriate Service during the development stage of all conservation plans, whether or not they are finalized prior to a listing decision. Sharing of the best available information can lead to developing better agreements. In the event that the focus species is listed, these planning efforts can be utilized as the basis for development of Safe Harbor Agreements or Habitat Conservation Plans, through which we can permit incidental take under Section 10(a) of the Act, or provide a basis for a recovery plan.

Issue 18: Several commenters stated that the policy should provide more sufficient, clear criteria by which the implementation and effectiveness of conservation efforts is monitored and assessed. One commenter also suggested that we require a specific reporting format to help show effectiveness of conservation efforts.

Response 18: When evaluating formalized conservation efforts under PECE, we will consider whether the effort contains provisions for monitoring and reporting implementation and effectiveness results (see criterion B.5).

Regarding a standard reporting format, the nature of the formalized conservation efforts we evaluate will probably vary a great deal. Efforts may range from complex to single-threat approaches. Therefore, for us to adopt a one-size-fits-all approach to report on monitoring efforts and results would be inappropriate.

Issue 19: One commenter stated that PECE is too demanding with respect to identification and commitment of resources "up-front," and that these strict requirements and commitments on conservation efforts harm the voluntary nature of agreements.

Response 19: Addressing the resources necessary to carry out a conservation effort is central to establishing certainty of plan implementation and effectiveness. Accordingly, we believe that PECE must establish a minimum standard to assure certainty of implementation and effectiveness. This certainty is necessary in determining whether the conservation effort has improved the status of species.

It is our intention and belief that the PECE criteria will actually increase the voluntary participation in conservation agreements by increasing the likelihood that parties' voluntary efforts and commitments that have yet to be implemented or have yet to demonstrate results will play a role in a listing decision.

Issues Related to Specific Changes

Several commenters recommended specific changes to the evaluation criteria. The recommended additions in language to the criteria are italicized and deletions are shown in strikeout to help the reader identify the proposed changes.

Issue 20: Commenters stated that there is potential confusion between evaluation criteria A.2. (authority) and A.3.(authorization) as they believed some Service staff may have difficulty distinguishing between an "authority," and an "authorization." To help eliminate this potential confusion, commenters requested that criterion A.2. be changed to read: "the legal authority of the party(ies) to the agreement or plan to implement the conservation effort and the legal procedural requirements necessary to implement the effort are described." They also requested that we change criterion A.3. to read: The legal requirements (e.g. permits, environmental review documents) necessary to implement the conservation effort are identified, and an explanation of how the party(ies) to the agreement or plan that will implement the effort will fulfill these requirements is provided."

Response 20: We agree with adding the word "legal" and also have incorporated additional language and separated this criterion (former criterion A.2) into two criteria (A.2. and A.3.). Evaluation Criterion A.2. now reads, "The legal authority of the party(ies) to the agreement or plan to implement the formalized conservation effort, and the commitment to proceed with the conservation effort are described." New evaluation Criterion A.3. reads, "The legal procedural requirements necessary to implement the effort are described, and information is provided indicating that fulfillment of these requirements does not preclude commitment to the effort." In making these changes, we recognize that there may be overlap between new criterion A.3. and the criterion on authorizations (now A.4.), but our intent is to separate a criterion on procedural requirements from substantive authorizations (e.g. permits). We believe that we need to specifically determine that the parties to the agreement will obtain the necessary authorizations. We also recognize that parties may not be able to commit to some conservation efforts until they have fulfilled procedural requirements (e.g. under the National Environmental Policy Act) since some laws preclude commitment to a specific action until certain procedures are completed. Additionally, in creating a new criterion A.3., we find it unnecessary to incorporate the suggested changes to old A.3. (now A.4.).

Issue 21: Commenters requested the following change to Criterion A.4. (now Criterion A.5.): "The level of voluntary participation (e.g., permission to enter private land or other contributions by private landowners) necessary to implement the conservation effort is identified, and an explanation of how the party(ies) to the agreement or plan that will implement the conservation effort will obtain that level of voluntary participation is provided (e.g., an explanation of why incentives to be provided are expected to result in the necessary level of voluntary participation)".

Response 21: We do not believe that including "an explanation of how the party(ies) * * * will obtain that level of voluntary participation * * *" will provide us with enough information in order to determine that necessary voluntary participation will, in fact, be obtained. Evaluation Criterion A.5. (formerly A.4.) now reads: "The type and level of voluntary participation (e.g., number of landowners allowing entry to their land, or number of participants agreeing to change timber management practices and acreage involved) necessary to implement the conservation effort is identified, and a high level of certainty is provided that the party(ies) to the agreement or plan that will implement the conservation effort will obtain that level of voluntary participation (e.g., an explanation of how incentives to be provided will result in the necessary level of voluntary participation)."

Issue 22: Commenters suggested that Evaluation Criterion A.5. (now criterion A.6.) be changed to read as "Any statutory or regulatory deficiency or barrier to implementation of the conservation effort is identified and an explanation of how the party(ies) to the agreement or plan that will implement the effort will resolve the deficiency or barriers is provided."

Response 22: We do not agree with the suggested language change. We believe that all regulatory mechanisms, including statutory authorities, must be in place to ensure a high level of certainty that the conservation effort will be implemented.

Issue 23: The suggested change to Evaluation Criterion A.6. (now A.7.) is "A fiscal schedule and plan is provided for the conservation effort, including a description of the obligations of party(ies) to the agreement or plan that will implement the conservation effort, and an explanation of how they will obtain the necessary funding is provided."

Response 23: We do not agree with the suggested language change since we believe that there must be a high level of certainty that the party(ies) will obtain the necessary funding to implement the effort. While we agree that including a fiscal schedule, a description of the obligations of the party(ies), and an explanation of how they will obtain the funding is important, this information, by itself, does not provide enough certainty for us to consider a formalized conservation effort that has not yet been implemented as contributing to a listing decision. Also see our response to Issue 41.

Issue 24: One commenter suggested that the Services should consider an incremental approach to evaluating implementation dates for the conservation effort.

Response 24: We agree with the commenter's suggested change. Evaluation Criterion A.8. (formerly A.7.) now reads as: "An implementation schedule (including incremental completion dates) for the conservation effort is provided."

Issue 25: Commenters suggested that Criterion A.8. (now A.9.) be revised to read: "The conservation agreement or plan that includes the conservation effort include a commitment by the party(ies) to apply their legal authorities and available resources as provided in the agreement or plan."

Response 25: The participation of the parties through a written agreement or plan establishes each party's commitment to apply their authorities and resources to implementation of each conservation effort. Therefore, it is unnecessary to include the suggested language; criterion A.9. (formerly A.8.) remains unchanged.

Issue 26: A commenter also suggested adding a criterion: "Evidence that other conservation efforts have been implemented for sympatric species within the same ecosystem that may provide benefits to the subject species is provided."

Response 26: We do not think it is necessary to add such a criterion. At the time of listing, we will take into consideration all relevant information, including the effect of other conservation efforts for sympatric species on the status of the species we are considering for listing.

Issue 27: Several commenters recommended that we make specific changes to the Criterion B.1. language to read as: "The nature and extent of threats being addressed by the conservation effort are described, and how the conservation effort will reduce the threats are defined." In addition, commenters suggested we change Criterion B.2. to read as: "Explicit incremental objectives for the conservation effort and dates for achieving them should be stated."

Response 27: We agree that, in addition to identifying threats, the plan should explain how formalized conservation efforts reduce threats to the species. Therefore, Evaluation Criterion B.1. now reads as: "The nature and extent of threats being addressed by the conservation effort are described, and how the conservation effort reduces the threats is described." We agree that conservation efforts should include incremental objectives. This allows the parties to evaluate progress toward the overall goal of a conservation effort, which is essential for adaptive

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management. In addition, setting and achieving interim objectives is helpful in maintaining support for the effort. Therefore, Evaluation Criterion B.2. now reads as: "Explicit incremental objectives for the conservation effort and dates for achieving them are stated."

Issue 28: Some commenters recommended that the party's (ies') prior record with respect to development and implementation of conservation efforts be recognized towards their credibility and reliability to implement future conservation efforts. A commenter also suggested adding a criterion to read as: "Demonstrated ability of the party(ies) to develop and implement effective conservation efforts for this or other species and habitats." Another comment suggested that the history and momentum of a program should be taken into account (e.g., watershed council programs) when considering the certainty of effectiveness and implementation. These considerations would help ensure a high level of certainty that regulatory mechanisms, funding authorizations, and voluntary participation will be adopted by a specified date adequate to provide certainty of implementation.

Response 28: Although it would be beneficial for the party(ies) to demonstrate their past abilities to implement effective formalized conservation efforts for the focus species or other species and habitats, we do not believe that this is necessary to demonstrate a high level of certainty that the conservation effort will be implemented. In addition, a criterion that emphasizes previous experience in implementing conservation efforts may limit formalized conservation efforts to only those party(ies) that have a track record and would unjustifiably constrain consideration of efforts by those who do not satisfy this criterion. Such parties can provide certainty in other ways. We agree that a party's (ies') prior record and history with respect to implementation of conservation efforts should be recognized towards their credibility and reliability. Information concerning a party's experience in implementing conservation efforts may be useful in evaluating how their conservation effort satisfies the PECE criteria. The momentum of a project is a good indication of the progress that is being made towards a party's (ies') conservation efforts, but momentum can decrease, and thus cannot be solely relied upon to determine the certainty that a formalized conservation effort will be implemented or effective.

Issue 29: One commenter stated that our use of "must" in meeting the criteria is inappropriate in the context of a policy, and the policy should rather be treated as guidance.

Response 29: The only mandatory statements in the policy refer to findings that we must make. In order for us to find that a particular formalized conservation effort has improved the status of the species, we must be certain that the formalized conservation effort will be implemented and will be effective. No party is required to take any action under this policy. Rather the policy provides us guidance on how we will evaluate formalized conservation efforts that have yet to be implemented or have yet to demonstrate effectiveness at the time of our listing decision.

Legal Issues

Issue 30: Many commenters mentioned past litigation (i.e., decisions on coho salmon and Barton Springs salamander) in which the courts have ruled against the Services in cases that have involved Candidate Conservation Agreements or other conservation efforts, and question how the PECE policy addresses this issue. Commenters question how this policy will keep the Services from relying on speculative conservation efforts.

Response 30: We referenced past adverse decisions when we published the draft policy. The purpose of PECE, in part, is to address situations similar to those in which some courts found past conservation efforts insufficient. We developed the PECE to establish a set of consistent standards for evaluating certain formalized conservation efforts at the time of a listing decision and to ensure with a high level of certainty that formalized conservation efforts will be implemented and effective. We agree that we may not rely on speculative promises of future action when making listing decisions.

Issue 31: Several commenters questioned the legality of considering private party's (ies') input when section 4(b)(1)(A) of the Act states "* * * and after taking into account those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species * * *" In addition, commenters stated that the PECE policy is inconsistent with the plain language and the congressional intent of the Act by allowing agencies to evaluate any private measures. They also stated that this was inconsistent with considering section 4(a)(1)(D), which only permits agencies to evaluate "existing regulatory mechanisms." They also stated that the Services incorrectly conclude that section 4(a)(1)(E), "other natural or manmade factors affecting [the species'] continued existence," allows the Services to consider actions of "any other entity" in making listing determinations. One commenter stated that there are no provisions to authorize the Services to consider voluntary conservation agreements by other Federal agencies. In 1982, the Act omitted 1973 language for listing determinations made with "other interested Federal agencies." In addition, the commenters stated that the Act imposes conservation duties on all Federal agencies only after the Services have taken the initial step in listing the species.

Response 31: Please refer to the Policy Scope section for an explanation of our authority under section 4 of the Act to assess all threats affecting the species status as well as all efforts that reduce threats to the species.

Issue 32: One commenter suggested that we formalize this policy by codifying it in the Code of Federal Regulations. They suggest that by adopting this policy as agency regulation, we can make the policy more binding, provide a basis for judicial deference, and thus hopefully reduce the amount of litigation.

Response 32: We believe that codifying PECE in the Code of Federal Regulations is not necessary because it is intended as a policy to guide how we will evaluate formalized conservation efforts when making listing decisions.

Issue 33: Some commenters believe that all regulatory mechanisms must be in place prior to finalizing a conservation plan, while other commenters feel that this requirement may dissuade voluntary conservation efforts of private landowners. One commenter stated that, based on the amount of time usually needed to enact most regulatory mechanisms, it seems appropriate to set this minimum standard for evaluating formalized conservation efforts. This criterion should prompt more serious political consideration of adopting a regulatory mechanism sooner rather than later. Another commenter suggested that, instead of requiring regulations, we should require cooperators to identify and address any regulatory deficiencies affecting the species.

Response 33: In order for us to determine with a high level of certainty that a formalized conservation effort will be implemented, among other things, all regulatory mechanisms necessary to implement the effort must be in place at the time we make our listing decision. However, there may be situations where regulatory mechanisms are not necessary for implementing the conservation effort due to the nature of the action that removes threats, or there may be situations where necessary regulatory mechanisms are already in place.

Issue 34: One commenter stated that only when an alternative regulatory mechanism provides the same or higher protections than listing can the threat factors be said to be alleviated. A high level of certainty over future funding or voluntary participation might be acceptable if alternative regulatory mechanisms to prevent take in the interim are in place.

Response 34: Determinations to list species under the Act are based solely on whether or not they meet the definitions of threatened or endangered as specified by the Act. Through PECE, we will evaluate, at the time of our listing decision, whether a formalized conservation effort adequately reduces threats and improves the status of the species to make listing unnecessary. Additional alternative regulatory mechanisms to prevent take are not necessary if the threats to the species are reduced to the point that the species does not meet the definitions of threatened or endangered.

Issue 35: One commenter stated concern that the Services would not be able to provide assurances to private landowners because no specific provisions in the Act authorize conservation agreements in lieu of listing, and that third party lawsuits also undermine the Services' assurances. One commenter asked what future protection of their ongoing actions participants would receive.

Response 35: Satisfying the PECE criteria does not provide assurances that we will not decide to list a species. Also, because of the individual nature of species and the circumstances of their status, PECE does not address how much conservation is required to make listing unnecessary. Because of the numerous factors that affect a species' status, we may list a species despite the fact that one or more formalized conservation efforts have satisfied PECE. However, assurances can be provided to non-Federal entities through an approved Candidate Conservation Agreement with Assurances (CCAA) and in an associated enhancement of survival permit issued under section 10(a)(1)(A) of the Act. Many property owners desire certainty with regard to future regulatory restrictions to guarantee continuation of existing land or water uses or to assure allowance for future changes in land use. By facilitating this kind of individual land use planning, assurances provided under the CCAA policy can substantially benefit many property owners. These agreements can have significance in our listing decisions, and we may also evaluate them according to the criteria in the PECE if they are not yet implemented or have not demonstrated results. However, we will make the determination of whether these CCAAs preclude or remove any need to list the covered species on a case-by-case basis in accordance with the listing criteria and procedures under section 4 of the Act.

Issue 36: Several commenters stated that the PECE does not always provide incentives to conserve species and is, therefore, not supported by the Congressional finding of section 2(a)(5) of the Act. The commenters stated that the parties lack incentives to develop conservation programs until after the species is listed (e.g., *Building Industry Association of Southern California* v. *Babbitt*, where listing the coastal California gnatcatcher encouraged enrollment in conservation programs.) In addition, they stated that PECE provides a means for the listing process to be avoided entirely, and, therefore, may often fail to provide incentives that Congress referred to in its findings in section 2(a)(5). They stated that the "system" of incentives to which that Congressional finding refers is already found in incidental take provisions in section 10 of the Act, which will better ensure development and implementation of successful conservation programs.

Response 36: PECE is not "a way to avoid listing" or an "in lieu of listing" policy. This policy outlines guidance on the criteria we will use to evaluate formalized conservation efforts in determining whether to list a species. Knowing how we will evaluate any unimplemented or unmeasured formalized conservation efforts may help parties draft more effective agreements. However, there is a conservation incentive because, if a species becomes listed, these efforts can contribute to recovery and eventual delisting or downlisting of the species. Also, see our response to Issue 35.

Issue 37: Several commenters stated that relying on unimplemented future conservation measures is inconsistent with the definitions of "threatened species" and "endangered species" as provided in section 3 of the Act, and that PECE's evaluation of future, unimplemented conservation efforts in listing determinations is inconsistent with both the plain language of the Act and Congressional intent. Also, the commenters stated that the PECE erroneously claims that the definitions of "threatened species" and "endangered species" connote future status, not present status.

Response 37: We agree that, when we make a listing decision, we must determine the species' present status which includes, in part, an evaluation of current threats. However, deciding or determining whether a species meets the definition of threatened or endangered also requires us to make a prediction about the future persistence of a species. Central to this concept is a prediction of future conditions, including consideration of future negative effects of anticipated human actions. The language of the Act supports this approach. The definitions for both "endangered species" and "threatened species" connote future condition, which indicates that consideration of whether a species should be listed depends in part on identification and evaluation of future actions that will reduce or remove, as well as create or exacerbate, threats to the species. We cannot protect species without taking into account future threats to a species. The Act does not require that, and species conservation would be compromised if, we wait until a threat is actually impacting populations before we list the species as threatened or endangered. Similarly, the magnitude and/or imminence of a threat may be reduced as a result of future positive human actions. Common to the consideration of both the negative and positive effects of future human actions is a determination of the likelihood that the actions will occur and that their effects on the species will be realized. Therefore, we consider both future negative and future positive impacts when assessing the listing status of the species. The first factor in section 4(a)(1)—"the present or threatened destruction, modification, or curtailment of [the species'] habitat or range"—identifies how analysis of both current actions affecting a species' habitat or range and those actions that are sufficiently certain to occur in the future and affect a species' habitat or range are necessary to assess a species' status. However, future Federal, state, local, or private actions that affect a species are not limited to actions that will affect a species' habitat or range. Congress did not intend for us to consider future actions affecting a species' habitat or range, yet ignore future actions that will influence overutilization, disease, predation, regulatory mechanisms, or other natural or manmade factors. Therefore, we construe Congress' intent, as reflected by the language of the Act, to require us to consider both current actions that affect a species' status and sufficiently certain future actions—either positive or negative—that affect a species' status.

Issue 38: Several commenters stated that PECE's "sufficient certainty" standard is inconsistent with the Act's "best available science" standard. They stated that courts have ruled that any standard other than "best available science" violates the plain language and the Congressional intent of the Act. The commenters also stated that the "sufficient certainty" standard violates Congressional intent because it weakens the standard required by the Act to list species and can result in unnecessary, and potentially harmful, postponement of affirmative listing.

Response 38: We agree that our listing decisions must be based on the best available science. PECE does not address or change the listing criteria and procedures established under section 4 of the Act. Listing analyses include the evaluation of conservation efforts for the species under consideration. PECE is designed to help ensure a consistent and rigorous review of formalized conservation efforts that have yet to be implemented or efforts that have been implemented but have not yet shown effectiveness by establishing a set of standards to evaluate the certainty of implementation and effectiveness of these efforts.

Issue 39: Several commenters stated that PECE reduces or eliminates public comment on proposed rules to list species and is in violation of the Administrative Procedure Act (APA). Further, they stated that PECE violates the APA by allowing submission of formalized conservation measures after the proposed rule is issued to list species as threatened or endangered. Receiving "conservation agreements or plans before the end of the comment period in order to be considered in final listing decision" encourages landowners to submit conservation agreements at the last minute to avoid public scrutiny, and the PECE process could be a potential delay tactic used by landowners to postpone the listing of species. They stated that the Courts agree that failure of the Services to make available to the public conservation agreements on which listing decisions are based violates the public comment provision of the APA.

Response 39: All listing decisions, including those involving formalized conservation agreements, will comply with the requirements of the APA and ESA. If we receive a formalized conservation agreement or plan during an open comment period and it presents significant new information relevant to the listing decision, we would either extend or reopen the public comment period to solicit public comments specifically addressing that plan or agreement. We recognize, however, that there may be situations where APA requirements must be reconciled with the ESA's statutory deadlines.

Issue 40: Several commenters expressed their concern that conservation efforts do not have binding obligations.

Response 40: While PECE does not require participants to have binding obligations, the policy does require a high level of certainty that a conservation effort will be implemented and effective at the time we make our listing decision. Furthermore, any subsequent failure to satisfy one or more PECE criteria would constitute new information and, depending on the significance of the formalized conservation effort to the species' status, may require a reevaluation of whether there is an increased risk of extinction, and whether that increased risk indicates that the species' status is threatened or endangered.

Funding Issues

Issue 41: Several commenters requested that we further specify our criteria stating that "a high level of certainty that the party(ies) to the agreement or plan that will implement the conservation effort will obtain the necessary funding is provided." In addition, one commenter questioned whether "a high level of certainty" for authorizations or funding was really an improvement over the status quo and suggested that we either list the required elements we will use to evaluate completeness of the conservation efforts or quantitatively define an evaluation standard.

Response 41: A high level of certainty of funding does not mean that funding must be in place now for implementation of the entire plan, but rather, it means that we must have convincing information that funding will be provided each year to implement relevant conservation efforts. We believe that at least 1 year of funding should be assured, and we should have documentation that demonstrates a commitment to obtain future funding, e.g., documentation showing funding for the first year is in place and a written commitment from the senior official of a state agency or organization to request or provide necessary funding in subsequent budget cycles, or documentation showing that funds are available through appropriations to existing programs and the implementation of this plan is a priority for these programs. A fiscal schedule or plan showing clear links to the implementation schedule should be provided, as well as an explanation of how the party(ies) will obtain future necessary funding. It is also beneficial for entities to demonstrate that similar funding was requested and obtained in the past since this funding history can show the likelihood that future funding will be obtained.

Issue 42: One commenter suggested that the PECE policy holds qualifying conservation efforts to a higher standard than recovery plans. The commenter quoted several existing recovery plans that included disclaimers about budget commitments associated with specific tasks. Therefore, the commenter concluded that it is unrealistic and unreasonable to mandate that funding be in place when a conservation effort is evaluated.

Response 42: The Act does not require that certainty of implementation be provided for recovery management actions for listed species or conservation efforts for nonlisted species. Likewise, the PECE does not require that certainty of implementation be provided for during development of conservation efforts for nonlisted species. It is inappropriate to consider the PECE as holding conservation plans or agreements to a higher standard than the standard that exists for recovery plans because the PECE does not mandate a standard for conservation plans or agreements at the time of plan development. Rather, the PECE provides us guidance for the evaluation of conservation efforts when making a listing decision for a nonlisted species.

Recovery plans for listed species and conservation plans or agreements for nonlisted species identify needed conservation actions but may or may not provide certainty that the actions will be implemented or effective. However, when making a listing decision for nonlisted species, we must consider the certainty that a conservation effort will be implemented and effective. The PECE establishes criteria for us to use in evaluating conservation efforts when making listing decisions.

It is possible that we would evaluate a management action identified in a recovery plan for a listed species using the PECE. If, for example, a yet-to-be-implemented task identified in a recovery plan for a listed species would also benefit a nonlisted species, we, in making a listing decision for the nonlisted species, would apply the PECE criteria to that task to determine whether it could be considered as contributing to a decision not to list the species or to list the species as threatened rather than endangered. In this situation, we would evaluate the management task identified in a recovery plan using the PECE criteria in the same way as other conservation efforts for the nonlisted species. That is, the recovery plan task would be held to the same evaluation standard in the listing decision as other conservation efforts.

Foreign Species Issues

Issue 43: One commenter asked why the proposed policy excluded conservation efforts by foreign governments, even though section 4(b)(1)(A) of the Act requires the Services to take such efforts into account. This commenter also stated that the proposed policy is contrary to "The Foreign Relations Law of the United States," which he argues requires the United States to defer to other nations when they have a "clearly greater interest" regarding policies or regulations being considered by the United States that could negatively affect their nations.

Response 43: As required by the Act, we have taken and will continue to take into account conservation efforts by foreign countries when considering listing of foreign species (sections 4(b) and 8 of the Act). Furthermore, whenever a species whose range occurs at least in part outside of the United States is proposed for a listing action (listing, change in status, or delisting), we communicate with and solicit the input of the countries within the range of the species. At that time, countries are provided the opportunity to share information on the status of the species, management of the species, and on conservation efforts within the foreign country. We will take those comments and information provided into consideration when evaluating the listing action, which by law must follow the analysis outlined in sections 4(a) and 4(b) of the Act. Thus, all listing decisions for foreign species will continue to comply with the provisions of the Act.

Issues Outside Scope of Policy

We received several comments that were outside of the scope of PECE. Below, we have briefly addressed these comments.

Issue 44: A comment was made that the Services should not list foreign species under the Act when such listing is in conflict with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Response 44: Considerations regarding CITES are outside the scope of the PECE. However, we do not believe there is a conflict with CITES and listing of a foreign species under the Act. When evaluating the status of foreign species under the Act, we take into consideration whether the species is listed under CITES (and if listed, at what level) and all available information regarding the listing. If you have questions regarding CITES, please contact the FWS Division of Scientific Authority at 4401 N. Fairfax Drive, Room 750, Arlington, VA 22203 or by telephone at 703–358–1708.

Issue 45: One commenter stated that all conservation agreements/plans should be subject to independent scientific peer review. This commenter also argued that any conservation agreement or plan for a candidate species should remove all known major threats for the species and convey a reasonably high certainty that the agreement or plan will result in full conservation of the species.

Response 45: We believe that scientific review can help ensure that formalized conservation efforts are comprehensive and effective, and we expect that most or all participants will seek scientific review, but we will not require a formal independent peer review of conservation plans at the time of development. If a formalized conservation plan is presented for a species that has been proposed for listing, all relevant information, including formalized conservation efforts, will be subject to independent scientific review consistent with our policy on peer review (59 FR 34270). We will also solicit public comments on our listing proposals.

The amount or level of conservation proposed in a conservation plan (e.g., removal of all versus some of the major threats) is outside the scope of PECE. Assuming that all of the PECE criteria have been satisfied for the efforts to which they apply, it stands to reason that plans that comprehensively address threats are likely to be more influential in listing decisions than plans that do not thoroughly address the conservation of the species. We believe that by establishing the PECE criteria for certainty of implementation and effectiveness, we are promoting the development of plans that improve the status of species. We expect that in some cases this improvement will reduce the risk of extinction sufficiently to make listing under the Act unnecessary, to result in listing a species as threatened rather than endangered, or to make classifying a species as a candidate for listing unnecessary.

Issue 46: Several commenters questioned the extent of state involvement in the development of conservation efforts. One commenter said that the policy should mandate that States be involved with plan development, and that states approve all conservation efforts.

Response 46: It is outside the scope of PECE to establish standards to determine who participates in the development of conservation efforts and at what level. In many cases, states play a crucial role in the conservation of species. For formalized conservation efforts to be effective, it is logical for the states to play an integral role. To that end, we highly encourage state participation to help ensure the conservation of the species, but we do not believe that states should be mandated to participate in the development of all conservation plans. In some cases, states may not have the resources to participate in these plans, and in other situations, individuals or non-state entities may have the ability to develop an effective and well-implemented plan that does not require state participation, but that contributes to the conservation of a species. Through our listing process, we will work with state conservation agencies, and, if the listing decision involves a public comment period, states have a formal opportunity to comment on any conservation efforts being considered in the listing decision.

Issue 47: Several comments were made regarding the feedback mechanisms to correct a party's (ies') inadequate or ineffective implementation of a conservation effort. It was suggested that the Services specify clearly, and based on scientific information, those factors which the Services believe indicate that a conservation effort is either not being implemented or not being effective. Comments also suggested that party(ies) be given reasonable time (e.g., 90–120 days) to respond to the Service's findings by either implementing actions, achieving objectives, or providing information to respond to the Services.

Response 47: PECE is not a regulatory approval process, and establishing a formal feedback mechanism between the Services and participants is not within the scope of PECE. The final determination whether to list a species under the Act will rest solely upon whether or not the species under consideration meets the definition of threatened or endangered as specified by the Act, which will include consideration of whether formalized conservation efforts that meet PECE criteria have enhanced the status of the species. We will provide guidance to improve conservation efforts when possible, but we cannot delay listing decisions in order to participate in a corrective review process when the best scientific and commercial data indicate that a species meets the definition of threatened or endangered.

Issue 48: One commenter requested that we clarify how significant the conservation agreement must be to the species, and describe the anticipated overall impact/importance to the species and the estimated extent of the species' overall range that the habitat conservation agreement might cover.

Response 48: PECE does not establish standards for how much or what kind of conservation is required to make listing a species under the Act unnecessary. We believe that high-quality formalized conservation efforts should explain in detail the impact and significance of the effort on the target species. However, at the time of our listing decision, we will evaluate formalized conservation efforts using PECE to determine whether the effort provides certainty of implementation and effectiveness and improves the status of the species. Through our listing process, we will determine whether or not a species meets the definition of threatened or endangered.

Issue 49: Several commenters wrote that states do not have additional resources to be pro-active on candidate conservation efforts, and suggested that funding for conservation plans or efforts should be provided by the Federal Government.

Response 49: This comment is outside the scope of the PECE. This policy establishes a set of standards for evaluating formalized conservation efforts in our listing decisions and does not address funding sources to develop and implement these efforts.

Summary of Changes From the Proposed Policy

We have slightly revised some of the evaluation criteria as written in the proposed policy. We made the following changes to reflect comments that we received during the public comment period. We added the word "legal" to criterion A.2., incorporated additional language ("the commitment to proceed with the conservation effort is described."), and separated this criterion into two criteria (A.2. and A.3.). We revised criterion A.3. (formerly part of A.2.) to recognize that parties cannot commit to completing some legal procedural requirements (e.g. National Environmental Policy Act) since some procedural requirements preclude commitment to a proposed action before the procedures are actually completed. We changed criterion A.5. (formerly A.4.) by adding "type" and "(e.g., number of landowners allowing entry to their land, or number of participants agreeing to change timber management practices and acreage involved)" and by replacing "why" with "how" and "are expected to" with "will." We deleted the word "all" at the beginning of criterion A.6. as we felt it was redundant. We added "(including incremental completion dates)" to criterion A.8. (formerly A.7.). To criterion B.1. we added "and how the conservation effort reduces the threats is described."

Also in the proposed policy we stated that if we make a decision not to list a species, or to list the species as threatened rather than endangered, based in part on the contributions of a formalized conservation effort, we will monitor the status of the species. We have clarified this in the final policy to state that we will monitor the status of the effort, including the progress of implementation of the formalized conservation effort.

Required Determinations

Regulatory Planning and Review

In accordance with Executive Order 12866, this document is a significant policy and was reviewed by the Office of Management and Budget (OMB) in accordance with the four criteria discussed below.

(a) This policy will not have an annual economic effect of $100 million or more or adversely affect an economic sector, productivity, jobs, the environment, or other units of government. The policy for the evaluation of conservation efforts when making listing decisions does not pertain to commercial products or activities or anything traded in the marketplace.

(b) This policy is not expected to create inconsistencies with other agencies' actions. FWS and NMFS are responsible for carrying out the Act.

(c) This policy is not expected to significantly affect entitlements, grants, user fees, loan programs, or the rights and obligations of their recipients.

(d) OMB has determined that this policy may raise novel legal or policy issues and, as a result, this action has undergone OMB review.

Regulatory Flexibility Act (5 U.S.C. 601 et seq.)

Under the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996), whenever an agency is required to publish a notice of rulemaking for any proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effect of the rule on small entities (i.e., small businesses, small organizations, and small government jurisdictions), unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities.

SBREFA amended the Regulatory Flexibility Act to require Federal agencies to provide the statement of the factual basis for certifying that a rule will not have a significant economic impact on a substantial number of small entities. The following discussion explains our determination.

We have examined this policy's potential effects on small entities as required by the Regulatory Flexibility Act and have determined that this action will not have a significant economic impact on a substantial number of small entities since the policy will not result in any significant additional expenditures by entities that develop formalized conservation efforts. The criteria in this policy describe how we will evaluate elements that are already included in conservation efforts and do not establish any new implementation burdens. Therefore, we believe that no economic effects on States and other entities will result from compliance with the criteria in this policy.

Pursuant to the Regulatory Flexibility Act, at the proposed policy stage, we certified to the Small Business Administration that this policy would not have a significant economic impact on a substantial number of small entities, since we expect that this policy will not result in any significant additional expenditures by entities that develop formalized conservation efforts. We received no comments regarding the economic impacts of this policy on small entities. Thus, we certify that this final policy will not have a significant adverse impact on a substantial number of small entities and conclude that a regulatory flexibility analysis is not necessary.

We have determined that this policy will not cause (a) any effect on the economy of $100 million or more, (b) any increases in costs or prices for consumers; individual industries; Federal, State, or local government agencies; or geographical regions, or (c) any significant adverse effects on competition, employment, investment, productivity, innovation, or the ability of U.S.-based enterprises to compete with foreign-based enterprises (see Economic Analysis below).

Executive Order 13211

On May 18, 2001, the President issued an Executive Order (E.O. 13211) on regulations that significantly affect energy supply, distribution, and use. Executive Order 13211 requires agencies to prepare Statements of Energy Effects when undertaking certain actions. Although this policy is a significant action under Executive Order 12866, it is not expected to significantly affect energy supplies, distribution, or use. Therefore, this action is not a significant energy action and no Statement of Energy Effects is required.

Unfunded Mandates Reform Act (2 U.S.C. 1501 et seq.)

In accordance with the Unfunded Mandates Reform Act (2 U.S.C. 1501 *et seq.*):

(a) This policy will not "significantly or uniquely" affect small governments. A Small Government Agency Plan is not required. We expect that this policy will not result in any significant additional expenditures by entities that develop formalized conservation efforts.

(b) This policy will not produce a Federal mandate on state, local, or tribal governments or the private sector of $100 million or greater in any year; that is, it is not a "significant regulatory action" under the Unfunded Mandates Reform Act. This policy imposes no obligations on state, local, or tribal governments (see Economic Analysis below).

Takings

In accordance with Executive Order 12630, this policy does not have significant takings implications. While state, local or Tribal governments, or private entities may choose to directly or indirectly implement actions that may have property implications, they would do so as a result of their own decisions, not as a result of this policy. This policy has no provision that would take private property.

Federalism

In accordance with Executive Order 13132, this policy does not have significant Federalism effects. A Federalism assessment is not required. In keeping with Department of the Interior and Commerce policy, we requested information from and coordinated development of this policy with appropriate resource agencies throughout the United States.

Civil Justice Reform

In accordance with Executive Order 12988, this policy does not unduly burden the judicial system and meets the requirements of sections 3(a) and 3(b)(2) of the Order. With the guidance provided in the policy, requirements under section 4 of the Endangered Species Act will be clarified to entities that voluntarily develop formalized conservation efforts.

Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.)

This policy contains collection-of-information requirements subject to the Paperwork Reduction Act (PRA) and which have been approved by Office of Management and Budget (OMB). The FWS has OMB approval for the collection under OMB Control Number 1018–0119, which expires on December 31, 2005. The NMFS has OMB approval for the collection under OMB Control Number 0648–0466, which expires on December 31, 2005. We may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Public reporting burden for FWS collections of information is estimated to average 2,500 hours for developing one agreement with the intent to preclude a listing, 320 hours for annual monitoring under one agreement, and 80 hours for one annual report. The FWS expects that six agreements with the intent of making listing unnecessary will be developed in one year and that four of these will be successful in making listing unnecessary, and therefore, the entities who develop these four agreements will carry through with their monitoring and reporting commitments. Public reporting burden for NMFS collections of information is estimated to average 2,500 hours for developing one agreement with the intent to preclude a listing, 320 hours for annual monitoring under one agreement, and 80 hours for one annual report. The NMFS expects that two agreements with the intent of making listing unnecessary will be developed in one year and that one of these will be successful in making listing unnecessary, and therefore, the entities who develop this agreement will carry through with their monitoring and reporting commitments. These estimates include the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate, or any other aspect of this data collection, including suggestions for reducing the burden, to the FWS and NMFS (see **ADDRESSES** section of this policy).

National Environmental Policy Act

We have analyzed this policy in accordance with the criteria of the National Environmental Policy Act (NEPA), the Department of the Interior Manual (318 DM 2.2(g) and 6.3(D)), and National Oceanic and Atmospheric Administration (NOAA) Administrative Order 216–6. This policy does not constitute a major Federal action significantly affecting the quality of the human environment. The FWS has determined that the issuance of the policy is categorically excluded under the Department of the Interior's NEPA procedures in 516 DM 2, Appendix 1 (1.10) and 516 DM 6, Appendix 1. NOAA has determined that the issuance of this policy qualifies for a categorical exclusion as defined by NOAA Administrative Order 216–6, Environmental Review Procedure.

ESA Section 7 Consultation

We have determined that issuance of this policy will not affect species listed as threatened or endangered under the Endangered Species Act, and, therefore, a section 7 consultation on this policy is not required.

Government-to-Government Relationship With Tribes

In accordance with the President's memorandum of April 29, 1994, "Government-to-Government Relations with Native American Tribal Governments" (59 FR 22951), E.O. 13175, and the Department of Interior's 512 DM 2, this policy does not directly affect Tribal resources. The policy may have an indirect effect on Native American Tribes as the policy may influence the type and content of conservation plans and efforts implemented by Tribes, or other entities. The extent of this indirect effect will be determined on a case-by-case basis during our evaluation of individual formalized conservation efforts when we make a listing decision. Under Secretarial Order 3206, we will, at a minimum, share with the entity that developed the formalized conservation effort any information provided by the Tribes, through the public comment period for the listing decision or formal submissions. During the development of conservation plans, we can encourage the incorporation of conservation efforts that will restore or enhance Tribal trust resources. After consultation with the Tribes and the entity that developed the formalized conservation effort and after careful consideration of the Tribe's concerns, we must clearly state the rationale for the recommended final listing decision and explain how the decision relates to our trust responsibility. Accordingly:

(a) We have not yet consulted with the affected Tribe(s). We will address this requirement when we evaluate formalized conservation efforts that have yet to be implemented or have recently been implemented and have yet to show effectiveness at the time we make a listing decision.

(b) We have not yet worked with Tribes on a government-to-government basis. We will address this requirement when we evaluate formalized conservation efforts that have yet to be implemented or have recently been implemented but have yet to show effectiveness at the time we make a listing decision.

(c) We will consider Tribal views in individual evaluations of formalized conservation efforts.

(d) We have not yet consulted with the appropriate bureaus and offices of the Department about the identified effects of this policy on Tribes. This requirement will be addressed with individual evaluations of formalized conservation efforts.

Information Quality

In Accordance with section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106–554), OMB directed Federal agencies to issue and implement guidelines to ensure and maximize the quality, objectivity, utility, and integrity of Government information disseminated to the public (67 FR 8452). Under our Information Quality guidelines, if we use a conservation plan or agreement as part of our decision to either list or not list a species under the Act, the plan or agreement is considered to be disseminated by us and these guidelines apply to the plan or agreement. The criteria outlined in this policy are consistent with OMB, Department of Commerce, NOAA, and Department of the Interior. FWS information quality guidelines. The Department of the Interior's guidelines can be found at *http://www.doi.gov/ocio/guidelines/515Guides.pdf*, and the FWS's guidelines can be found at *http://irm.fws.gov/infoguidelines/*. The Department of Commerce's guidelines can be found at *http://www.osec.doc.gov/cio/oipr/iqg.html*, and the NOAA/NMFS's guidelines can be found at *http://www.noaanews.noaa.gov/stories/iq.htm*. Under these guidelines, any affected person or organization may request from FWS or NMFS, a correction of information they believe to be incorrect in the plan or agreement. "Affected persons or organizations" are those who may use, be benefitted by, or be harmed by the disseminated information (i.e., the conservation plan or agreement). The process for submitting a request for correction of information is found in the respective FWS and NOAA guidelines.

Economic Analysis

This policy identifies criteria that a formalized conservation effort must satisfy to ensure certainty of implementation and effectiveness and for us to determine that the conservation effort contributes to making listing a species unnecessary or contributes to forming a basis for listing a species as threatened rather than endangered. We developed this policy to ensure consistent and adequate evaluation of agreements and plans when making listing decisions. The policy will also provide guidance to States and other entities on how we will evaluate certain formalized conservation efforts during the listing process.

The criteria in this policy primarily describe elements that are already included in conservation efforts and that constitute sound conservation planning. For example, the criteria requiring identification of responsible parties, obtaining required authorizations, establishment of objectives, and inclusion of an implementation schedule and monitoring provisions are essential for directing the implementation and affirming the effectiveness of conservation efforts. These kinds of "planning" requirements are generally already included in conservation efforts and do not establish any new implementation burdens. Rather, these requirements will help to ensure that conservation efforts are well planned and, therefore, increase the likelihood that conservation efforts will ultimately be successful in making listing species unnecessary.

The development of an agreement or plan by a state or other entity is completely voluntary. However, when a state or other entity voluntarily decides to develop an agreement or plan with the specific intent of making listing a species unnecessary, the criteria identified in this policy can be construed as requirements placed on the development of such agreements or plans. The state or other entity must satisfy these criteria in order to obtain and retain the benefit they are seeking, which is making listing of a species as threatened or endangered unnecessary.

The criteria in the policy require demonstrating certainty of implementation and effectiveness of formalized conservation efforts. We have always considered the certainty of implementation and effectiveness of conservation efforts when making listing decisions. Therefore, we believe that no economic effects on states and other entities will result from using the criteria in this policy as guidance.

Furthermore, publication of this policy will have positive effects by informing States and other entities of the criteria we will use in evaluating formalized conservation efforts when making listing decisions, and thereby guide states and other entities in developing voluntary formalized conservation efforts that will be successful in making listing unnecessary. Therefore, we believe that informational benefits will result from issuing this policy. We believe these benefits, although important, will be insignificant economically.

Authority

The authority for this action is the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Policy for Evaluation of Conservation Efforts When Making Listing Decisions

Policy Purpose

The Fish and Wildlife Service and National Marine Fisheries Service developed this policy to ensure consistent and adequate evaluation of formalized conservation efforts (conservation efforts identified in conservation agreements, conservation plans, management plans, and similar documents) when making listing decisions under the Act. This policy may also guide the development of conservation efforts that sufficiently improve a species' status so as to make listing the species as threatened or endangered unnecessary.

Definitions

"Adaptive management" is a method for examining alternative strategies for meeting measurable biological goals and objectives, and then, if necessary, adjusting future conservation management actions according to what is learned.

"Agreements and plans" include conservation agreements, conservation plans, management plans, or similar documents approved by Federal agencies, State and local governments, Tribal governments, businesses, organizations, or individuals.

"Candidate species," as defined by regulations at 50 CFR 424.02(b), means any species being considered for listing as an endangered or a threatened species, but not yet the subject of a proposed rule. However, the FWS includes as candidate species those species for which the FWS has sufficient information on file relative to status and threats to support issuance of proposed listing rules. The NMFS includes as candidate species those species for which it has information indicating that listing may be warranted, but for which sufficient information to support actual proposed listing rules may be lacking. The term "candidate species" used in this policy refers to those species designated as candidates by either of the Services.

"Conservation efforts," for the purpose of this policy, are specific actions, activities, or programs designed to eliminate or reduce threats or otherwise improve the status of a species. Conservation efforts may involve restoration, enhancement, maintenance, or protection of habitat; reduction of mortality or injury; or other beneficial actions.

"Formalized conservation efforts" are conservation efforts identified in a conservation agreement, conservation plan, management plan, or similar document. An agreement or plan may contain numerous conservation efforts.

Policy Scope

When making listing decisions, the Services will evaluate whether formalized conservation efforts contribute to making it unnecessary to list a species, or to list a species as threatened rather than endangered. This policy applies to those formalized conservation efforts that have not yet been implemented or have been implemented, but have not yet demonstrated whether they are effective at the time of a listing decision. We will make this evaluation based on the certainty of implementing the conservation effort and the certainty that the effort will be effective. This policy identifies the criteria we will use to help determine the certainty of implementation and effectiveness. Listing decisions covered by the policy include findings on petitions to list species, and decisions on whether to assign candidate status, remove candidate status, issue proposed listing rules, and finalize or withdraw proposed listing rules. This policy applies to formalized conservation efforts developed with or without a specific intent to influence a listing decision and with or without the involvement of the Services.

Section 4(a)(1) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1533(a)(1)), states that we must determine whether a species is threatened or endangered because of any of the following five factors:(A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.

Although this language focuses on impacts negatively affecting a species, section 4(b)(1)(A) requires us also to "tak[e] into account those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species, whether by predator control, protection of habitat and food supply, or other conservation practices, within any area under its jurisdiction, or on the high seas." Read together, sections 4(a)(1) and 4(b)(1)(A), as reflected in our regulations at 50 CFR 424.11(f), require us to take into account any State or local laws, regulations, ordinances, programs, or other specific conservation measures that either positively or negatively affect a species' status (i.e., measures that create, exacerbate, reduce, or remove threats identified through the section 4(a)(1) analysis). The manner in which the section 4(a)(1) factors are framed supports this conclusion. Factor (D) for example—ldquo;the inadequacy of existing regulatory mechanisms"—indicates that overall we might find existing regulatory mechanisms adequate to justify a determination not to list a species.

Factor (E) in section 4(a)(1) (any "manmade factors affecting [the species'] continued existence") requires us to consider the pertinent laws, regulations, programs, and other specific actions of any entity that either positively or negatively affect the species. Thus, the analysis outlined in section 4 of the Act requires us to consider the conservation efforts of not only State and foreign governments but also of Federal agencies, Tribal governments, businesses, organizations, or individuals that positively affect the species' status.

While conservation efforts are often informal, such as when a property owner implements conservation measures for a species simply because of concern for the species or interest in protecting its habitat, and without any specific intent to affect a listing decision, conservation efforts are often formalized in conservation agreements, conservation plans, management plans, or similar documents. The development and implementation of such agreements and plans has been an effective mechanism for conserving declining species and has, in some instances, made listing unnecessary. These efforts are consistent with the Act's finding that "encouraging the States and other interested parties * * * to develop and maintain conservation programs * * * is a key * * * to better safeguarding, for the benefit of all citizens, the Nation's heritage in fish, wildlife, and plants" (16 U.S.C. 1531 (a)(5)).

In some situations, a listing decision must be made before all formalized conservation efforts have been implemented or before an effort has demonstrated effectiveness. We may determine that a formalized conservation effort that has not yet been implemented has reduced or removed a threat to a species when we have sufficient certainty that the effort will be implemented and will be effective.

Determining whether a species meets the definition of threatened or endangered requires us to analyze a species' risk of extinction. Central to this risk analysis is an assessment of the status of the species (i.e., is it in decline or at risk of decline and at what rate is the decline or risk of decline) and consideration of the likelihood that current or future conditions or actions will promote (see section 4(b)(1)(A)) or threaten a species' persistence. This determination requires us to make a prediction about the future persistence of a species, including consideration of both future negative and positive effects of anticipated human actions. The language of the Act supports this approach. The definitions for both "endangered species" and "threatened species" connote future condition, which indicates that consideration of whether a species should be listed depends in part on identification and evaluation of future actions that will reduce or remove, as well as create or exacerbate, threats to the species. The first factor in section 4(a)(1)—"the present or *threatened* destruction, modification, or curtailment of [the species'] habitat or range"—identifies how analysis of both current actions affecting a species' habitat or range and those actions that are sufficiently certain to occur in the future and affect a species' habitat or range are necessary to assess a species' status. However, future Federal, State, local, or private actions that affect a species are not limited to actions that will affect a species' habitat or range. Congress did not intend for us to consider future actions affecting a species' habitat or range, yet ignore future actions that will influence overutilization, disease, predation, regulatory mechanisms, or other natural or manmade factors. Therefore, we construe Congress' intent, as reflected by the language of the Act, to require us to consider both current actions that affect a species' status and sufficiently certain future actions—either positive or negative—that affect a species' status. As part of our assessment of future conditions, we will determine whether a formalized conservation effort that has yet to be implemented or has recently been implemented but has yet to show effectiveness provides a high level of certainty that the effort will be implemented and/or effective and results in the elimination or adequate reduction of the threats.

For example, if a state recently designed and approved a program to eliminate collection of a reptile being considered for listing, we must assess how this program affects the status of the species. Since the program was just designed, an implementation and effectiveness record may not yet exist. Therefore, we must evaluate the likelihood, or certainty, that it will be implemented and effective, using evidence such as the State's ability to enforce new regulations, educate the public, monitor compliance, and monitor the effects of the program on the species. Consequently, we would determine that the program reduces the threat of overutilization of the species through collecting if we found sufficient certainty that the program would be implemented and effective.

In another example, a state could have a voluntary incentive program for protection and restoration of riparian habitat that includes providing technical and financial assistance for fencing to exclude livestock. Since the state has already implemented the program, the state does not need to provide certainty that it will be implemented. If the program was only recently implemented and no record of the effects of the program on the species' status existed, we would evaluate the effectiveness of this voluntary program at the time of our listing decision. To assess the effectiveness, we would evaluate the level of participation (e.g., number of participating landowners or number of stream-miles fenced), the length of time of the commitment by landowners, and whether the program reduces the threats on the species. We would determine that the program reduces the threat of habitat loss and degradation if we find sufficient certainty that the program is effective.

In addition, we will consider the estimated length of time that it will take for a formalized conservation effort to produce a positive effect on the species. In some cases, the nature, severity, and/or imminence of threats to a species may be such that a formalized conservation effort cannot be expected to produce results quickly enough to make listing unnecessary since we must determine at the time of the listing decision that the conservation effort has improved the status of the species.

Federal agencies, Tribal governments, state and local governments, businesses, organizations, or individuals contemplating development of an agreement or plan should be aware that, because the Act mandates specific timeframes for making listing decisions, we cannot delay the listing process to allow additional time to complete the development of an agreement or plan. Nevertheless, we encourage the development of agreements and plans even if they will not be completed prior to a final listing decision. Such an agreement or plan could serve as the foundation for a special rule under section 4(d) of the Act, which would establish only those prohibitions necessary and advisable for the conservation of a threatened species, or for a recovery plan, and could lead to earlier recovery and delisting.

This policy provides us guidance for evaluating the certainty of implementation and effectiveness of formalized conservation efforts. This policy is not intended to provide guidance for determining the specific level of conservation (e.g., number of populations or individuals) or the types of conservation efforts (e.g., habitat restoration, local regulatory mechanisms) specifically needed to make listing particular species unnecessary and does not provide guidance for determining when parties should enter into agreements. We do encourage early coordination in conservation measures to prevent the species from meeting the definition of endangered or threatened.

If we make a decision not to list a species or to list the species as threatened rather than endangered based in part on the contributions of a formalized conservation effort, we will track the status of the effort including the progress of implementation and effectiveness of the conservation effort. If any of the following occurs: (1) a failure to implement the conservation effort in accordance with the implementation schedule; (2) a failure to achieve objectives; (3) a failure to modify the conservation effort to adequately address an increase in the severity of a threat or to address other new information on threats; or (4) we receive any other new information indicating a possible change in the status of the species, then we will reevaluate the status of the species and consider whether initiating the listing process is necessary. Initiating the listing process may consist of designating the species as a candidate species and assigning a listing priority, issuing a proposed rule to list, issuing a proposed rule to reclassify, or issuing an emergency listing rule. In some cases, even if the parties fully implement all of the conservation efforts outlined in a particular agreement or plan, we may still need to list the species. For example, this may occur if conservation efforts only cover a portion of a species' range where the species needed to be conserved, or a particular threat to a species was not anticipated or addressed at all, or not adequately addressed, in the agreement or plan.

Evaluation Criteria

Conservation agreements, conservation plans, management plans, and similar documents generally identify numerous conservation efforts (i.e., actions, activities, or programs) to benefit the species. In determining whether a formalized conservation effort contributes to forming a basis for not listing a species, or for listing a species as threatened rather than endangered, we must evaluate whether the conservation effort improves the status of the species under the Act. Two factors are key in that evaluation: (1) for those efforts yet to be implemented, the certainty that the conservation effort will be implemented and (2) for those efforts that have not yet demonstrated effectiveness, the certainty that the conservation effort will be effective. Because the certainty of implementation and effectiveness of formalized conservation efforts may vary, we will evaluate each effort individually and use the following criteria to direct our analysis.

A. The certainty that the conservation effort will be implemented:

1. The conservation effort, the party(ies) to the agreement or plan that will implement the effort, and the staffing, funding level, funding source, and other resources necessary to implement the effort are identified. 2. The legal authority of the party(ies) to the agreement or plan to implement the formalized conservation effort, and the commitment to proceed with the conservation effort are described.3. The legal procedural requirements (e.g. environmental review) necessary to implement the effort are described, and information is provided indicating that fulfillment of these requirements does

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not preclude commitment to the effort. 4. Authorizations (e.g., permits, landowner permission) necessary to implement the conservation effort are identified, and a high level of certainty is provided that the party(ies) to the agreement or plan that will implement the effort will obtain these authorizations. 5. The type and level of voluntary participation (e.g., number of landowners allowing entry to their land, or number of participants agreeing to change timber management practices and acreage involved) necessary to implement the conservation effort is identified, and a high level of certainty is provided that the party(ies) to the agreement or plan that will implement the conservation effort will obtain that level of voluntary participation (e.g., an explanation of how incentives to be provided will result in the necessary level of voluntary participation). 6. Regulatory mechanisms (e.g., laws, regulations, ordinances) necessary to implement the conservation effort are in place. 7. A high level of certainty is provided that the party(ies) to the agreement or plan that will implement the conservation effort will obtain the necessary funding. 8. An implementation schedule (including incremental completion dates) for the conservation effort is provided. 9. The conservation agreement or plan that includes the conservation effort is approved by all parties to the agreement or plan.

B. The certainty that the conservation effort will be effective:

1. The nature and extent of threats being addressed by the conservation effort are described, and how the conservation effort reduces the threats is described. 2. Explicit incremental objectives for the conservation effort and dates for achieving them are stated. 3. The steps necessary to implement the conservation effort are identified in detail. 4. Quantifiable, scientifically valid parameters that will demonstrate achievement of objectives, and standards for these parameters by which progress will be measured, are identified. 5. Provisions for monitoring and reporting progress on implementation (based on compliance with the implementation schedule) and effectiveness (based on evaluation of quantifiable parameters) of the conservation effort are provided.6. Principles of adaptive management are incorporated.

These criteria should not be considered comprehensive evaluation criteria. The certainty of implementation and effectiveness of a formalized conservation effort may also depend on species-specific, habitat-specific, location-specific, and effort-specific factors. We will consider all appropriate factors in evaluating formalized conservation efforts. The specific circumstances will also determine the amount of information necessary to satisfy these criteria.

To consider that a formalized conservation effort(s) contributes to forming a basis for not listing a species or listing a species as threatened rather than endangered, we must find that the conservation effort is sufficiently certain to be implemented and effective so as to have contributed to the elimination or adequate reduction of one or more threats to the species identified through the section 4(a)(1) analysis. The elimination or adequate reduction of section 4(a)(1) threats may lead to a determination that the species does not meet the definition of threatened or endangered, or is threatened rather than endangered. An agreement or plan may contain numerous conservation efforts, not all of which are sufficiently certain to be implemented and effective. Those conservation efforts that are not sufficiently certain to be implemented and effective cannot contribute to a determination that listing is unnecessary or a determination to list as threatened rather than endangered. Regardless of the adoption of a conservation agreement or plan, however, if the best available scientific and commercial data indicate that the species meets the definition of "endangered species" or "threatened species" on the day of the listing decision, then we must proceed with appropriate rule-making activity under section 4 of the Act.

Dated: September 16, 2002.

Steve Williams,

Director, Fish and Wildlife Service.

December 23, 2002.

William T. Hogarth,

Assistant Administrator for Fisheries, National Marine Fisheries Services.

[FR Doc. 03–7364 Filed 3–27–03; 8:45 am]

BILLING CODES 4310–55–S and 3510–22–S

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 679

[Docket No. 021212306–2306–01; I.D. 032403A]

Fisheries of the Exclusive Economic Zone Off Alaska; Pollock in Statistical Area 610 of the Gulf of Alaska

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Modification of a closure.

SUMMARY: NMFS is reopening directed fishing for pollock in Statistical Area 610 of the Gulf of Alaska (GOA) for 24 hours. This action is necessary to fully use the B season allowance of the total allowable catch (TAC) of pollock specified for Statistical Area 610.

DATES: Effective 1200 hrs, Alaska local time (A.l.t.), March 26, 2003, through 1200 hrs, A.l.t., March 27, 2003.

FOR FURTHER INFORMATION CONTACT: Mary Furuness, 907–586–7228.

SUPPLEMENTARY INFORMATION: NMFS manages the groundfish fishery in the GOA exclusive economic zone according to the Fishery Management Plan for Groundfish of the Gulf of Alaska (FMP) prepared by the North Pacific Fishery Management Council under authority of the Magnuson-Stevens Fishery Conservation and Management Act. Regulations governing fishing by U.S. vessels in accordance with the FMP appear at subpart H of 50 CFR part 600 and 50 CFR part 679.

NMFS closed the B season directed fishery for pollock in Statistical Area 610 of the GOA under § 679.20(d)(1)(iii) on March 19, 2003 (68 FR 13857, March 21, 2003).

NMFS has determined that, approximately 986 mt of pollock remain in the B season directed fishing allowance. Therefore, in accordance with 679.25(a)(2)(i)(C) and (a)(2)(iii)(D), and to fully utilize the B season allowance of pollock TAC specified for Statistical Area 610, NMFS is terminating the previous closure and is reopening directed fishing for pollock in Statistical Area 610 of the GOA. In accordance with § 679.20(d)(1)(iii), the Regional Administrator finds that this directed fishing allowance will be reached after 24 hours. Consequently, NMFS is prohibiting directed fishing for pollock in Statistical Area 610 of the GOA effective 1200 hrs, A.l.t., March 27, 2003.

Owens Tui Chub (*Siphateles bicolor snyderi* = *Gila bicolor snyderi*)

[Species photo to come]

Legal Status

State: Endangered, Fully Protected
Federal: Endangered (50 FR 31592–31597)
Critical Habitat: Designated on August 5, 1985 (50 FR 31592–31597)
Recovery Planning: Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties (USFWS 1998)
Notes: The 5-year review for this species (USFWS 2009) found that threats that were present when the Owens tui chub was listed are still present with new threats identified. The recovery priority number assigned was 3, which indicates the taxon is a subspecies that faces a high degree of threat and has a high potential for recovery (USFWS 2009).

Taxonomy

The Owens tui chub (*Siphateles bicolor snyderi*) is a member of the minnow family (*Cyprinidae*). It was described in 1973 as a subspecies of tui chub endemic to the Owens Basin (Miller 1973) as *Gila bicolor snyderi*. Simons and Mayden (1998) published a paper addressing the classification of the North America genera of *Cyprinidae* and, based on ribonucleic acid sequences, restored *Siphateles* from a subgenus to a full genus. The California Department of Fish and Game (CDFG) currently includes the species under the genus *Siphateles* (CDFG 2011), and the U.S. Fish and Wildlife Service (USFWS) proposes the taxonomic change from *G. b. snyderi* to *S. b. snyderi* (USFWS 2009). This taxonomic change will not affect its federal listing status.

It is morphologically similar to the Mohave tui chub (*S. b. mohavensis*) and Lahontan tui chub (*S. b. obesus*). It is distinguished from its closest relative, the Lahontan tui chub, by scales with a weakly developed or absent basal shield, lateral and apical radii that number 13 to 29, the structure of its pharyngeal arches, the number of anal fin rays, gill-raker counts of 10 to 14, and 52 to 58 lateral line scales (Miller 1973). Dorsal and lateral coloration varies from bronze to dusky green, grading to silver or white on the belly. The species may reach a total length of 12 inches. The Owens tui chub evolved in the Owens River watershed with only three other smaller species of fishes, Owens pupfish (*Cyprinodon radiosus*), Owens speckled dace (*Rhinichthys osculus* ssp.), and Owens sucker (*Catostomus fumeiventris*) (USFWS 2009).

Based on recent genetic research, Chen et al. (2007) proposed that the Cabin Bar Ranch population is a separate lineage—the Toikona tui chub lineage—from the Owens tui chub lineage. They do not propose making a formal taxonomic split from the Owens tui chub until more information becomes available.

Descriptions of the species' physical characteristics can be found in USFWS (1998) and USFWS (2009).

Distribution

General

The Owens tui chub is endemic to the Owens Basin (Owens Valley, Round Valley, and Long Valley) of Inyo and Mono counties, California (USFWS 1998).

Distribution and Occurrences within the Plan Area

Historical

Early fish collections in the Owens Basin documented Owens tui chub in Owens Lake, several sites along the Owens River from Long Valley to Lone Pine, tributary streams near the Owens River in Long Valley and Owens Valley, Fish Slough, and irrigation ditches and ponds near Bishop, Big Pine, and Lone Pine (Miller 1973; USFWS 2009). Although there is only one record for Owens tui chub in the Plan Area from before 1990 in the California Natural Diversity Database (CNDDB) (Figure SP-F4; Dudek 2011), the scattered distribution of these localities and the ease with which researchers captured fish suggest that Owens tui chub were common and occupied all valley floor wetlands near the Owens River in Inyo and Mono counties (USFWS 2004).

Recent

Currently, genetically pure Owens tui chub is limited to six isolated sites in the Owens Basin: Hot Creek Headwaters (AB Spring and CD Spring), Little Hot Creek Pond, Upper Owens Gorge, Mule Spring, White Mountain Research Station (operated by the University of California), and Sotcher Lake, the last of which is outside the historical range of the species in Madera County (USFWS 2009). However, there are only three recent occurrence records documented in the CNDDB database (Figure SP-F4; Dudek 2011). In 1987, Owens tui chub were found occupying irrigation ditches and a spring at Cabin Bar Ranch on the southwest shore of Owens Dry Lake, and became known as the Cabin Bar Ranch population (USFWS 2009). Predation from introduced largemouth bass (*Micropterus salmoides*) and bluegill sunfish (*Lepomis macrochirus*), and failure to maintain adequate water quality and quantity, extirpated the Cabin Bar Ranch population of Owens tui chub in 2003 (USFWS 2009). However, prior to extirpation, 24 individuals were placed in an artificial pond and moved to Mule Spring in 1990; all extant fish of this group descend from this transplant (Chen et al. 2007). The Plan Area includes the former Cabin Bar Ranch population and the Mule Spring population (see Figure SP-F4). USFWS (1998) has proposed three conservation areas within the Plan Area: Mule Spring, Black Rock, and Southern Owens (the Cabin Bar Ranch population was found on the southwest shore of Owens Dry Lake).

Natural History

Habitat Requirements

The Owens tui chub occurs in low-velocity waters with well-developed beds of aquatic plants, rocks, and undercut banks with bottoms of gravel (Leunda et al. 2005; Moyle 2002). Dense aquatic vegetative cover is likely important to Owens tui chubs for predator avoidance, reproduction, water velocity displacement, and feeding (McEwan 1989, as cited in Geologica 2003; McEwan 1991). Plant species observed in occupied habitat at the Hot Creek Headwaters population include watercress (*Nasturtium officinale*), water fern (*Azolla filiculoides*), duckweed (*Lemna* sp.), pondweed (*Potamogeton* sp.), aquatic buttercup (*Ranunculus aquatilis*), and elodea (*Elodea canadensis*) (McEwan 1991). McEwan (1991) provides details of the habitat structure at the Hot Creek Headwaters population, where plants cover approximately 50% to 75% of the stream surface area. The plants typically grow out from the sides in the main channel, forming dense beds along the stream margins that delineate a small chute of swift-flowing water in the center of the channel. In the backwater areas with zero water velocities, vegetation covers nearly 100% of the surface area. There is a limited die-off of vegetation beds during the winter, but most of the beds persist due to the thermal characteristics of the headsprings.

Water temperature within occupied habitat varies to a great degree (as summarized in Geologica [2003]). It can be fairly constant at spring sites (14–18°C [57–64°F]), hotter at hot springs (21–25 °C [70–77°F]), and cooler in a river (36–78°F [2–25°C]) (Geologica 2003). Within occupied habitat where measurements exist, pH ranges from 6.6 to 8.9 (McEwan 1989; Geologica 2003), dissolved oxygen varies from 5 to 9.3 milligrams/liter (Malengo 1999; Geologica 2003), and alkalinity varies from 68.0 to 88.4 parts per million (McEwan 1989).

The Owens tui chub is restricted to six total populations, five of which are within the historical range of the species. Of these five populations, three (Hot Creek Headwaters, Little Hot Creek Pond, and Upper Owens Gorge) are located in small, isolated, man-altered portions of these waterways. The other two populations (Mule Spring and White Mountain Research Station) exist in manmade ponds at upland sites with water supplied by artificial methods. A detailed account of the habitat at each of the extant populations can be found in the 5-year review (USFWS 2009).

Table 1. Habitat Associations for Owens Tui Chub

Land Cover Type	Land Cover Use	Habitat Designation	Habitat Parameters	Supporting Information
Low-velocity waters	Breeding/foraging	Primary	Low-velocity waters with well-developed beds of aquatic vegetation, rocks, and undercut banks	Direct observation studies

Sources: USFWS 2009; Leunda et al. 2005; McEwan 1991, Geologica 2003.

Foraging Requirements

The results of a gut content analysis indicate that Owens tui chub is an opportunistic omnivore that utilizes a wide variety of food items (McEwan 1991). Aquatic vegetation is especially important as it provides forage and habitat for aquatic invertebrates, the main food item of the Owens tui chub (McEwan 1989, as cited in Geologica 2003; McEwan 1991). Specific food items that appear to be of importance include chironomids, larvae of two species of hydroptillid caddisfly, other aquatic invertebrates, plant material, and detritus (McEwan 1991). There is evidence that the diet varies seasonally at the Hot Creek Headwaters (McEwan 1991); the dominant items in Owens tui chub diet there are chironomid larvae and algae in spring, chironomid larvae in summer, hydroptillid caddisflies in fall, and chironomid larvae in winter (McEwan 1991). Owens tui chubs feed mainly by gleaning and grazing among submerged vegetation (Geologica 2003).

Reproduction

Sexual maturity in Owens tui chub appears dependent on the microhabitat. For example, sexual maturity in springs with constant water temperature has been recorded at 2 years for females and 1 year for males, in comparison to more varied temperatures where males and females reach sexual maturity at 2 years (McEwan 1990, as cited in USFWS 2009). In general, tui chubs congregate from later winter to early summer to spawn over aquatic vegetation or gravel substrates (Kimsey 1954, as cited in Geologica 2003). More specifically, McEwan (1990, as cited in USFWS 2009), recorded spawning from late winter to early summer at spring habitats, and from spring to early summer in riverine and lacustrine or lake-like habitats. Spawning appears to be triggered by day length and warming water temperatures (McEwan 1989, 1990, as cited in USFWS 2009). With the adhesive quality of the eggs, spawning usually occurs over gravel substrate or aquatic vegetation (USFWS 2009). Multiple spawning bouts during the breeding season are likely (Moyle 2002), and females may produce large numbers of eggs at each bout (Geologica 2003). Embryos hatch in 3 to 6 days (Moyle 2002), and may be influenced by water temperature, with eggs hatching earlier in warmer water (Cooper 1978, as cited in USFWS 2009). Larvae remain near aquatic plants after hatching (Moyle 2002). Growth during the first summer is rapid and slows at maturity, usually in the second to fourth year (Moyle 2002).

Table 2. Key Seasonal Periods for Owens Tui Chub

	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Breeding			X	X	X	X	X					

Sources: USFWS 1998, 2009.

Spatial Activity

The dispersal, home range, and migratory patterns of Owens tui chub are not well understood. Many of the locations where they are currently found are completely isolated from other populations. Tui chubs congregate from late winter to early summer to spawn over aquatic vegetation or gravel substrates (USFWS 2009). Chen et al. (2007) have determined that the Owens tui chub lineage is more genetically distinct from the Cabin Bar Ranch population (the Toikona tui chub lineage) than the Lahontan tui chub, which may represent independent lines of evolution (i.e., no dispersal). Morphology, swimming ability, and behavior all suggest the species is not adapted to movement through rapid waters (Moyle 2002). Therefore, movement of this species likely requires the presence of vegetation beds so that high-velocity areas are encountered only briefly. Jenkins (1990, as cited in Geologica 2003) observed no Owens tui chub in the Owens River Gorge within riffle habitat. Dispersal of other species of tui chub has been inferred using gene flow, where unidirectional dispersal and bidirectional inter-basin gene flow have been recorded (Chen 2006). In addition, daily migrations have been observed for tui chub in large, deep lakes during summer, whereas they move between deep water during the day and shallow water during the night (Moyle 2002).

Ecological Relationships

Owens tui chub were once common and occupied all valley floor wetlands near the Owens River in Inyo and Mono counties. Since that time, predaceous non-native fishes, extensive development of water resources, and interbreeding with Lahontan tui chub has resulted in population decline and habitat loss.

Currently, the major threat to the species is introgression with Lahontan tui chub (Chen et al. 2007). The Owens tui chub is reliant on slow-moving freshwater habitats that provide food and cover, but that are free of non-native aquatic predators and other tui chub subspecies and hybrids. It requires aquatic vegetation for cover, foraging, and spawning, as well as gravel substrates for spawning. If one or more of these elements are absent, it can be quickly extirpated from a location.

Population Status and Trends

Global: Critically imperiled (NatureServe 2011)
State: Same as above
Within Plan Area: Same as above

Since its listing in 1985, three new populations of Owens tui chub have been established, bringing the current number to six. Four of these populations are in small, manmade or man-altered waters, and one is outside the historical range of the species at an artificial lake (Sotcher Lake). USFWS (2009) recommends that a Recovery Priority Number of 3 be assigned to Owens tui chub, which indicates that the taxon is a subspecies that faces a high degree of threat and has a high potential for recovery. The threats that were present when the Owens tui chub was listed are still present with new threats identified (USFWS 2009).

Threats and Environmental Stressors

USWFS (2009) provides a detailed explanation of the threats to Owens tui chub, which are summarized here. Currently, the major threat to the species is introgression (i.e., hybridization) with Lahontan tui chub (Chen et al. 2007), which has resulted in extirpation throughout most of its range (USFWS 2009). In 1973, the Lahontan tui chub was introduced as baitfish into many of the streams in the Owens Basin. Historically, the Owens tui chub and Lahontan tui chub were isolated from each other, but now hybridization has been documented for populations in Mono County—at Hot Creek (downstream from the hatchery), Mammoth Creek, Twin Lakes–Mammoth, June Lake, and Owens River Upper Gorge Tailbay. In Inyo County, hybridization has been documented at A1 Drain, C2 Ditch, and McNally Canal (Madoz et al. 2005, as cited in USFWS 2009; Chen 2006, as cited in USFWS 2009). If the barriers that are acting to isolate the Owens tui chub populations from Lahontan tui chub become permeable, this could result in the loss of genetically pure populations of Owens tui chubs at Hot Creek Headwaters, Little Hot Creek Pond, and the Upper Owens Gorge. In addition, the opportunities to establish new populations of Owens tui chub in the Owens Basin are limited by the presence of hybrids in the Owens River and its tributaries. Currently, the only viable locations for establishing the Owens tui chub are isolated springs or the headwaters of streams with downstream barriers to upstream movement of Lahontan tui chubs or hybrids.

USFWS (50 FR 31592–31597) identified extensive habitat destruction and modification as threats to the Owens tui chub, and this is current as of today. Currently, Owens Basin water is in high demand that is expected to increase, which would reduce the overall availability of surface waters. The survival of two populations (White Mountain Research Station and Mule Spring) is dependent upon the continual maintenance of the artificial water supply and assurance of adequate water quality. The Upper Owens Gorge population is a pool created by a beaver dam that is eroding, which is slowly reducing the lacustrine habitat for Owens tui chubs.

Submerged aquatic vegetation is a key habitat requirement for the Owens tui chub, but not with large amounts of emergent vegetation because it may provide cover for nonnative predators of Owens tui chubs, such as bullfrogs and crayfish (*Procambarus* sp.). At the spring sites (Hot Creek Headwaters, Little Hot Creek Pond, and Mule Spring), emergent vegetation (e.g., cattail) have reduced and altered the aquatic habitat, and routine removal of emergent vegetation is required. The Mule Spring and White Mountain Research Station populations require routine management of water quantity and water quality. The environment that the Upper Owens Gorge population inhabits has been severely altered by the construction of a dam, with no mechanism to manage adequate releases of water downstream of the dam.

Since listing, evidence of disease has been observed in some populations of the Owens tui chub (USFWS 2009). In AB Spring at Hot Creek Headwaters, Bogan et al. (2002, as cited in USFWS 2009) found evidence of infection in six of the seven Owens tui chubs that were collected for genetic analysis. Since disease has been identified in Owens tui chubs, it is considered a threat. However, the magnitude of this threat is unknown (USFWS 2009).

The final listing rule (50 FR 31592–31597) identified predation by introduced non-native fish as a major threat to the Owens tui chub. Predation by non-native largemouth bass and brown trout is thought to have eliminated Owens tui chubs from much of their historical range in the Owens River (Chen and May 2003), and it is believed that non-native fish (largemouth bass and bluegill sunfish) played a role in extirpating the Cabin Bar Ranch population (Chen et al. 2007). Mosquito fish (*Gambusia affinis*) may also present a threat, as they are known to prey on small individuals of Mohave tui chub (Archdeacon 2007, as cited in USFWS 2009). At Mule Spring, bullfrogs are present and probably prey on Owens tui chubs, as they are known to prey on other subspecies of tui chubs (Parmenter 2009, as cited in USFWS 2009).

The inadequacy of existing regulatory mechanisms is considered a threat at this time by USFWS (2009), largely due to unregulated actions that could overdraft the aquifer in the Owens Valley Groundwater Basin area, which may result in reduced or no water flow to existing isolated springs and headwater springs of streams in the Owens Basin. The issue stems from the fact that the aquifer in the Owens Basin has not been adjudicated and its use is not regulated.

Any reduction in flow from springs in the Owens Basin would result in further reductions of habitat quality and quantity for the Owens tui chub at springs and tributaries of the Owens River.

Currently, Owens tui chub populations are small, between 100 and 10,000 individuals; therefore, random events that may cause high mortality or decreased reproduction could readily eliminate an entire population, which would have a significant effect on the viability of Owens tui chub populations. Furthermore, because the number of populations is small (six) and each is vulnerable to this threat, the risk of extinction is exacerbated (USFWS 2009). The Owens tui chub has experienced population loss from environmental stochastic events and will likely do so in the future. For example, the Cabin Bar Ranch population was lost because of an apparent failure to maintain adequate water quality and quantity and the introduction of non-native predators. Another example is the disappearance of Owens tui chub from the Owens Valley Native Fishes Sanctuary (Fish Slough). Reasons for the loss of this population are not known, but the small, isolated nature of this population likely contributed to their extirpation (USFWS 2009).

In small populations, such as the Owens tui chub, there are a number of factors that may reduce the amount of genetic diversity retained within populations and may increase the chance that deleterious recessive genes are expressed. Loss of diversity could limit the species' ability to adapt to future environmental changes and contributes to inbreeding depression (i.e., loss of reproductive fitness and vigor) (USFWS 2009). Deleterious recessive genes could reduce the viability and reproductive success of individuals. Isolation of the six remaining populations, preventing any natural genetic exchange, will lead to a decrease in genetic diversity.

Conservation and Management Activities

The recovery plan (USFWS 1998) provides a detailed account of management goals that need to be successfully implemented in order for the species to be delisted:

- Establish multiple, self-sustaining populations of Owens tui chubs throughout much of the historical range of the species in six identified conservation areas;
- Ensure these populations are self-sustaining;
- Ensure that each population contains juvenile and three additional age classes, and that the biomass of Owens tui chubs exceed the biomass of deleterious, non-native aquatic predatory species, which would demonstrate successful recruitment and minimal predation on smaller Owens tui chubs by non-native aquatic species;
- Reduce competition with non-native aquatic species;
- Increase the ability to conserve and protect aquatic habitats;
- Implement measures to prevent hybridization with introduced Lahontan tui chubs;
- To the extent possible, reduce the probability of the loss of Owens tui chub populations from stochastic events; and
- Complete an approved management plan and implementing agreement that address water quantity and groundwater management with the land managers.

These recovery plan criteria do not address threats from disease; catastrophic events that may affect the Owens Basin; demographic, genetic, or environmental stochasticity; or climate change. The recovery plan identifies no recovery criteria for the Toikona lineage, as the occurrence of this lineage was unknown when the recovery plan was approved. The 5-year review (USFWS 2009) finds that none of these management goals has either not been achieved or can't be evaluated.

Data Characterization

The distribution of and threats to Owens tui chub are sufficiently well known to allow coverage of this species in the Desert Renewable Energy Conservation Plan. Missing pieces of information on this species include the lack of understanding of the Toikona lineage as far as origin, genetics, and ecophysiology (Chen et al. 2007). Additionally, the lack of management plans at each of the six existing populations has resulted in less than ideal protections for the species and a poor understanding of the population dynamics. A reintroduction plan with a specific genetic distribution of the current populations is also needed. Considering the degree of known introgression between Lahontan and Owens tui chub (Chen et al. 2007), data on the distribution of genetically pure Owens tui chub and existing barriers is key.

Management and Monitoring Considerations

The Plan Area includes the former Cabin Bar Ranch population and the Mule Spring population, as well as three proposed conservation areas: Mule Spring, Black Rock, and Southern Owens Dry Lake. The genetically important and distinct Toikona lineage that occurs in the Plan Area descended from a total of 24 founders from Cabin Bar Ranch and its extant population is confined to two diminutive artificial ponds at Mule Spring (Chen et al. 2007). Chen et al. (2007) have determined that the Owens tui chub lineage is more genetically distinct from the Toikona lineage than the Lahontan tui chub, which illustrates the genetic importance of the Toikona lineage. They have also determined that the Toikona lineage is suffering from low genetic variation that may be a consequence of founder effects. Specific management within the Plan Area may include development of a management plan specific to the Mule Spring population. The management plan should propose methods to secure the conservation and the management of water quantity, water quality, habitat, and aquatic predators at the existing occupied ponds at Mule Spring. It should also illustrate in detail how to create new populations for the Toikona lineage, as well as increase effective population size. This detail should include a specific standardized genetic protocol. Candidate conservation areas to be evaluated within the Plan Area for new Toikona lineage populations may include Black Rock, Southern Owens Dry Lake, and other areas at Mule Spring. Evaluation criteria may include the presence of suitable habitat and the absence of predators and the Lahontan tui chub and their hybrids. Because so little is known about the Toikona lineage, additional studies and research should be proposed, such as origin, genetics, and ecophysiology.

Predicted Species Distribution in Plan Area

Species model summary and results will be provided following model development.

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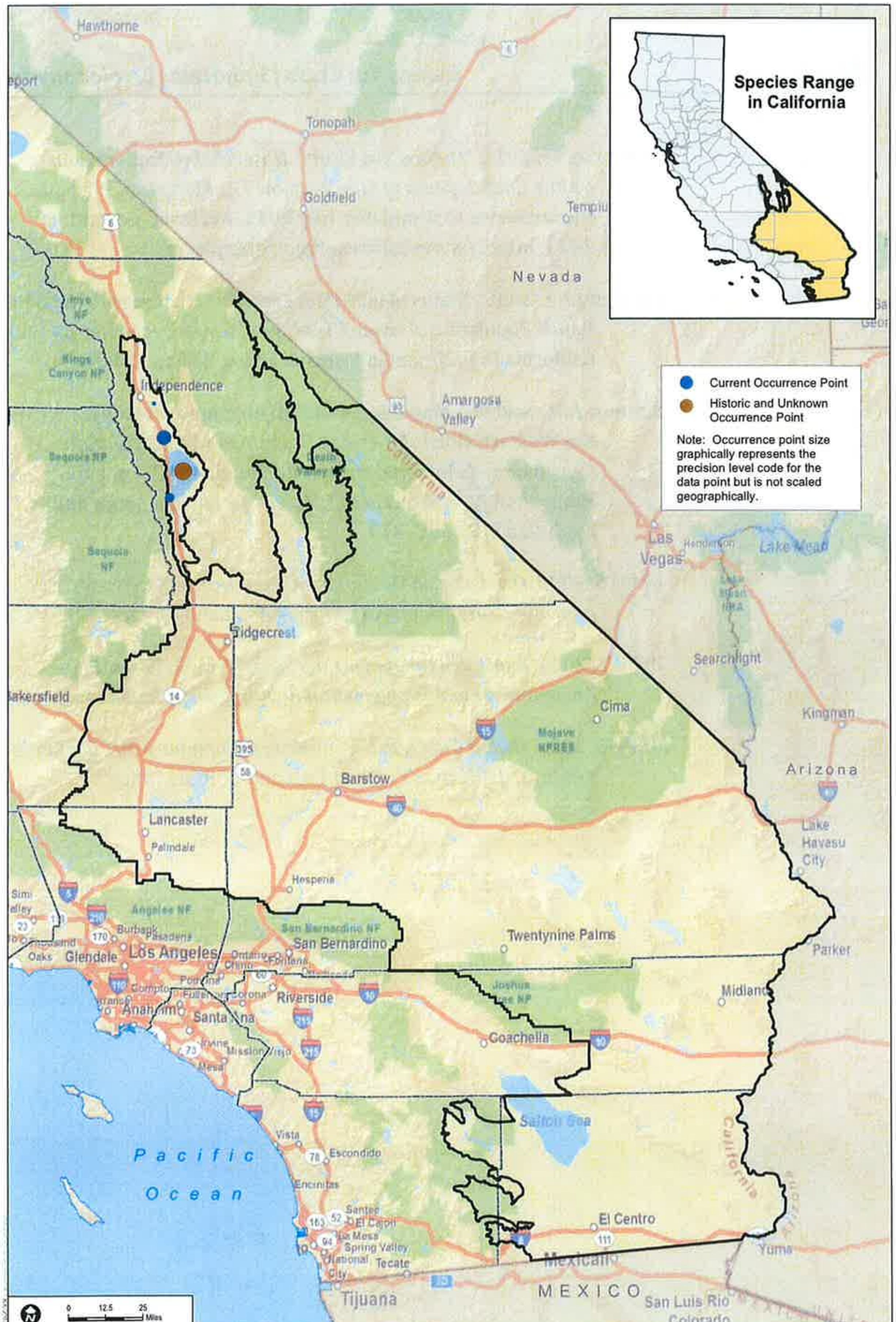

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FIGURE SP-F4

Owens Tui Chub Occurrences in the Plan Area (N=4)

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GEOTHERMAL DEVELOPMENT AND CHANGES IN SURFICIAL FEATURES: EXAMPLES FROM THE WESTERN UNITED STATES

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Key Words: geothermal development, hot springs, impacts, monitoring

ABSTRACT

Changes in surficial thermal features and land-surface elevations can accompany development of geothermal reservoirs. Such changes have been documented to varying extents at geothermal fields in the Western United States, including Long Valley caldera, Coso Hot Springs, and Amadee Hot Springs in California, and Steamboat Springs, Beowawe, Dixie Valley, and Brady Hot Springs in Nevada. The best-documented cases are for the Casa Diablo area in Long Valley caldera, California and for Steamboat Springs, Nevada where hydrologic monitoring programs have delineated some combination of declines in thermal-water discharge, increases in fumarolic steam discharge, and subsidence. At other areas noted above, similar types of changes have occurred but existing monitoring programs do not permit the same level of analysis of cause-and-effect relationships between such surficial changes and contributing factors.

1. INTRODUCTION

In most respects, geothermal energy offers considerable advantages over other forms of electrical and direct-use energy development in terms of minimizing adverse environmental effects. However, exploitable geothermal reservoirs are commonly associated with surficial thermal features such as hot springs and fumaroles, and some level of change in such features can be expected to accompany subsurface pressure changes associated with the production and injection of reservoir fluids. Geothermal reservoir pressure and temperature declines can also result in subsidence of the land surface. Perhaps the best-documented examples are from the Wairakei and Broadlands geothermal fields in New Zealand (Allis, 1981; Glover et al., 1996).

Most areas of existing or potential geothermal development in the Western United States include natural thermal features such as hot springs, geysers, spring-fed thermal pools, and steam-heated features such as fumaroles and hot pools. The extent that these features may be impacted by geothermal development depends on many factors, including both the properties of the subsurface and the details of the development (production and injection) scheme. The hydrologic and mechanical properties of the subsurface are usually not sufficiently known before development begins to predict the distribution and magnitude of surficial changes. Ideally, a hydrologic monitoring program should be in operation before and during development in order to delineate changes from both natural and man-made influences. For a variety of institutional, economic, and engineering reasons, this ideal is rarely met. Even when monitoring data are available, it is often difficult to quantify the relative effects of different factors that can influence surficial conditions, e.g. variations in precipitation and groundwater recharge, pumpage of groundwater aquifers, and crustal unrest (earthquakes and deformation).

The following list (see Figure 1 for locations) includes areas for which some degree of documentation exists for changes in surficial thermal features and land-surface elevations, followed by references to background information.

- Amadee Hot Springs, California: Land subsidence (Unpublished consultant's reports available from Lassen County Planning Department and California Division of Oil, Gas, and Geothermal Resources)
- Beowawe, Nevada: Cessation of geyser discharge (Layman, 1984; Faulder et al., 1997)
- Brady Hot Springs, Nevada: Cessation of hot-spring discharge and onset of boiling and steam upflow from shallow aquifers (Garside and Schilling, 1979)
- Coso Hot Springs, California: Increased activity of steam-heated features (Combs and Rotstein, 1975; Moore and Austin, 1983)
- Dixie Valley, Nevada: Increased activity of steam-heated features and subsidence (Benoit, 1997; Bergfeld et al., 1998)
- Long Valley caldera, California: Increased steam discharge in the well field, decreased thermal-water discharge at sites downstream from the well field, and subsidence (Sorey and Farrar, 1998)
- Steamboat Springs, Nevada: Cessation of geyser discharge (Sorey and Colvard, 1992)

In this paper, we describe the hydrologic monitoring program and the evidence for changes in surficial features associated with ongoing geothermal development in the Casa Diablo area of Long Valley caldera. We also compare and contrast the Long Valley development experience with that at Steamboat Springs, Nevada, and comment on situations at the other development areas listed above.

2. LONG VALLEY CALDERA, CALIFORNIA

2.1 Geothermal Development

The geothermal system in Long Valley involves upflow from a source reservoir in the west moat of the caldera and lateral outflow of thermal water in a generally west to east direction (Sorey et al., 1991). Reservoir temperatures range from 214°C beneath the west moat, to 170°C at Casa Diablo, and 110°C near Hot Creek gorge in the east moat of the caldera (Figure 2). Hot springs discharge primarily within Hot Creek gorge. Geothermal development currently consists of three binary power plants on a combination of private and public lands located at Casa Diablo. The plants produce a total of about 40 MW from wells that tap the shallow, 170°C, reservoir at depths of ~150 m. Plant MP-1 has been in continuous operation since 1985; plants MP-2 and PLES-1 began operations in 1991. In this single-phase, closed system,

cooled geothermal water at ~80°C is reinjected in the well field at depths of about 600 m. Total flow rate through the plants is about 900 kg/s.

Inadvertent leaks of isobutane working fluid into the injection wells at Casa Diablo have provided a useful chemical tracer within the geothermal system. Isobutane has been detected in fumaroles at and near Casa Diablo and in the Hot Bubbling Pool 5 km to the east. Fluorescein tracer tests and isobutane data indicate that less than 10% of the fluid injected at Casa Diablo moves into the production zone. Instead, most of it flows away from the well field within the injection reservoir. The appearance of isobutane at distant thermal features, however, indicates a higher degree of connection between these two zones outside the well field.

2.2 Hydrologic Monitoring Program

The Long Valley area, which includes the resort town of Mammoth Lakes, has numerous features of geologic, hydrologic, and recreational significance. Concerns over possible impacts of geothermal and water-resources developments on surficial thermal features led to establishment of the Long Valley Hydrologic Advisory Committee (LVHAC) in 1987. LVHAC membership includes the U.S. Bureau of Land Management, U.S. Forest Service, U.S. Geological Survey (USGS), Mono County, California State Department of Fish and Game, Mammoth Community Water District, geothermal developers, and various environmental organizations. As described by Farrar and Lyster (1990), the purpose of the LVHAC was to implement a hydrologic monitoring program focused on early detection of changes in surficial features that could be influenced by water-resource developments within the caldera. The LVHAC provides information to permitting agencies on such changes and recommends mitigation alternatives for specific development projects. The committee is advisory and as such its recommendations do not create legal obligations. The USGS, as a non-voting member of the LVHAC, is responsible for collecting and compiling hydrologic monitoring data, and has on occasion been requested to prepare interpretive reports based on these data.

In addition to the hydrologic monitoring program conducted by the USGS, each resource developer is required to monitor conditions in and around their well fields. Thermal and nonthermal subcommittees of the LVHAC meet with specific developers to discuss both public and proprietary monitoring and development data and interpretive analyses of such information. Findings and/or recommendations are conveyed to the LVHAC. Experience has shown that this full and open disclosure and discussion of public and proprietary monitoring data has allowed a more complete understanding of changes accompanying development and promoted an attitude of trust that has helped to avoid litigation. One example of this process is the planning and completion of a numerical model of the response of the geothermal field to development. The modeling was funded by the developer and carried out by one of its consultants, but input and review were sought from members of the thermal subcommittee.

The LVHAC monitoring program includes thermal springs east of Casa Diablo (Figure 2), streamflow measurement sites along Mammoth and Hot Creek, and both thermal and nonthermal wells (e.g. CH10B, and M-14, respectively). Areas of environmental concern include thermal springs at the Hot Creek Fish Hatchery and in Hot Creek gorge. The Hatchery springs discharge at a composite temperature near 16°C, considered optimum for trout-rearing operations. These springs contain a small (~5%) component of thermal water. Springs in Hot Creek gorge discharge at temperatures up to boiling (93°C), and provide a popular environment for bathing in heated creek water.

2.3 Changes in Surficial Features

Geothermal development at Casa Diablo has resulted in declines in reservoir pressure and temperature over the 1985-1998 period. As exemplified by data from observation well 65-32 on the edge of the well field (Figure 3), a cumulative pressure change of 0.1 Mpa between 1985 and 1990 was followed by an additional drop of 0.25 Mpa during 1991 in response to increased production and deepening of injection wells. Between 1991 and 1999, reservoir pressures have declined by about 0.1 Mpa, for a total decline of 0.45 Mpa (4.5 bars). The reduction in reservoir temperature amounts to 10-15°C, compared with localized reductions of ~80°C in the deeper injection zone. Boiling conditions in the heated groundwater system above the production reservoir have resulted in significant steam occurrences at and near the land surface, including fumaroles occupying former hot-spring vents, steam collecting beneath building foundations, and steam flowing upward through the roots of trees.

Data from the USGS monitoring program outside the Casa Diablo area (Sorey and Farrar, 1998a, b) show cessation of spring flow at Colton Spring (2 km east of Casa Diablo) and declines in water level in Hot Bubbling Pool (HBP, 5 km east of Casa Diablo). The water-level record for thermal well CW-3 adjacent to HBP correlates with the pressure record from well 65-32, indicating that the 0.25 Mpa pressure decline in the well field in 1991 (equivalent to a water-level drop of 25 m) caused a drop of 1.2 m in water level at this distance.

At the Hot Creek Fish Hatchery, chemical-flux measurements show that the thermal-water component in the springs has declined by some 30-40% since 1990. However, temperatures in the Hatchery springs have changed mainly in response to variations in the nonthermal component caused by seasonal and annual variations in groundwater recharge. The apparent lack of observable response in spring temperature accompanying the decline in thermal-water component suggests a moderating influence of conductive heating from rocks within and adjacent to the shallow flow zone containing a mixture of thermal and nonthermal fluids.

Total thermal-water discharge at Hot Creek gorge is calculated from chemical flux measurements at gaging sites on Hot Creek upstream and downstream from the thermal springs. Within a measurement error of ~15%, no decrease in thermal-water flow has been detected over the 1988-1998 period and the presence of isobutane has not been detected in the gorge springs. It appears from this that the current level of geothermal development has not caused detectible hydrologic changes beyond distances of about 5 km from the well field.

Leveling data collected along Highway 395 show subsidences in the vicinity of Casa Diablo beginning in 1986,

superimposed on a general pattern of uplift that began in 1980 in response to crustal unrest (Sorey and Farrar, 1998; Sorey et al., 1995). Since 1988, benchmarks at Casa Diablo have subsided approximately 25 cm relative to benchmarks on the resurgent dome, which have risen approximately 20 cm. This perhaps represents a unique situation in that subsidence induced by geothermal fluid withdrawal has allowed the actual land surface elevation to remain relatively constant, while intermittent intrusive activity has cause significant uplift of the surrounding region.

3. STEAMBOAT SPRINGS, NEVADA

3.1 Geothermal Development

The geothermal system beneath the Steamboat Hills, located about midway between Reno and Carson City, Nevada, is currently being developed by two well fields and associated power plants (Figure 4). To the south, the higher-temperature Caithness Power Incorporated (CPI) development involves single-stage steam flash and residual liquid injection. To the north, the lower-temperature Far West Capital (FWC) project involves production and injection of pressurized single-phase liquid and binary power plant conversion. Electrical production totals about 15 MW at the CPI plant and 85-90% of produced fluids are reinjected north of the production well field. The generating capacity of the FWC plants totals about 40 MW and 100% of produced fluids are reinjected in wells adjacent to the production well field.

Between the two development areas is a silica terrace through which hot springs and geysers discharged until 1987, when sustained testing of geothermal wells began and water levels in the spring vents began falling (Sorey and Colvard, 1992; Collar and Huntley, 1990; Collar, 1990). Analyses of available hydrologic and geochemical data have led various authors to conclude that a single, interconnected, geothermal system exists in the Steamboat Springs area (Sorey and Colvard, 1992; Mariner and Janik, 1995, and White, 1968). Hot water flows upward beneath the Steamboat Hills and then laterally toward the north and northeast. In addition to the main terrace described above, the ultimate point of discharge of thermal water under pre-development conditions was Steamboat Creek.

3.2 Hydrologic Monitoring Program

Regulation and monitoring activities at Steamboat have tended to be more complex and difficult to pursue than at Long Valley. Although there are multiple regulatory jurisdictions involved at each area, the absence of an entity such as the LVHAC at Steamboat has made it more difficult to conduct adequate monitoring and to provide for interpretive studies of changes associated with development. This situation still exists today, in spite of the fact that part of the silica terrace and adjacent areas to the west were designated an Area of Critical Environmental Concern by the Bureau of Land Management (Sorey and Colvard, 1992).

Each developer has been responsible for monitoring conditions in and around their well field. A set of wells drilled for testing and monitoring exists in the FWC well field; in the CPI well field wells drilled for stratigraphic information are monitored. A network of wells drilled into the nonthermal groundwater system surrounding the Steamboat Hills is included in the monitoring program carried out by FWC.

3.3 Changes in Surficial Features

Data on pressure changes in the developed well fields are either not publicly available or are difficult to interpret. Pressures declines in both fields appear to be minimal (~0.05 Mpa, or 0.5 bars). This indicates high reservoir transmissivity and pressure support from injection wells. Indeed, tracer tests at the FWC show that most of the injected water remains within the well field (Rose et al., 1999). This is in contrast to the situation at Long Valley described above.

By the time monitoring programs began in earnest in 1986, the geysers and springs were in decline and by 1987, liquid discharge on the main terrace had stopped. Monitoring of water levels in some spring vents continued through 1989, when water levels in the silica-lined spring conduits fell beyond the reach of measuring equipment. Two measurements were also made in 1989-1990 of thermal-water discharge in Steamboat Creek, using chloride flux techniques, for comparison with similar estimates made in the 1950-1960 period (Sorey and Colvard, 1992). These data suggest declines in total discharge of about 40%.

The analysis by Sorey and Colvard (1992) concluded that declines in hot-spring activity and thermal-water discharge at Steamboat Springs resulted from a combination of (1) successive years of below-normal precipitation and groundwater recharge, (2) groundwater pumpage in the South Truckee Meadows (north of the Steamboat Hills), and (3) geothermal fluid production. It was not possible at that time to adequately determine the relative impacts of each factor. However, precipitation has returned to normal or above-normal levels since 1994 and monitoring records show that groundwater levels have risen significantly since that time and are now at nearly the same levels as in the late 1980's. Although no recent measurements have been attempted of water levels in the spring vents on the main terrace, there is no evidence of any renewed spring flow.

4. OTHER AREAS OF GEOTHERMAL DEVELOPMENT

The scale and type of geothermal development at other noted areas in the Western United States vary widely, ranging from a small binary-electric power plant supplied by two production wells and no injection wells at Amadee Hot Springs in northeastern California to the ~250 Mwe steam-flash power plants at Coso Hot Springs in eastern California (Figure 1). In all but one case, all or most of the development area and surficial thermal features are privately owned. The exception is the Coso Hot springs area south of Long Valley in eastern California, where most of the land under development is part of the federally operated China Lake Naval Weapons Center. Thermal features at Coso Hot Springs, located adjacent to the well field, are traditionally utilized by local Native Americans. Environmental agreements between the Navy, the U.S. Bureau of Land Management, and Native American organizations call for mitigation in the event that geothermal development causes changes that negatively effect future use for religious and ceremonial purposes (Bureau of Land Management, 1980).

In cases where geothermal reservoirs and associated surficial thermal features are on privately owned land, regulations governing geothermal development are usually specified by state or county agencies, rather than federal agencies. Monitoring programs may not include observations of thermal features, so that information about changes in thermal features or land elevations is usually anecdotal or unpublished and often not sufficiently detailed to provide adequate documentation of cause-and-effect relations. Even when thermal features are on public lands, hydrologic monitoring may be deemed unnecessary where expected changes in thermal features or land-surface elevations are judged a-priori to be either mitigatable or insignificant.

A common aspect of changes induced by development of hot-water reservoirs is the reduction of liquid discharge in springs and geysers and the increase in steam discharge in fumaroles and other steam-heated features. Available information indicates that such changes have occurred at Long Valley, Steamboat, Beowawe, Amadee Hot Springs, and Brady Hot Springs, while at Coso Hot Springs and Dixie Valley naturally occurring steam discharge has increased during development. At Amadee Hot Springs, Brady Hot Springs, Dixie Valley, and Long Valley, reductions in reservoir pressure have also induced significant levels of land subsidence and ground cracking. As pointed out previously, documentation of such changes and determinations of the influence of various factors on the thermal features is adequate only for Long Valley. At Beowawe and Steamboat Springs, reductions and cessation of geyser activity accompanied the pre-development testing of production wells in the 1970's, at a time when monitoring efforts were inadequate. Some of the previously cited references contain information on thermal features at the "other" areas of geothermal development discussed in this section; additional pertinent references are listed below:

- Beowawe: Zoback (1979); White (1998); Layman (1984); Olmsted and Rush (1987)
- Brady Hot Springs: Ettinger and Brugman (1992); Harrill (1970), Osterling (1969); Olmsted et al. (1975)
- Coso Hot Springs: Monahan and Condon (1991a,b); Erskine and Lofgren (1989); Fournier et al. (1980); Fournier and Thompson (1982)
- Dixie Valley: Williams et al. (1997); Waibel (1987)

5. CONCLUSIONS

Changes in surficial thermal features and land elevations accompanying geothermal development should be viewed as the rule, rather than the exception. This follows from the nature of geothermal reservoirs within flow systems that commonly include discharge of fluids at the land surface. In the absence of fluid injection in locations proximal to such discharge areas, reductions in reservoir pressure will cause some degree of reduction in fluid upflow feeding the thermal features. Natural geyser activity should be expected to be most sensitive to such changes because of the unique combination of processes and characteristics typically required for geyser discharge. Where hot fluids occur at relatively shallow depths, either within a developed reservoir or in the overlying groundwater system, pressure reduction can also induce boiling conditions that result in increases in steam discharge at the land surface.

Factors other than pressure reductions in geothermal reservoirs can influence the temperature and flow rate of surficial thermal features. Information gained from hydrologic monitoring in and around the developed well fields, both during and prior to the development period, can allow quantification of the timing and magnitude of cause-and-effect relations between various factors that affect surficial thermal discharge and guide attempts to mitigate any adverse impacts caused by development.

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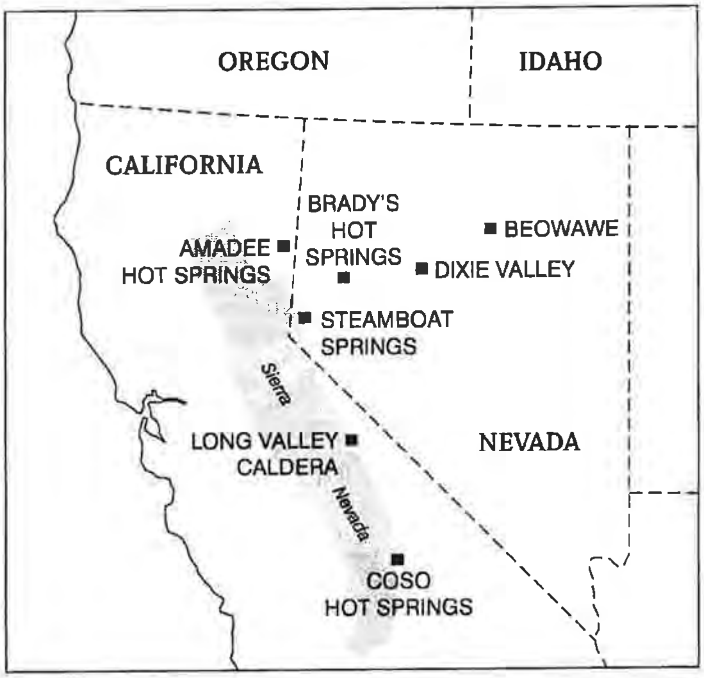


Figure 1. Locations of some geothermal fields where development has been associated with changes in thermal features and/or land subsidence.

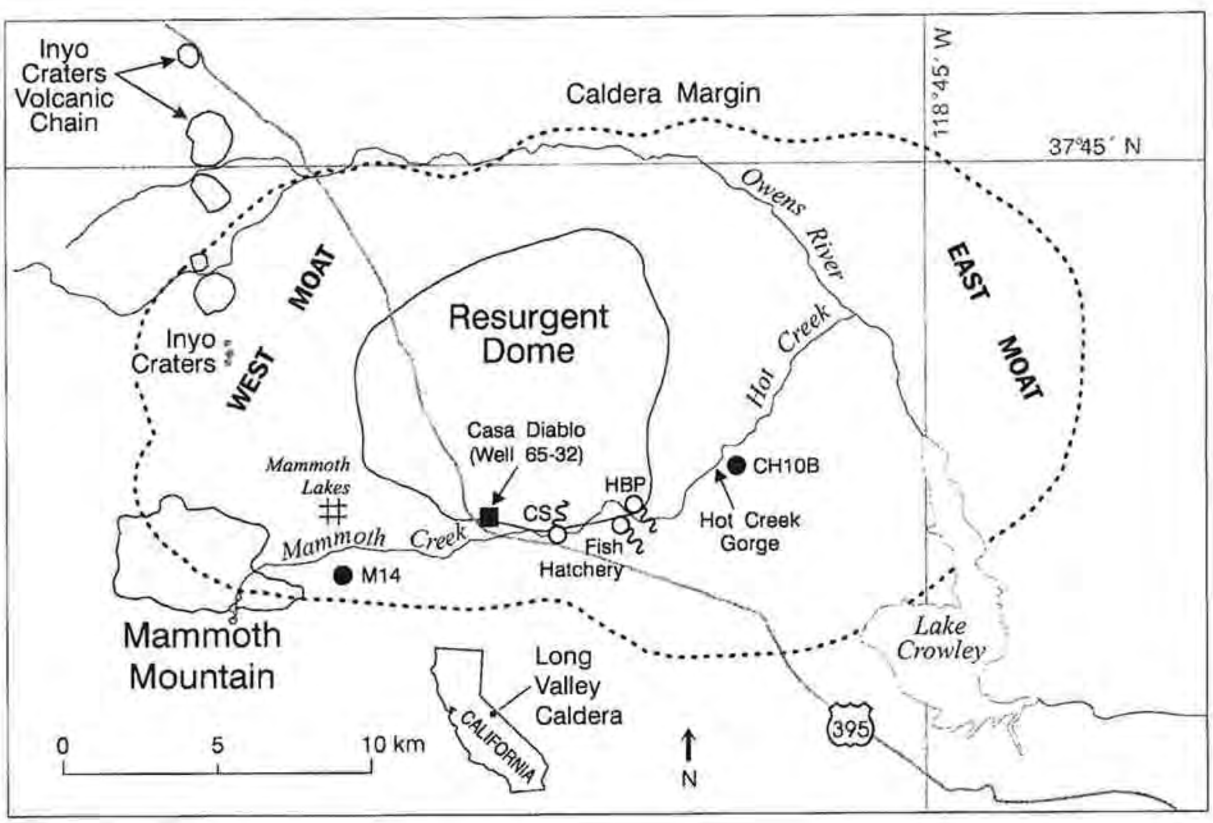


Figure 2. Map of Long Valley caldera showing various geologic and cultural features, and key sites in the hydrologic monitoring program directed by the Long Valley Hydrologic Advisory Committee.

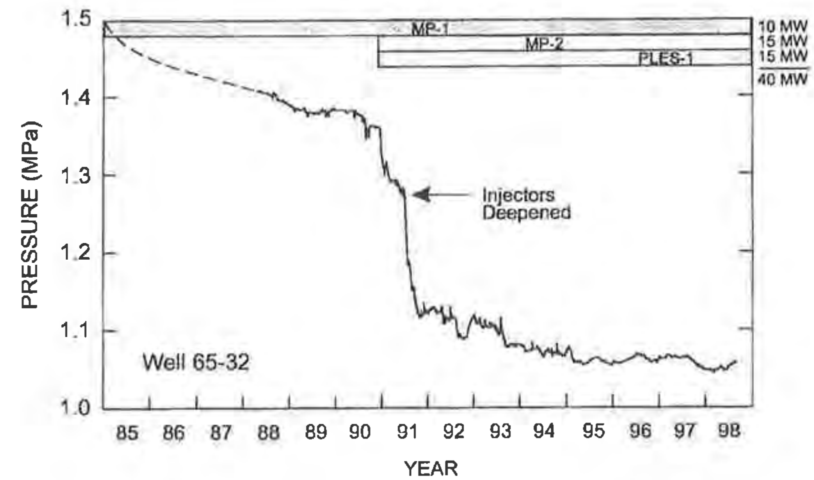


Figure 3. Pressure history in observation well 65-32, located on the edge of the geothermal well field at Casa Diablo, and periods of operation of three geothermal power plants.

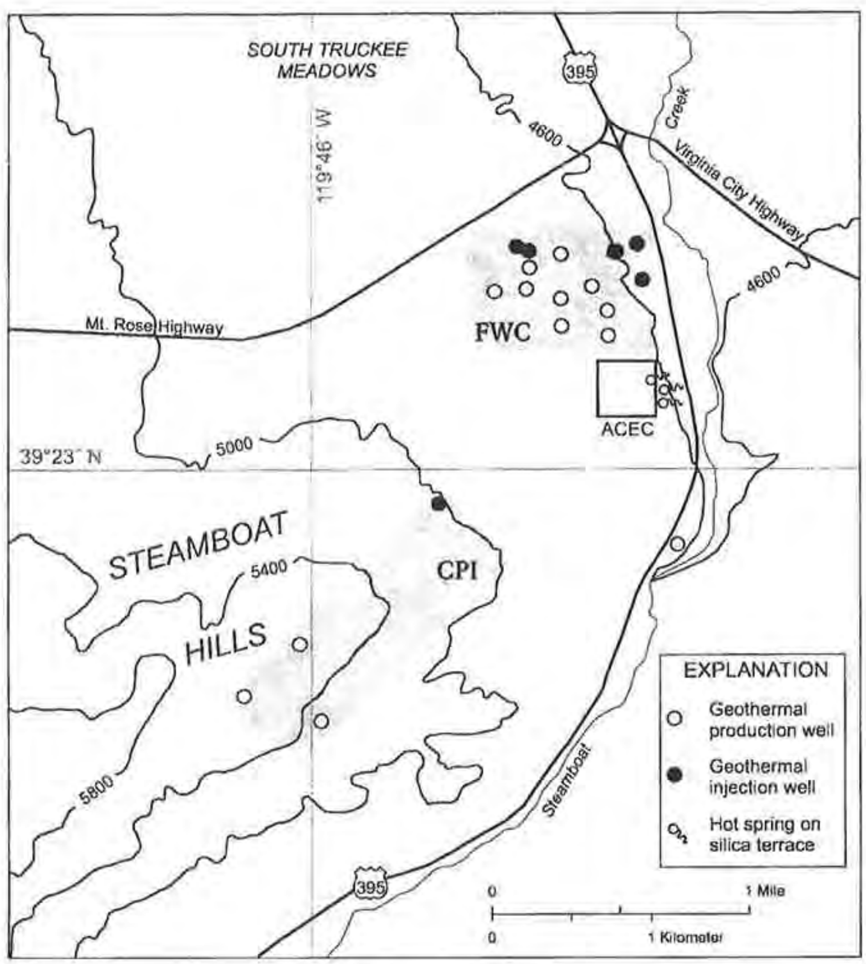


Figure 4. Map of the Steamboat Hills and surrounding region showing approximate wellfield areas for the Caithness Power, Incorporated (CPI) and Far West Capital (FWC) geothermal developments, locations of most of the production and injection wells, some of the vents on the main silica terrace that formerly included active hot springs and geysers, and the outline of the Area of Critical Environmental Concern (ACEC) designated by the Bureau of Land Management.

Appendix M

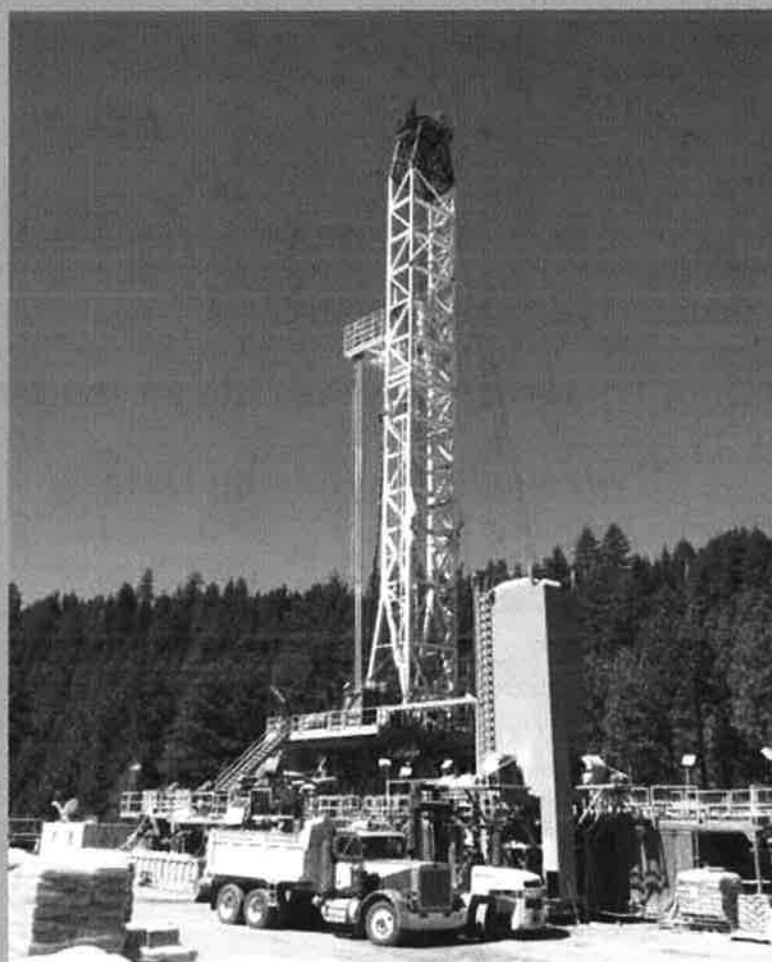
Long Valley Hydrologic Advisory Committee

Hydrologic Monitoring Data

Comment Letter I9

Long Valley Hydrologic Advisory Committee Hydrologic Monitoring Data

For the Period Ending December 2011



Unpublished provisional U.S. Geological Survey Data
Submitted by J.F. Howle, C.D. Farrar, and Kevin Bazar
Prepared February 13, 2012

LIST OF DATA

GROUND-WATER LEVELS

<u>Daily Mean Water Levels</u>

Hydrograph for well CH-10B.
Hydrograph for well LV-19.

FISH HATCHERY DATA – 1988 through 2011

<u>Measured Values for sites FHAB, FHCD, FH23</u>

Discharge – Daily mean values
Water temperature – Daily mean values

<u>Calculated Values</u>

Thermal water discharge estimate – AB and CD
Thermal water as percent – AB and CD
Total and thermal water discharge -- AB and CD combined

HOT CREEK DATA

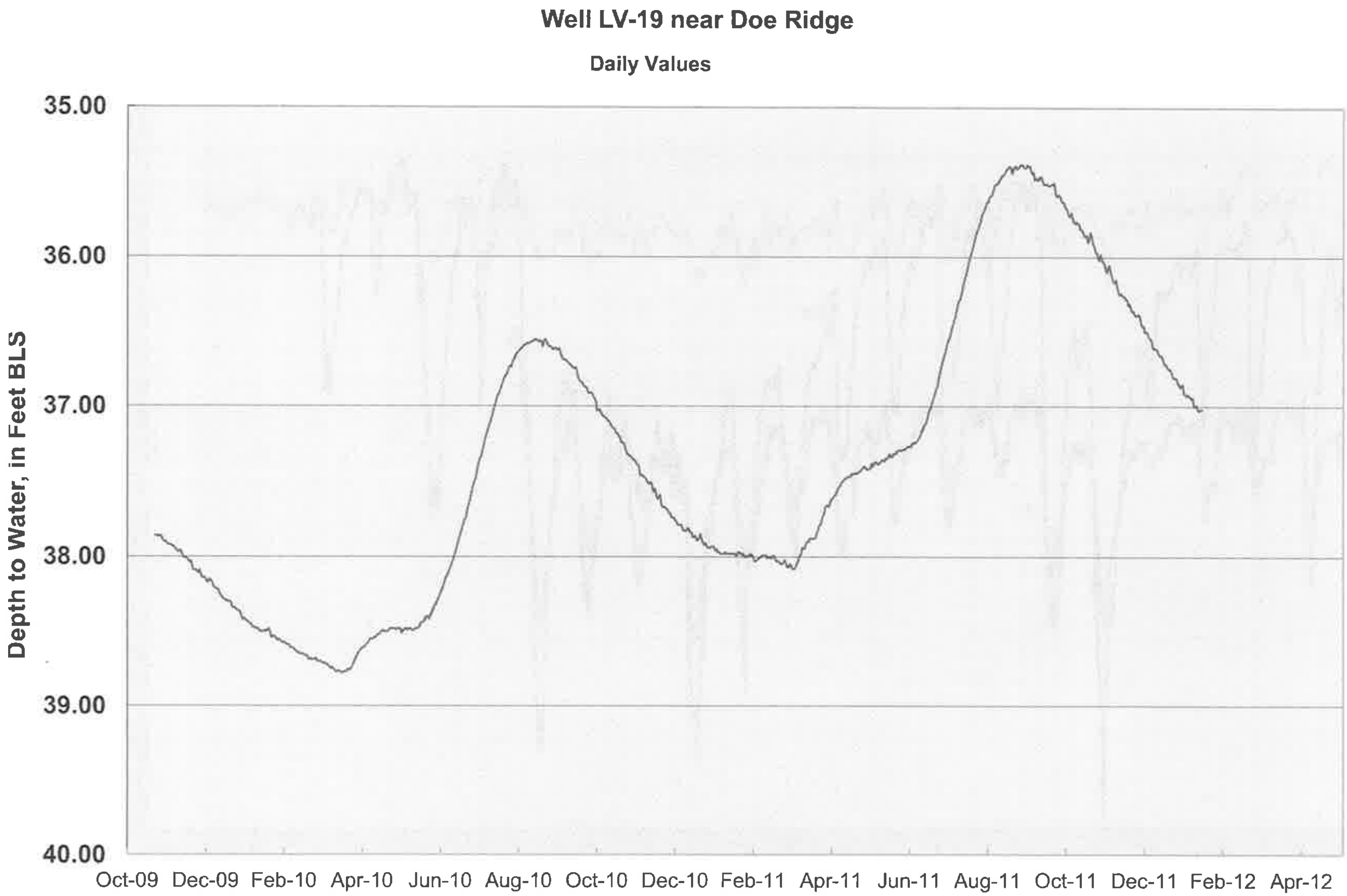
Hot Creek flume daily mean discharge 1983 through 2011
Graph of estimated thermal water discharge 1988 through 2011

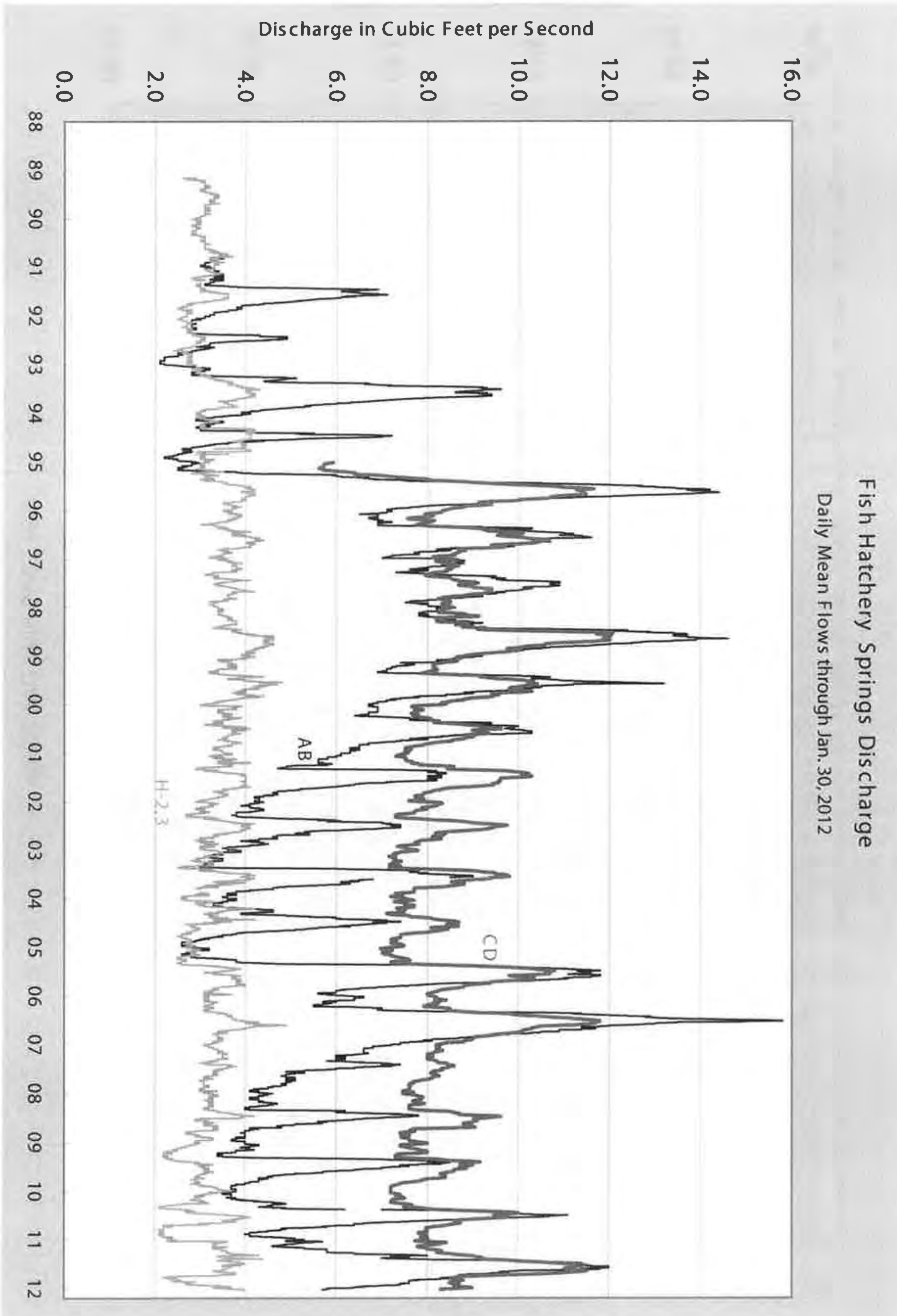
PRECIPITATION

Precipitation measured at Mammoth Ranger Station 1982 through 2011
Precipitation by months

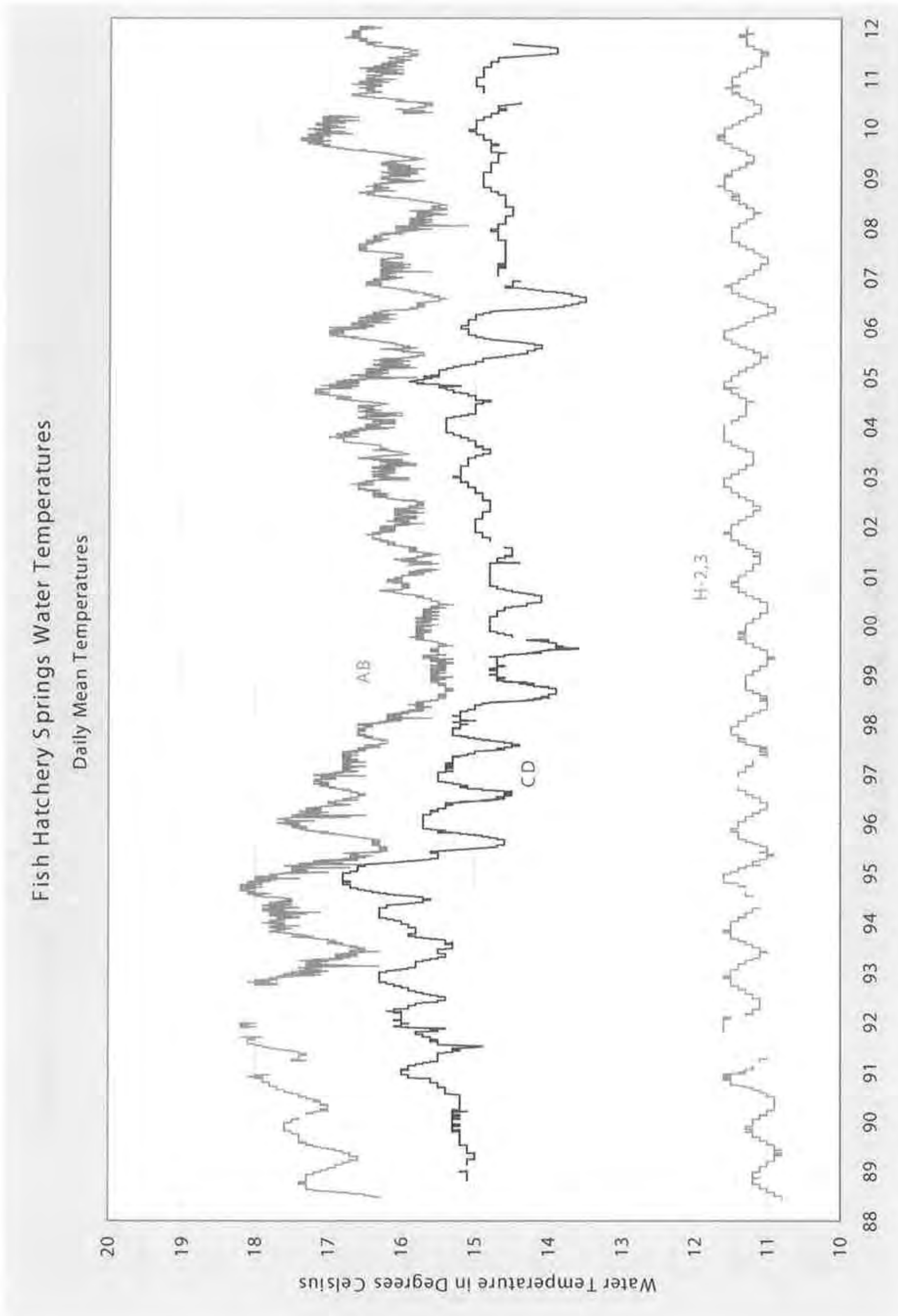
Cover Photo: Well 12-25 during drilling, August 25, 2011.

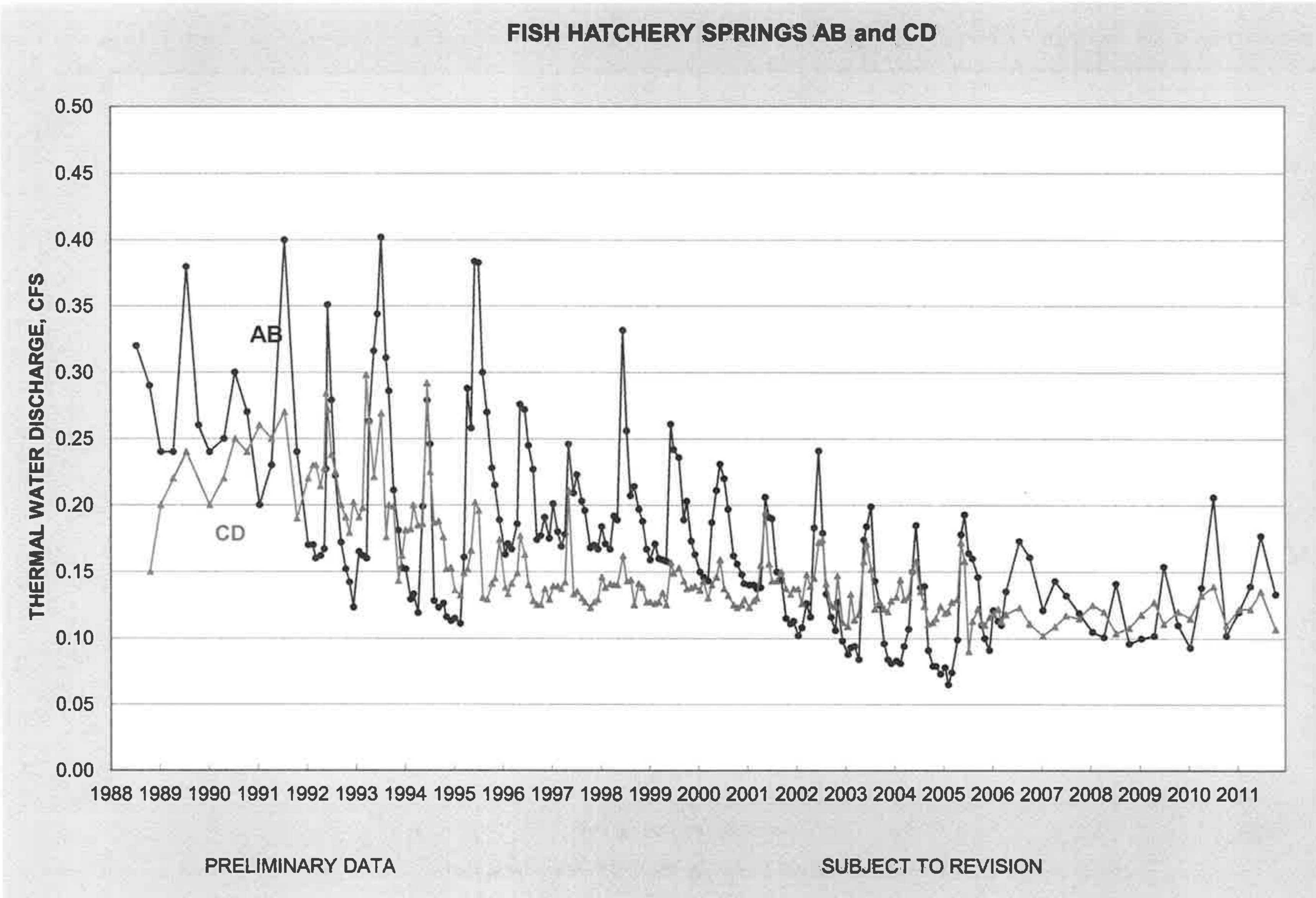

Well CH-10B
Daily Values through Jan. 30, 2012
Depth to Water in Feet
Water Level Altitude, in Feet AMSL
70
71
72
73
74
75
76
77
78
79
80
7409
7408
7407
7406
7405
7404
7403
7402
7401
7400
7399
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011

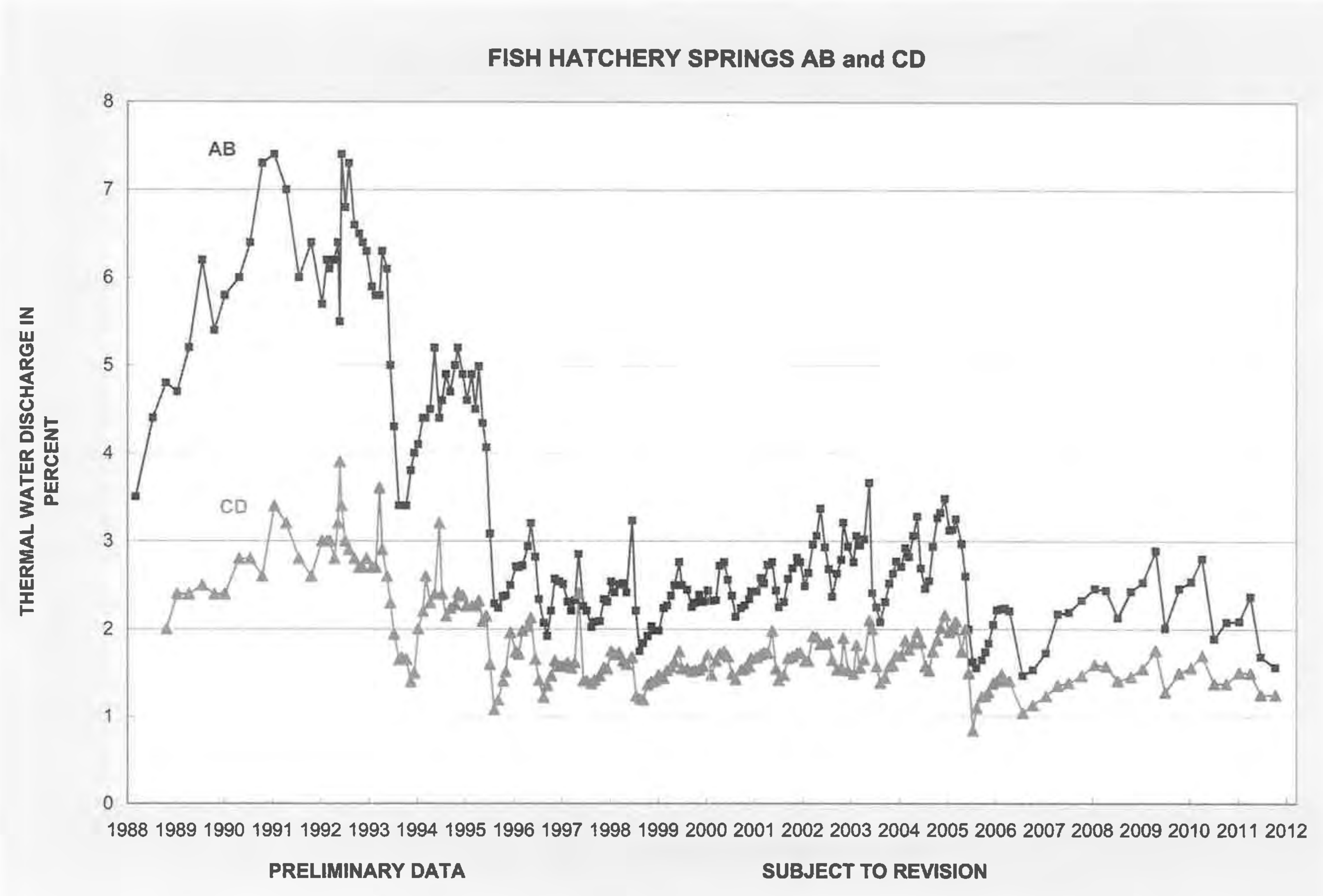

Well LV-19 near Doe Ridge
Daily Values
Depth to Water, in Feet BLS
35.00
36.00
37.00
38.00
39.00
40.00
Oct-09
Dec-09
Feb-10
Apr-10
Jun-10
Aug-10
Oct-10
Dec-10
Feb-11
Apr-11
Jun-11
Aug-11
Oct-11
Dec-11
Feb-12
Apr-12

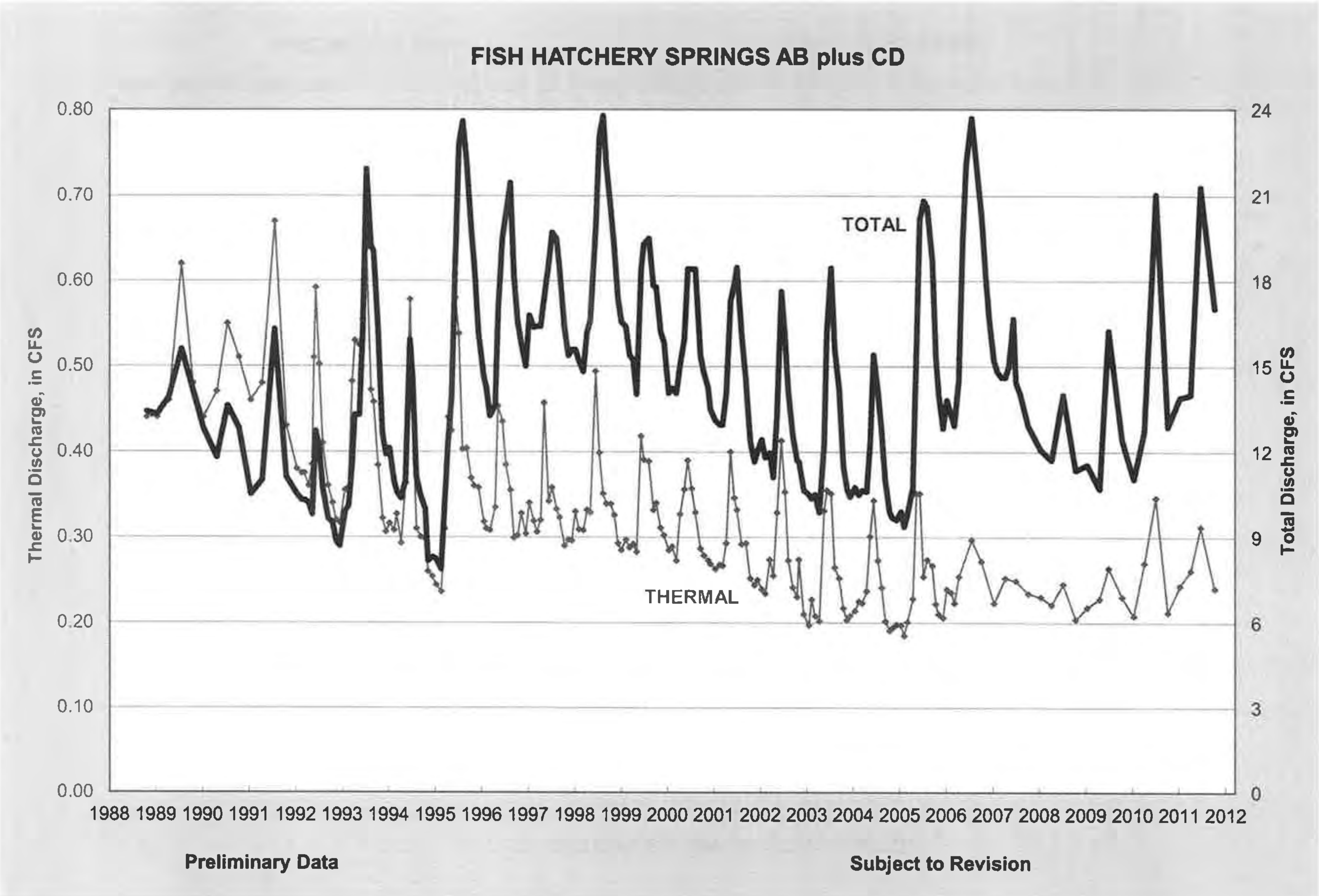

Fish Hatchery Springs Discharge
Daily Mean Flows through Jan. 30, 2012
Discharge in Cubic Feet per Second
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
88
89
90
91
92
93
94
95
96
97
98
99
00
01
02
03
04
05
06
07
08
09
10
11
12
AB
CD
H-2,3

Comment Letter I9



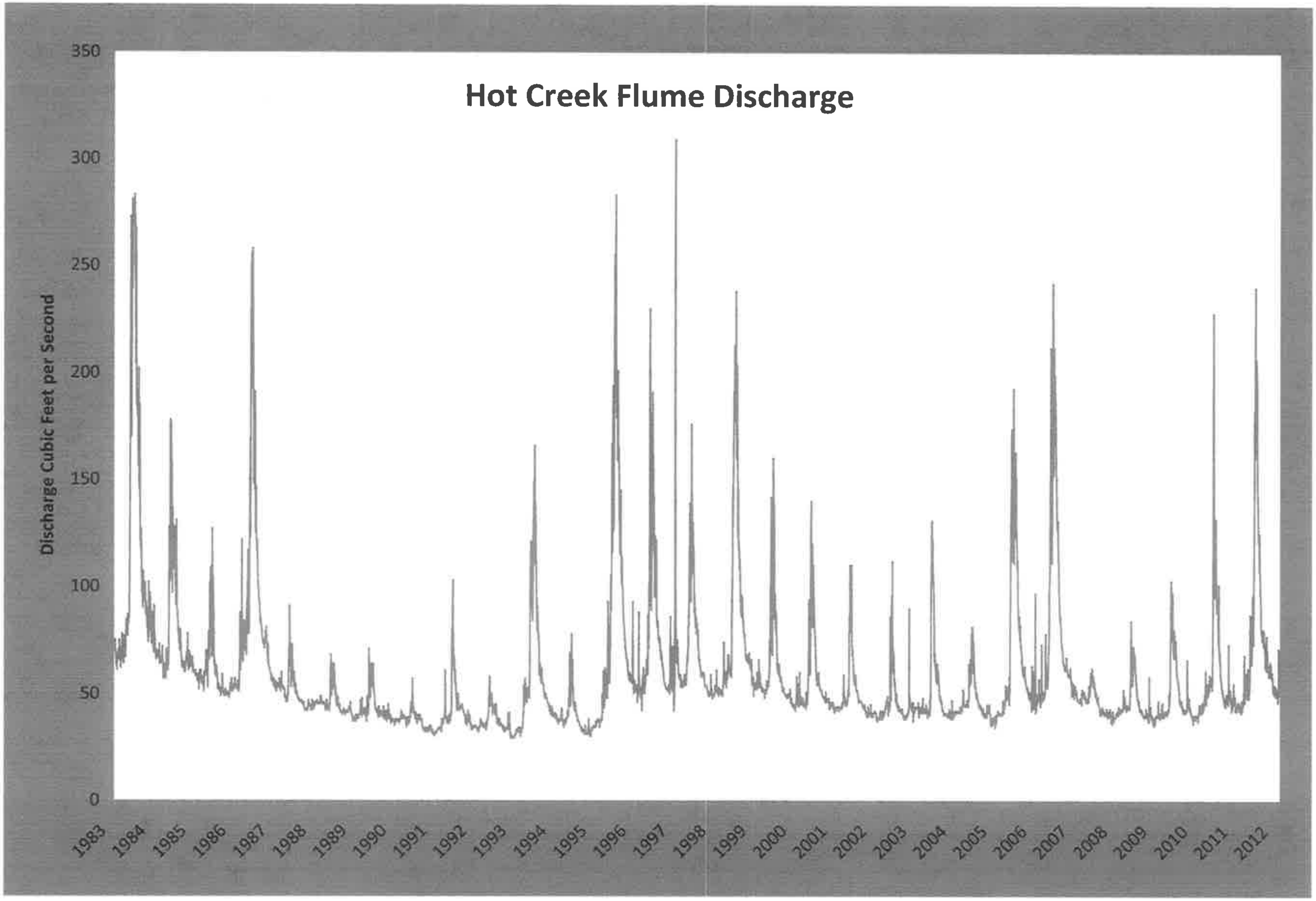

FISH HATCHERY SPRINGS AB and CD
THERMAL WATER DISCHARGE, CFS
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
AB
CD
1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
PRELIMINARY DATA
SUBJECT TO REVISION

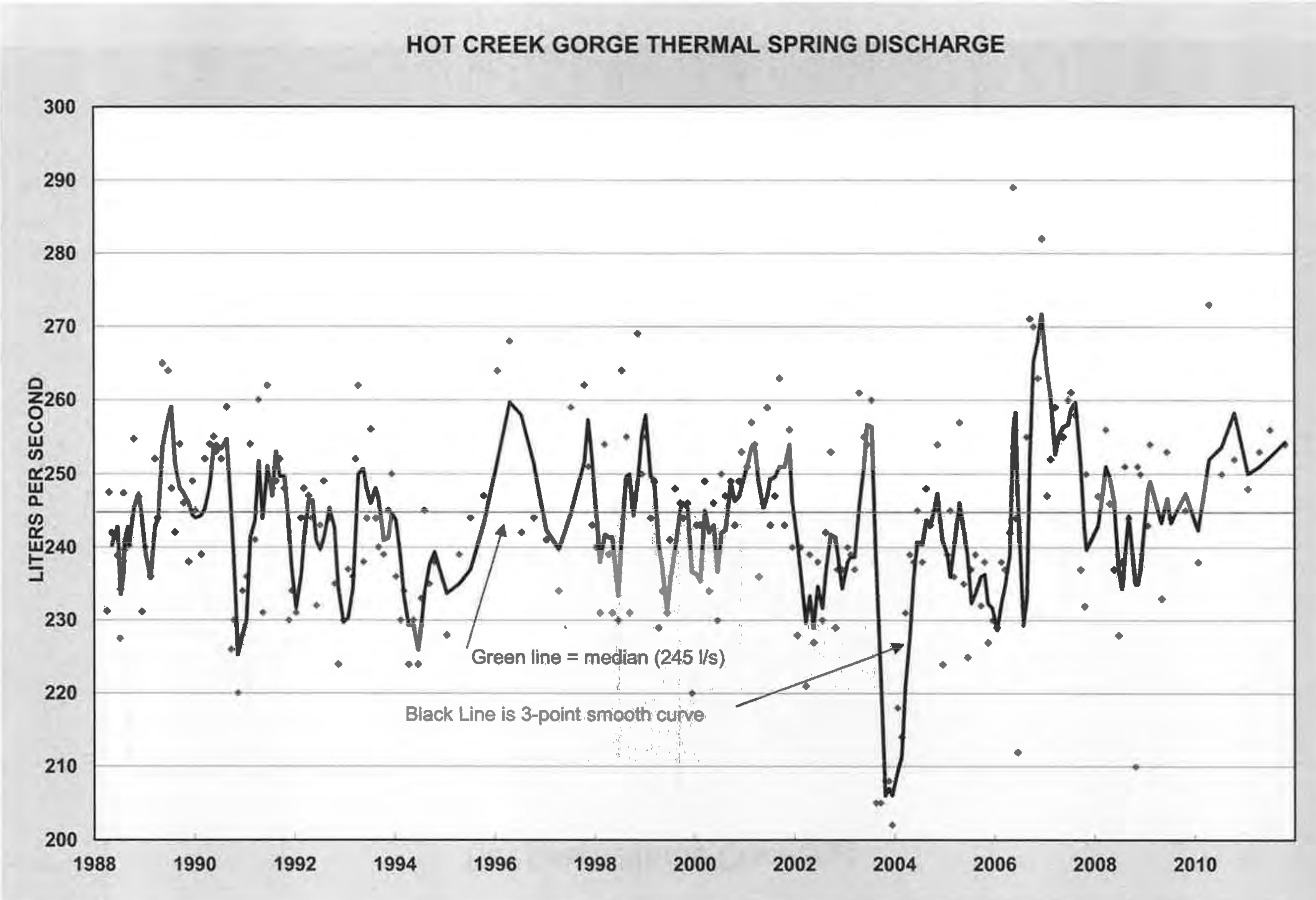

FISH HATCHERY SPRINGS AB and CD
AB
CD
THERMAL WATER DISCHARGE IN PERCENT
0
1
2
3
4
5
6
7
8
1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
PRELIMINARY DATA
SUBJECT TO REVISION



2/13/2012

PLOT_AB_CD.TQ_Q


Hot Creek Flume Discharge
Discharge Cubic Feet per Second
350
300
250
200
150
100
50
0
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012



2/13/2012

PRELIMINARY DATA SUBJECT TO REVISION

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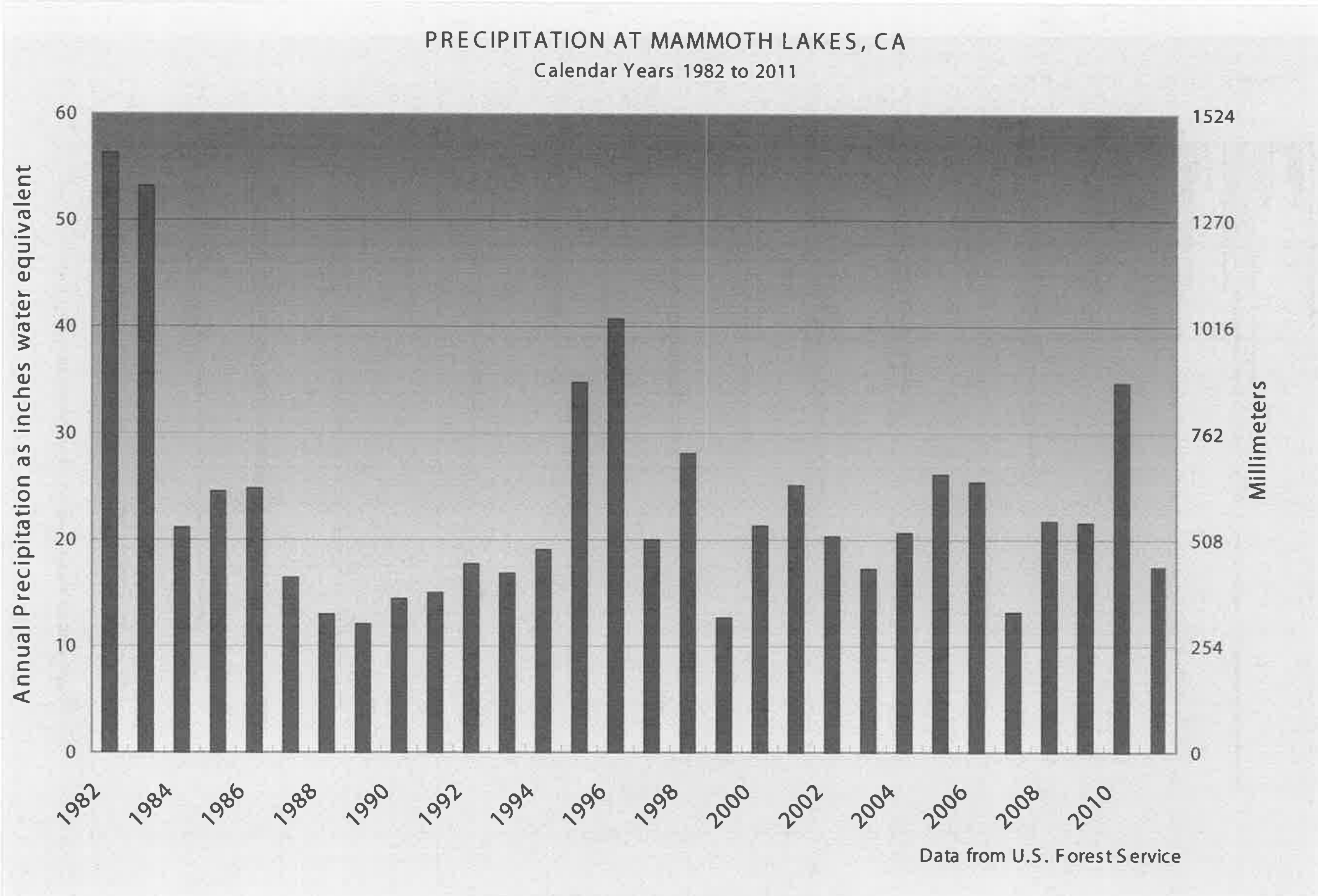
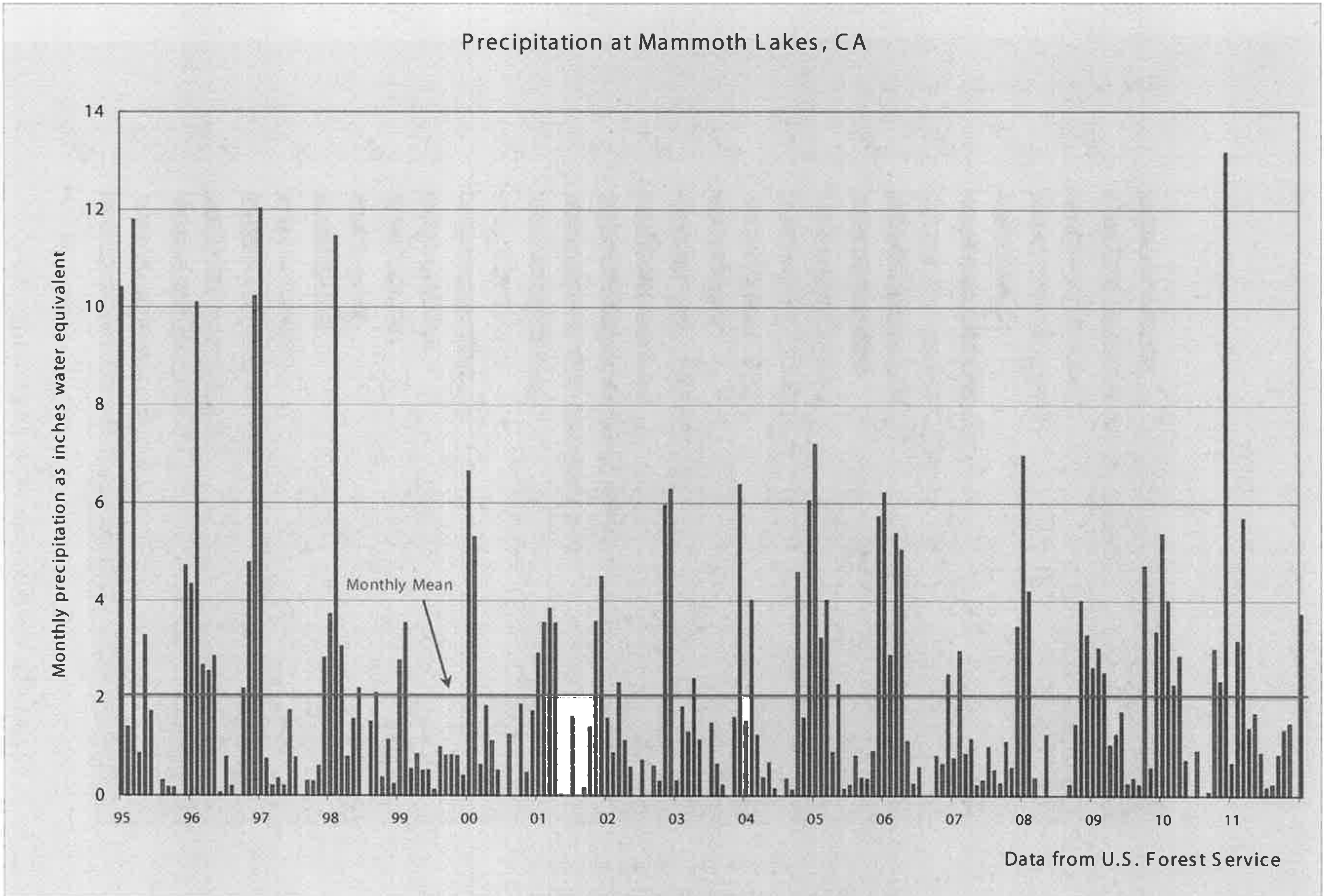

PRECIPITATION AT MAMMOTH LAKES, CA
Calendar Years 1982 to 2011
Annual Precipitation as inches water equivalent
60
50
40
30
20
10
0
1524
1270
1016
762
508
254
0
Millimeters
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Data from U.S. Forest Service


Precipitation at Mammoth Lakes, CA
Monthly precipitation as inches water equivalent
14
12
10
8
6
4
2
0
Monthly Mean
95
96
97
98
99
00
01
02
03
04
05
06
07
08
09
10
11
Data from U.S. Forest Service

2/9/2012

Appendix N

USGS Agreement with Mono County

for Water Resources Investigations

Form 9-1366
(Oct. 2005)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	6000000956
Agreement #:	12WSCA19200
Project #:	
TIN #:	95-6005661
Fixed Cost Agreement	☑ Yes ☐ No

FOR
WATER RESOURCES INVESTIGATIONS

THIS AGREEMENT is entered into as of the 1st day of November, 2011, by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the MONO COUNTY ECONOMIC DEVELOPMENT DEPARTMENT, party of the second part.

1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation for the cooperative water resources investigations in the Mono County Economic Development Department area, herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of $0.

(a) $0.00 by the party of the first part during the period November 1, 2011 **to** October 31, 2012

(b) $73,000.00 by the party of the second part during the period November 1, 2011 **to** October 31, 2012

USGS DUNS IS 1761-38857

(c) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.

(d) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.
7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

Page 2 of 2

Form 9-1366 continued	U.S. Department of the Interior U.S. Geological Survey Joint Funding Agreement	Customer #:	6000000956
		Agreement #:	12WSCA19200
		Project #:	
		TIN #:	95-6005661

8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at costs, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.
9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered **quarterly**. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983).

U.S. Geological Survey
United States
Department of the Interior

MONO COUNTY ECONOMIC DEVELOPMENT DEPARTMENT

USGS Point of Contact

Name: Tammy Seubert
Address: 6000 J Street, Placer Hall
Sacramento, CA 95819-6129
Telephone: (916) 278-3040
Email: tseubert@usgs.gov

Customer Point of Contact

Name: Daniel L. Lyster, Director
Address: Post Office Box 2415
Mammoth Lakes, California 93546
Telephone:
Email:

Signatures

By Eric G. Reichard Date 1/19/2012
Name: Eric G. Reichard
Title: Director, USGS California Water Science Center

By ________ Date ________
Name:
Title:

By ________ Date ________
Name:
Title:

Signatures

By Dan Lyster Date 1-26-12
Name:
Title:

By ________ Date ________
Name:
Title:

By ________ Date ________
Name:
Title:

Appendix O

Former Mono County Zoning Ordinance

Title 19

ZONING*

Chapters:

* Editor's Note: The Zoning and Development Code of Mono County was adopted by Ord. 86-520A and amended by Ords. 86-522, 86-520-E, 87-520-E, 87-520-F and 88-520-F. Certain provisions originally set out in Ord. 397 as amended by Ords. 73-435, 79-397-R, 79-397-T, 81-397, 81-397-BB, 85-397-SS have been codified as well.

Chapter 19.00

INTRODUCTORY PROVISIONS

Sections:

19.00.010 Adoption.

There is an adopted zoning and development code for the county as provided by law. (Added by Supp. 1, 1991)

19.00.020 Intent.

The zoning and development code is intended to serve as a basis for all land use regulations adopted by the county. (Added by Supp. 1, 1991)

19.00.030 Authority for regulations.

The zoning and development code is adopted pursuant to the following authority:

A. Local Ordinances and Regulations—California Constitutions, Article XI, Section 7.

B. Planning and Zoning Law, California Government Code, Title 7.

C. Mobilehome Parks Act, California Health and Safety Code, Division 13, Part 2.1.

D. Airport Approaches Zoning Law, California Government Code, Title 5, Division 1, Part 1, Chapter 2, Article 6.5. (Added by Supp. 1, 1991)

19.00.040 Purpose.

A. The purpose of this title is:

1. To encourage, classify, designate, regulate, restrict and segregate the highest and best location for, and use of, buildings, structures, and land for agriculture, housing, commerce, trade, industry, water conservation or other purposes in appropriate places;

2. To regulate and limit the height and sizes of buildings and other structures hereafter designated, erected or altered;

3. To regulate and determine the size of yards and other open spaces;

4. To regulate and limit the density of population; and

5. To divide the unincorporated area of the county into districts of such number, shape and area as may be deemed best suited to carry out these regulations and provide for this enforcement.

B. Furthermore, such regulations are deemed necessary in order to:

1. Encourage the most appropriate use of land;

2. To conserve and stabilize the value of property;

3. To provide adequate open spaces for light and air and to prevent and fight fires;

4. To prevent undue concentration of population;

5. To lessen congestion of streets;

6. To facilitate adequate provisions for community utilities such as water, sewage, schools and other public requirements; and

7. To promote the public health, safety and general welfare. (Added by Supp. 1, 1991)

19.00.050 Consistency.

All of the provisions of the zoning and development code and all of the provisions of the various area general plans prepared therefrom, as well as, any land use authorized by the zoning and development code, shall be consistent with the "Countywide General Plan." Consistency shall mean that the various land uses authorized by the zoning and development code or the various area general plans are compatible with the goals, policies, implementation measures, land uses and programs specified in the "Countywide General Plan." (Added by Supp. 1, 1991)

19.00.060 Interpretation.

Unless otherwise provided, any ambiguity concerning the content or application of the zoning and development code shall be resolved by the planning commission. Furthermore, unless otherwise provided, any ambiguity concerning the content and application of the various area general plans shall be resolved by the planning commission. (Added by Supp. 1, 1991)

19.00.070 Restrictions.

It is not intended by the zoning and development code to interfere with or abrogate or annul any easement, covenant or other agreement between parties. Where the zoning and development code imposes a greater restriction upon the use of building or land, or upon the height of buildings, or requires larger open spaces than are imposed or required by other ordinances, rules, regulations or by easements, covenants or agreements, the provisions of the zoning and development code shall control. (Added by Supp. 1, 1991)

19.00.080 Construction and definition.

For the purpose of carrying out the intent of this title, words, phrases and terms shall be deemed to have the meaning ascribed to them in Chapter 19.01. In construing the provisions of this title, specific provisions shall supersede general provisions relating to the same subject. (Added by Supp. 1, 1991)

19.00.090 Title.

The ordinance codified in this title (Chapters 19.00 to 19.46) shall be known as the "Mono County Zoning and Development Code." (Added by Supp. 1, 1991)

Chapter 19.59

RE DISTRICT—RESOURCE EXTRACTION

Sections:

19.59.010 Purpose and intent.

The intent of the resource extraction (RE) district is to evaluate and, if appropriate, permit resource extraction projects in a manner that is consistent with the provisions of the Mono County general plan, applicable area plans, and applicable state and federal laws, such as the Surface Mining and Reclamation Act of 1975 (SMARA). The resource extraction (RE) district has been established to protect the environment and allow for the conditional development of on-site resources, including but not limited to, mineral resources, geothermal resources, wind and solar energy resources, hydropower resources and timber resources. (Ord. 94-02 § 2 (part), 1994)

19.59.020 Applicability.

The resource extraction (RE) district may be applied only to areas with existing or proposed resource development activities. The establishment of resource extraction (RE) districts is also intended to encourage and facilitate public awareness concerning the potential for resource and energy-related extraction activities in areas where significant resource deposits or energy-related resources have been identified.

In compliance with general plan policies, mining operations, geothermal operations, small-scale hydroelectric generation facilities, wind and solar energy generation facilities and similar resource extraction activities may be permitted only in areas designated resource management and zoned resource extraction. Within those areas, all resource development projects shall comply with the provisions of this chapter. (Ord. 94-02 § 2 (part), 1994)

19.59.030 Criteria for applying the RE district zone.

In applying the RE district zone to a specific site, one or more of the following criteria must be demonstrated to the satisfaction of the county:

A. An active resource development project currently exists on the subject lands.

B. The project qualifies under the "vesting" provisions as specified in the California Surface Mining and Reclamation Act (SMARA).

C. It has been reasonably determined to the satisfaction of the county that potentially significant resources exist on the lands under consideration. This determination may be based on reports filed by a registered professional acceptable to the county, and funded by the applicant, or in the case of surface mining operations, on mineral land classification reports filed in conjunction with SMARA.

D. In areas with conflicting resource values, it has been reasonably determined to the satisfaction of the county that the proposed resource development activity, and therefore the proposed RE district, is the highest and best use of the land, and is in full compliance with the general plan. (Ord. 94-02 § 2 (part), 1994)

19.59.040 Uses permitted.

The following uses are permitted within the RE district, plus such other uses as the planning commission finds to be similar and not more obnoxious or detrimental to the public health, safety and welfare:

A. Geological, geochemical or geophysical mapping, surface sampling by hand of outcrops and soil, and activities which do not involve extensive excavation, devegetation, or other potentially significant environmental effects;

B. Such other uses as the director may determine to be of an infrequent nature and which involve only minor surface disturbances;

C. Residential uses are limited to caretaker units or on-call employee housing associated with on-site resource development projects; such residential units shall be removed during the final reclamation process. Residential subdivisions or other types of permanent residential development are not allowed;

D. Agricultural uses that are compatible with the resource extraction activity. (Ord. 94-02 § 2 (part), 1994)

19.59.050 Uses permitted subject to director review.

The following uses may be permitted subject to review and approval by the director in conformance with the director review process:

A. Excavations or grading conducted for farming or on-site construction for the purpose of restoring land following a flood or natural disaster;

B. Resource development activities involving the prospecting for, or extraction of, minerals for commercial purposes and the removal of overburden in total amounts of less than one thousand cubic yards in any one parcel of one acre or less;

C. Resource development activities that do not involve either the removal of more than one thousand cubic yards of minerals, ore or overburden; or involve more than one acre in any one parcel;

D. Surface mining operations that are required by federal law in order to protect a mining claim, if such operations are conducted solely for this purpose and in compliance with applicable federal regulations which administer the affected mined lands;

E. Such other surface mining operations as are categorically determined by the State Mining and Geology Board to be exempt from the provisions of SMARA; and/or those particular resource development activities with similar impacts that the county may determine to be of infrequent nature and/or involve insignificant amounts of surface disturbance. (Ord. 94-02 § 2 (part), 1994)

19.59.060 Uses permitted subject to use permit.

The following uses may be permitted subject to obtaining a use permit in conformance with applicable provisions of the county general plan and the Mono County Code:

A. Surface mining operations as defined in SMARA;

B. Subsurface mining operations;

C. Exploring, drilling, processing, stockpiling and transporting of gas, oil and other hydrocarbons;

D. Exploring, drilling and development of geothermal resources;

E. Construction and operation of geothermal power plants, hydropower plants, and wind and solar power plants;

F. Resale and wholesale distributing of materials produced on site and accessory uses, including but not limited to constructing and using rock crushing plants, aggregate washing, screening and drying facilities and equipment, ore reduction plants, asphalt and concrete batching plants, and storage of materials and machinery which is in use and utilized by the permitted operation. (Ord. 94-02 § 2 (part), 1994)

19.59.070 Use permit requirements.

A. Filing.

1. Submittal. An application for a use permit shall be accompanied by the appropriate filing fee and shall be submitted to the planning department or energy management department on forms provided by the applicable department. Applications must be complete.

2. Acceptance. An application for a use permit shall not be deemed complete or accepted for filing and the processing time limits shall not begin to run until the planning or energy management department accepts the application as complete.

B. Procedure.

1. Use Permit Processing. Within thirty days after receipt of a resource use permit application, the department shall review the application and shall notify the applicant or his designated representative, in writing, concerning any application deficiencies.

a. Applications shall be deemed complete, unless the applicant or his designated representative has been notified in writing that the application is incomplete prior to the expiration of the thirty-day review period. Acceptance of the application as complete shall not constitute an indication of project approval.

b. Complete applications shall be processed in accordance with the provisions of Chapter 19.38, Use Permits, and for surface mining operations, with the applicable provisions of SMARA.

2. Nonuse of Permit. In conformance with Chapter 19.38, Use Permits, failure to commence diligent resource development activities within one year subsequent to permit issuance, or within the period determined by the planning commission, shall render the use permit null and void. Documentation that the operator has made every attempt to secure required permits at the state or federal level but that, despite due diligence, the permits have not yet been issued may serve to stay this requirement.

C. Environmental Compliance. Permits shall be processed in accordance with CEQA, the Mono County Environmental Handbook and general plan policies. Common environmental documentation may be used for the exploratory and development permit stages of a project when consistent with CEQA.

Permits shall contain conditions which assure compliance with CEQA and with applicable laws and regulations of Mono County and other agencies with jurisdiction.

D. Monitoring. In accordance with general plan policies and CEQA requirements, when applicable, permits shall contain conditions for ongoing monitoring of operations.

The conservation/open space element contains monitoring requirements for geothermal development, mineral resource development and timber development. (Ord. 94-02 § 2 (part), 1994)

19.59.080 Project development—Phasing requirements.

In compliance with general plan policies, geothermal projects shall be developed in a phased manner. In addition to the phasing requirements listed below, energy resource extraction projects shall comply with all phasing requirements in the general plan (conservation/open space element, energy resource policies).

A. Phasing of Geothermal Projects. Geothermal development shall be subject to the following phased permitting process:

1. The geothermal exploration permit shall regulate geothermal exploration and reservoir characterization activities. The primary purpose of the exploratory phase is to determine hydrologic, geologic and other relevant characteristics of the geothermal resource being considered for development. During the exploratory phase, the permittee shall develop sufficient data, to the satisfaction of the county, to determine whether there is a geothermal resource adequate to sustain the proposed development project.

2. The geothermal development permit shall regulate geothermal development, operations, termination of operations, site reclamation, and reserve monitoring. The purpose of the development phase is to regulate all geothermal development, including the siting and construction of facilities, conditions of operation, maintenance of roads and equipment, and to assure the protection of the environment.

B. Phasing of Other Resource Development Activities. Other resource development activities may be subject to a phased permitting process, depending on the nature of the resource and its development. (Ord. 94-02 § 2 (part), 1994)

19.59.090 Amendments.

A. Minor Amendments to an Approved Resource Development Permit.

1. Minor Amendment: Minor changes to an approved resource development permit may be approved by the planning department director or the energy management director in accordance with the following provisions.

2. Processing: Requests for approval of a minor amendment shall be submitted on forms provided by the planning department or energy management department, along with the applicable fees. Within thirty days of receipt of such a request, the appropriate director shall determine whether or not the application should be considered a minor amendment. The director shall approve or deny the request and notify the applicant in writing within ten days of his decision. The decision of the director as to whether or not the request should be approved or denied shall be final, unless an appeal is filed. If it is determined that the request is not a minor amendment, the request may be processed as a major amendment.

3. Requests for a minor amendment may be approved only if the director is able to make all of the following findings:

a. The proposed change involves only minor changes in the siting or operations of the project and will not affect the basic character or implementation of the permit.

b. No substantial adverse environmental damage, either on-site or off-site, will result from the proposed change and the proposed change is consistent with adopted environmental determinations.

c. The proposed change will not be detrimental to the public health, safety and welfare and is compatible with the objectives and policies of the general plan and applicable specific plans.

B. Major Amendments to an Approved Resource Development Use Permit.

1. Major Amendment: Major amendments to approved resource development use permits may be approved by the planning commission subject to the following provisions.

2. Processing: Applications for proposed amendments shall be submitted on forms provided by the planning department or energy management department and shall include such data as may be required to complete an environmental assessment. Applications shall include the required filing fee, and shall be noticed and scheduled for public hearing before the planning commission in the same manner as the original permit submittal.

3. Amendments may be approved by the planning commission only if all of the following findings can be made:

a. The proposed amendments are necessary or desirable to assure a more practical recovery of the resource or to avoid multiple future disturbances of surface land or waters.

b. No substantial adverse environmental damage, either on-site or off-site, will result from the proposed change and that the proposed change is consistent with adopted environmental determinations.

c. The security required to be filed by the applicant with the county is adequate or additional security has been filed to guarantee compliance with the revised permit.

d. The permit, as amended, will continue to meet the requirements of this chapter and will be conducted in conformity with all applicable laws, ordinances and regulations of all agencies with jurisdiction over the resource development project.

e. The approval of the amendment will not be detrimental to the public health, safety or welfare and is compatible with the objectives and policies of the general plan, and applicable specific plans, the zoning and approved end use of the site. (Ord. 94-02 § 2 (part), 1994)

19.59.100 Development standards.

The following minimum development standards shall apply to all projects in the resource extraction district unless amended through the specific plan process. Other standards or conditions identified during the use permit process may also apply.

A. Lot Size and District Area. The minimum lot size and district area shall be forty acres or a quarter, quarter section, with the exception of patent and/or historical mining claims and "vested operations" which shall be considered on a case-by-case basis. Minimum lot size and district area may be reduced in conformance with the development plan or specific plan process.

B. Setbacks.

1. No processing equipment or facilities shall be located and no resource development shall occur within the following minimum horizontal setbacks:

a. One hundred feet from any interior public street or highway unless the public works director determines that a lesser distance would be acceptable.

b. One hundred feet away from any exterior property line;

c. Five hundred feet from any adjacent private dwelling, institution, school or other building or location used for public assemblage;

d. No geothermal development located within the Hot Creek buffer zone shall occur within five hundred feet on either side of a surface watercourse (as indicated by a solid or broken blue line on U.S. Geological Survey 7.5 or 15-minute series topographic maps).

2. No residential uses shall be located within the following minimum horizontal setbacks:

a. Fifty feet from any interior public street or highway unless the public works director determines that a lesser distance would be acceptable;

b. Fifty feet from any exterior property line.

C. Visual Impacts.

1. Siting. All resource development projects shall be sited, designed and operated to minimize impacts to the surrounding visual environment, in conformance with applicable provisions of the county's general plan and this code. The conservation/open element contains policies relating to the siting of various types of energy resource projects.

2. Screening. Screening shall be required for uses which are contiguous to any residential or commercial district or use, for uses in scenic highway corridors or important visual areas, and for uses with an identified significant visual impact. Screening may be achieved through the use of siting, landscaping, fencing, contour grading, constructed berms and/or other appropriate measures. If landscaping is chosen as a method of screening, a landscape plan shall be submitted as part of the use permit application.

3. Lighting. Exterior lighting shall be shielded and indirect and shall be minimized to that necessary for security and safety.

4. Materials and Colors. Materials for structures, fences, etc. should harmonize with the natural surroundings, whenever possible. Materials should be nonreflective or should be painted with a matte finish. Colors for structures, fences, etc. should blend into the natural surroundings.

D. Erosion and Sediment Control.

1. Siting. All resource development projects shall be sited designed and operated to minimize erosion and sediment transport, in conformance with applicable provisions of the county's general plan, this code, and applicable state and federal regulations. The conservation/open element, energy resource section, contains policies relating to the siting of various types of energy resource projects.

Siting should minimize impacts to the natural landscape. Project design should encourage the joint use of facilities whenever possible in order to minimize disturbance to the natural environment. Access and construction roads should be located so that natural features are preserved and erosion is minimized.

2. Site Disturbance. Earthwork, grading and vegetative removal shall be minimized. Existing access roads shall be utilized whenever possible. Construction of new access roads, frontage roads or driveways shall be avoided except where essential for health and safety. Earthwork and grading shall be performed in accordance with Chapter 13.08 of this code.

3. Revegetation. Site disturbances shall be revegetated in conformance with the reclamation plan developed pursuant to Chapter 19.60 of this code.

4. Drainage. Drainage facilities shall be constructed and maintained in accordance with Chapter 13.08 of this code and with any applicable requirements of the

Lahontan regional water quality control board pertaining to waste discharge.

E. Cultural Resources. The applicant shall stop work and notify appropriate agencies and officials if archaeological evidence is encountered during construction or operations. No disturbance of an archaeological site shall be permitted until such time as the applicant hires a qualified consultant and an appropriate report is filed with the county planning department which identifies acceptable site mitigation measures, which shall then become conditions of the use permit and the reclamation plan (if applicable).

F. Noise. All resource development projects shall be sited, designed and operated to minimize noise impacts to the surrounding environment, in conformance with applicable provisions of the county's general plan (noise element) and Chapter 10.16 of this code.

G. Air Quality. All resource development projects shall be designed and operated in compliance with all requirements of the great basin unified air pollution control district and applicable provisions of the county's general plan.

H. Safety, Including Hazardous Materials and Hazardous Waste. All projects shall comply with applicable safety standards. Hazardous waste shall be maintained in conformance with the Mono County general plan (hazardous waste management element) and the Mono County integrated waste management plan. (Ord. 94-02 § 2 (part), 1994)

19.59.110 Reclamation requirements.

Standards and procedures for the reclamation of resource development activities in Mono County are contained in Chapter 19.60 of this code. All resource development projects must comply with Chapter 19.60 of this code. Reclamation plans must be submitted as part of the use permit application. (Ord. 94-02 § 2 (part), 1994)

19.59.120 Financial assurances.

Financial assurance requirements for the reclamation of resource development activities in Mono County are contained in Chapter 19.60 of this code. All resource development projects must comply with the financial assurance requirement. (Ord. 94-02 § 2 (part), 1994)

19.59.130 Inspections.

A. Requirements. The use permit shall establish an inspection schedule for compliance with use permit conditions. Inspections shall occur at least once a year, but may occur more often depending on the nature of the project. The inspection schedule may change over the lifetime of the project. The annual inspection for mining operations shall coincide with the annual inspection required by SMARA. Chapter 19.60 establishes an inspection schedule for reclamation plans. The required inspections for compliance with use permit conditions and reclamation plan requirements should coincide.

B. Procedure. The operator shall file a request for annual inspection with the county compliance officer at least once in each calendar year. Requests for annual inspections shall be accompanied by the appropriate filing fee.

The compliance officer shall inspect or cause to be inspected the site within thirty working days of receipt of the application for inspection and the filing fee. Unless otherwise agreed, failure to inspect within thirty working day shall be deemed a finding that the resource development operation is in compliance with its use permit. (Ord. 94-02 § 2 (part), 1994)

19.59.140 Administration.

A. Appeals. Appeals of any decision resulting from the requirements of this chapter may be made in conformance with the provisions of Chapter 19.42, Appeals.

B. Fees. Fees required in conjunction with the provisions of this chapter shall be established from time to time by the board of supervisors. (Ord. 94-02 § 2 (part), 1994)

19.59.150 Enforcement.

A. Enforcement. The provisions of this chapter shall be enforced by the energy management department, the planning department, and/or the county compliance officer or such other persons as may be designated by the board of supervisors. Enforcement of the provisions contained in this chapter shall be in accordance with applicable provisions of this code.

B. Right of Entry. Whenever it becomes necessary to inspect resource development activities as provided in this chapter or to investigate complaints associated with resource development activities or to monitor conditions of approval as may be imposed on resource development activities, reasonable access to the project site shall be afforded by the operator in conformance with Chapter 1.08 of this code. Authorized representatives of the county, upon presentation of appropriate credentials, shall have access to the site without advance notice. (Ord. 94-02 § 2 (part), 1994)

Comment Letter I9

Potential Environmental Impacts of Dust Suppressants: "Avoiding Another Times Beach"

An Expert Panel Summary

Las Vegas, Nevada

May 30 – 31, 2002

Potential Environmental Consequences of Dust Suppressants

U.S. Environmental Protection Agency
Office of Research and Development
National Exposure Research Laboratory
Environmental Sciences Division
Characterization and Monitoring Branch

UNLV

Example Uses

1. Unpaved roads and parking areas
2. Harvested fields
3. Temporary disturbed vacant land (construction sites)
4. Earth moving activities (landfills, mining)

Exposure Pathways

- **A.** Atmospheric transport and transformation
- **B.** Surface runoff carrying suppressants and/or breakdown products
- **C.** Uptake of dust suppressant by plants
- **D.** Ingestion of dust suppressant constituents by animals
- **E.** Ingestion of exposed animals by humans
- **F.** Infiltration conveying suppressants to vadose zone and ground-water table
- **G.** Volatilization
- **H.** Occupational contact by applicators: dermally, orally or by inhalation
- **I.** Potential impacts on soil microbial ecology

Exposure Pathways *(continued)*

- **J.** Transport of suppressant particulates by wind erosion to unintended areas
- **K.** Off-site runoff of dust suppressant and carrier solvent
- **L.** Consumption of contaminated groundwater
- **M.** Downwind drift of spray off-site during application
- **N.** Ingestion of dust suppressant constituents by humans

Comment Letter I9

EPA/600/R-04/031
March 2004

Potential Environmental Impacts of Dust Suppressants: "Avoiding Another Times Beach"

An Expert Panel Summary
Las Vegas, Nevada
May 30-31, 2002

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Executive Summary

A.1 Background

In the past decade, there has been an increased use of chemical dust suppressants such as water, salts, asphalt emulsion, vegetable oils, molasses, synthetic polymers, mulches, and lignin products. Dust suppressants abate dust by changing the physical properties of the soil surface and are typically used on construction sites, unpaved roads, and mining activities. The use of chemical dust suppressants has increased dramatically due to rapid population growth and increased emphasis on the need to control particulates in the interest of air quality. In the United States, there are over 2,500,000 km of public unpaved roads, of which 25% (625,000 km) are treated with chemical dust suppressants. A critical problem in the arid southwestern U.S. is dust suppression on land disturbed for residential construction.

Recognizing that it is important to achieve and maintain clean air, the concern that prompted this report is that application of dust suppressants to improve air quality could potentially have other adverse environmental impacts. Times Beach, Missouri is a classic example where the resolution of dust emissions from unpaved roads leads to the creation of a Superfund site. In 1972 and 1973 waste oil contaminated dioxin was sprayed on unpaved roads and vacant lots for dust control in Times Beach. After realizing the adverse situation that had occurred, the costs to relocate the residents and clean up the site was over $80 million. Much more stringent regulations are now in place to avoid another Times Beach; however, there is still concern over the use of dust suppressants since most products used as dust suppressants are by-products and their exact composition is unknown.

The purpose of this report is to summarize the current state of knowledge on the potential environmental impacts of chemical dust suppressants. Furthermore, the report summarizes the views of an Expert Panel that was convened on May 30-31, 2002 at the University of Nevada, Las Vegas to probe into the potential environmental issues associated with the use of dust suppressants.

A.2 Current State of Knowledge

There are several major categories of dust suppressants: hygroscopic salts, organic petroleum-based, organic nonpetroleum-based, synthetic polymer emulsions, electrochemical products, mulches of wood fiber or recycled newspaper, and blends that combine components from the major categories. Dust suppressants are frequently formulated with waste products recycled from other industries.

Most of the research on dust suppressants has been conducted by industry and has focused on the effectiveness (or performance) of dust suppressants, that is, the ability to abate dust. Little information is available on the potential environmental and health impacts of these compounds. Potential environmental impacts include: surface and groundwater quality deterioration; soil contamination; toxicity to soil and water biota; toxicity to humans during and after application; air pollution from volatile dust suppressant components; accumulation in soils; changes in hydrologic characteristics of the soils; and impacts on native flora and fauna populations.

The major known effects of salts in the environment relate to their capacity to move easily with water through soils. Water quality impacts include possible elevated chloride concentrations in streams downstream of application areas and shallow groundwater contamination. In the area near the application of salts, there could be negative impacts to plant growth. For organic non-petroleum based dust suppressants, ligninsulfonate has been shown to reduce biological activity and retard fish growth. Organic petroleum-based dust suppressants have been shown to be toxic to avian eggs; however, the leachate concentrations in other studies were low in comparison to health-based standards. There is also concern with the use of recycled oil waste that may have heavy metals and PCBs.

A.3 View of the Experts

The expert panel was not able to identify specific concerns on the use of dust suppressants due to the high amount of variability associated with site conditions, dust suppressant composition, and application techniques. The experts did agree more attention should be paid to dust suppressant composition and management. The determination of whether a problem might exist in any given case, however, must be based on the assessment of site-specific conditions.

The potential impact of dust suppressants on soils and plants includes changes in surface permeability, uptake by plant roots that could affect growth, and biotransformation of the dust suppressants in the soil into benign or toxic compounds depending on the environmental conditions and associated microbiota. Vegetation adjacent to the area where dust suppressants are applied could be impacted by airborne dust suppressants. This includes browning of trees along roadways and stunted growth. These effects will vary since different plants have different tolerances.

The potential impact of dust suppressants to water quality and aquatic ecosystems include contaminated ground and surface waters, and changes in fish health. Dust suppressants that are water-soluble can be transported into surface waters and materials that are water-soluble but do not bind tenaciously to soil can enter the groundwater. Fish may be affected by direct ingestion of toxic constituents and also by changes in water quality (e.g., BOD, DO, salinity).

A.4 Current Programs/Guidelines

There are no federal regulations controlling the application of dust suppressants; however, some states have developed guidelines for the use of dust suppressants. These include the U.S. Environmental Protection Agency (EPA) Environmental Technology Verification (ETV) program, three state programs in California, Michigan, and Pennsylvania, and a county-level program in Clark County, Nevada. In Canada, there is the Canada ETV national program.

Although there are no specific regulations in place to control dust suppressant application, it is noteworthy that existing regulations promulgated under the Resource Conservation Recovery Act (RCRA), Comprehensive Environmental Response Compensation and Liability Act (CERCLA), Superfund Amendments and Reauthorization Act (SARA), Clean Water Act (CWA) and TOSCA restrict the introduction of harmful substances into the environment. Regardless, there is concern that since no one program addresses the use of dust suppressants, the enforcement of what is used as dust suppressants could "slip through the regulatory cracks."

A.5 Path Forward (Recommendation)

The expert panel and organizing committee identified several important issues related to scientific research and information about dust suppressant, and regulations on the use of the products. Below is a summary of the major issues and recommendations for each of these categories:

Scientific issues

- Develop a comprehensive definition of an "effective" dust suppressant that includes the performance, costs and environmental impacts
- Better understanding of the composition of the dust suppressants and how they change after application
- Better understanding of dust characteristics and development of methods to assist in the selection of the most appropriate dust suppressant for a specific site
- Develop a framework (e.g., decision-making tree, expert system) for dust suppressant selection and assessing potential environmental impacts
- Develop an easily accessible information center, a "clearinghouse", which could help applicators, regulators, and the public acquire the information about dust suppressants. The recommended form of this clearinghouse is as a World Wide Web site
- Conduct field experiments that provide additional information on the "effectiveness" of a dust suppressant with a particular focus on the environmental impacts as well as the performance of the dust suppressants

Regulations

- Establishing an interagency working group that evaluates the cross media and cross jurisdictional issues associated with the use of dust suppressants
- Review existing state and federal regulatory databases to determine if the compounds found in dust suppressants are restricted or prohibited. This should also be done to close regulatory loopholes that allow entry of unlimited industrial waste into the environment when they are classified as dust suppressants
- Evaluate whether existing programs such as Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), RCRA, CERCLA, SARA, CWA, TOSCA and Ecological Soil Screening Level (Eco-SSL) guidance will serve as good models for the development of risk-based regulations
- Develop a standardized assessment methodology that can be used to estimate soil mass fractions of dust suppressant constituents at a particular site. An example is provided in the main part of this report
- Identify standardized environmental tests (e.g., water quality, toxicity) that all dust suppressants manufacturers would have to perform on their products

Foreword

The purpose of this report is to summarize the current state of knowledge of dust suppressants and potential environmental consequences. The material presented here is based on knowledge gained from scientific literature, industry reports, conversations with industry representatives and regulators, and an expert panel hosted by the University of Nevada - Las Vegas (UNLV) and the U.S. Environmental Protection Agency (EPA). The expert panel on the "Potential Environmental Effects of Dust Suppressant Use: Avoiding Another Times Beach" met on the University of Nevada, Las Vegas, campus on May 30-31, 2002 to consider whether or not dust suppressants pose risks to the environment or human health and how they should be used and managed.

Support for the expert panel and preparation of this report was provided by EPA Region 9 who encouraged the EPA's Office of Research and Development in Las Vegas to consider the use of dust suppressants and their potential environmental and human health impacts.

The expert panel considered the potential for unintended consequences from dust suppressants and also if guidelines or regulations on the use of dust suppressants might prevent future problems. Twenty-six (26) experts from varying disciplines were invited to participate in the panel. They represented hydrologists, soil scientists, microbiologists, industry, applicators, and regulators. Several participants had specific knowledge about dust suppressants, but the majority was selected because of their expertise in a specific discipline. They were asked to participate in the panel and use their expertise for discussing the current and future use of dust suppressants in a variety of settings. The specific objectives for this expert panel were to: (1) review, and add to, industrial and scientific knowledge on the composition of dust suppressants; (2) interpret the body of knowledge, and identify physical, chemical, biological, and regulatory issues related to the environmental impacts of dust suppressants; (3) begin to develop a strategy to assist federal, state, and local agencies in regulating the use of dust suppressants; and (4) contribute to a report describing the expert interpretations and a strategy for permitting the use of dust suppressants.

The panel and additional reviewers were asked to review this final report as to whether it fairly reflects the current knowledge of dust suppressants and their applications, potential problems, and a path forward to further resolve those problems and other issues. The report reflects a combination of views of the Expert Panel Organizing Committee and the Expert Panel, and information from the scientific literature and industry. There were many views presented by the group of experts and some of them differed. The statements and/or views of individual members or several members of the Expert Panel are referenced as (Expert Panel 2002), and scientific literature references use a standard reference form (e.g., Bolander, 1999).

The report is written for several audiences. It is intended to be a guidance document for regulators at federal, state, and local levels, scientific researchers, and the environmental community. It serves as a primer to give readers general background information on what dust suppressants are, how they are used, and what potential regulatory issues arise from their use. It provides the local-level employee, who has been given the task of learning about dust suppressants and assessing whether her or his organization should develop regulations, a basic understanding of the issues and kinds of questions that need to be asked about a particular dust suppressant application. It also provides information that could ultimately be used to determine the need for federal regulation of dust suppressants.

Section 1 of the report provides an introduction and frames the potential problems associated with the use of dust suppressants. Section 2 provides an overview of dust suppressants, the various uses, and the current regulations/guidelines. Section 3 summarizes the current state of knowledge on environmental impacts of dust suppressants from the scientific literature and the Expert Panel. Section 4 outlines a framework for assessing the potential environmental impacts of dust suppressants. Finally, Section 5 lists the scientific and regulatory issues that are not resolved at this time and should be considered if guidelines are to be developed for dust suppressant use.

A draft version of this report was submitted to all of the 26 Expert Panelists and 10 outside individuals from government agencies, universities, and industry. A total of 19 individuals provided comments to the Organizing Committee. All comments were considered, and revisions were made to strengthen the report. Following is a list of the external reviewers.

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Acronyms

APG	Application Practice Guidelines
ASTM	American Society of Testing and Materials
BOD	Biological oxygen demand
CalCert	California Environmental Technology Certification program
CCCP	Clark County Comprehensive Planning
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
COD	Chemical oxygen demand
CWA	Clean Water Act
DO	Dissolved oxygen
Eco-SSL	Ecological Soil Screening Level guidance
ETV	Environmental Technology Verification program
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
MDEQ	Michigan Department of Environmental Quality
MSDS	Material Safety Data Sheet
PM	Particulate matter
PSCDGRS	Pennsylvania Conservation Commission Dirt and Gravel Roads Maintenance Program
RBCA	Risk Based Corrective Action
RCRA	Resource Conservation Recovery Act
RO	Reverse Osmosis
RTAC	Road and Transportation Association of Canada
SARA	Superfund Amendments and Reauthorization Act
SIPs	State Implementation Plans
TCDD	Tetrachlorodibenzodioxin
TCLP	Toxicity characteristic leaching procedure
TDS	Total Dissolved Solids
TOC	Total organic carbon
TOSCA	Toxic Substance Control Act
TPH	Total petroleum hydrocarbons
TSCA	Toxic Substance Control Act
TPH	Total petroleum hydrocarbons
TS	Total solids

TSS	Total suspended solids
TVS	Total volatile solids
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USDOT	U.S. Department of Transportation
UNLV	University of Nevada, Las Vegas
VOC	Volatile organic compounds

Section 1

Introduction

The use of chemical dust suppressants in the United States is increasing, due to high rates of population growth in arid regions, the need to reduce airborne particulate matter to meet air quality standards, and increased recognition of the value of reducing erosion and maintenance costs on unpaved roads. Dust suppressants are used to control erosion and maintenance costs on unpaved roads, and to abate fugitive dust in mining, on construction sites, agricultural fields, livestock facilities, disturbed vacant land, landfills, and in steel mills. Materials used as dust suppressants include water, salts, asphalt emulsion, vegetable oils, molasses, synthetic polymers, mulches, and lignin products. Dust suppressants abate dust by changing the physical properties of the soil surface. The mechanisms by which suppressants abate dust vary with product type; some form crusts or protective surfaces on the soil, others act as binding agents causing particles to agglomerate together, and some attract moisture to the soil particles.

Across the United States, over 625,000 kilometers of public, unpaved roads are treated with chemical dust suppressants (Midwest Industrial Supply, Inc., personal communication). In Las Vegas, Nevada, and Phoenix, Arizona, degraded air quality from disturbed land and unpaved roads in the extremely arid environment has led to the potential for widespread use of dust suppressants. In spite of the growing use of dust suppressants, there are no agreed upon definitions, standards of performance and almost no regulation of dust suppressant contents, application rates, or management practices. Understanding of direct and indirect effects of dust suppressants on human health and the environment is limited. Frameworks for making meaningful cost benefit analysis of either benefits or risks are not yet developed.

There is concern that the unexamined use of dust suppressants might create future environmental and health liabilities similar to the problems resulting from dust suppressant use in Times Beach, Missouri in the 1970's. In 1972 and 1973 waste oil containing dioxin was sprayed on unpaved roads for dust control in Times Beach (EPA, 1983). A subsequent flood raised fears that dioxin had contaminated homes and yards. In 1983, the 2,800 people of Times Beach were permanently relocated at a cost of approximately $30 million (EPA, 1988) and the town was closed. Costs to excavate and incinerate the contaminated soils were estimated to be an additional $50 million (EPA, 1988). To avoid similar contamination and cost from current uses of dust suppressants, it is important to take an early, comprehensive look at dust suppressants and their application and to develop policies, guidelines, and recommendations for their use.

Although some programs have been developed to evaluate dust suppressant effectiveness and safety, most programs are voluntary; so most dust suppressant use is unregulated. Waste products or industrial by-products are often used as suppressants, with little examination of the product's hazardous constituents. Application practices are also not regulated. The method and frequency of application and amount of material applied varies. While risks to human health and the environment may be taken into consideration, the primary consideration driving the decision to use a particular suppressant is its initial cost. Frequently reliable performance data does not exist to determine true cost-effectiveness.

Several states (California, Michigan, Pennsylvania) and counties (Clark County, Nevada) are developing guidelines for the use of dust suppressants: where, when and which suppressant to use for a given environment. The guidelines (See Section 2.7) developed by the above agencies are based on limited information and are not sufficient for developing standard protocol in determining whether a dust suppressant should be used. These guidelines were developed out of a need to prevent adverse environmental impacts. An extensive testing program would be needed to develop standard protocol for dust suppressant use.

Other agencies are interested in developing regulations for dust suppressant use, but feel there is little guidance available. Thus, the overall goal of this report is to summarize the current state of knowledge on dust suppressants. The material in the following sections focuses on the current state of knowledge about dust suppressants, areas where information is missing, and proposes an assessment framework for making decisions on the use of dust suppressants.

Section 2

Background

2.1 What are Dust Suppressants?

There is no standard definition of a dust suppressant. Dust suppressants are materials used to control particulate matter emissions from land surfaces. They can include physical covers (such as vegetation, aggregate, mulches, or paving) and chemical compounds. This report focuses on chemical dust suppressants and one physical cover (fiber mulch). Chemical products used for dust suppression fall into eight main categories, listed in Table 2-1. They include water, products manufactured specifically as dust suppressants, natural or synthetic compounds, and waste or by-products from other uses and manufacturing processes. In 1991, 75-80% of all dust suppressants used were chloride salts and salt brine products, 5-10% were ligninsulfonates, and 10-15% were petroleum-based products (Travnik, 1991). The products are usually provided as a concentrate. Dilution for application varies from 1:1 to 1:20 (1 part concentrate to 20 parts water) depending on the specific dust suppressant, application type, and site conditions. Since many of the products are mixed with water, non-aqueous phase liquids are not commonly used in dust suppressant formulation (Expert Panel, 2002).

The control of dust emission is closely related to erosion control, but differs slightly. In both cases, the goal is to restrict the movement of soil particles. Dust suppressants are used to prevent soil particles from becoming airborne. Erosion control technologies aim to minimize soil movement on and off a given site. Since erosion control agents counteract the forces of both wind and water, they may have different properties than dust suppressants, which are used primarily to prevent wind erosion. The minor differences in the definition and classification of these materials may become important as decision makers and regulators begin to focus on unintended, negative consequences of these products.

<u>Water</u> alone can be a dust suppressant. It is commonly used on construction sites and unpaved roads where the surfaces are disturbed only for short time periods. Water is probably the most cost effective short-term solution for dust control (Gebhart *et al.*, 1999); however, the cost will vary depending on climatic conditions influencing water availability. The application rate is important since a heavy application may turn the road into mud destroying the soil's structure and damage its ability to perform as the subgrade. In some areas, reclaimed water is used for dust control. In these cases, the quality needs to be considered as well as the potential for human exposure to reclaimed water and environmental and wildlife impacts.

<u>Salts and Brines</u> are the most common type of dust suppressant used (Travnik, 1991). Calcium chloride ($CaCl_2$) and magnesium chloride ($MgCl_2$) are the major products in this category (Sanders and Addo, 1993). Calcium chloride is a byproduct of the ammonia soda (Solvay) process and a joint product from natural salt brines. Magnesium chloride is derived from seawater evaporation or from industrial byproducts. These products stabilize the soil surface by absorbing moisture from the atmosphere, so it is critical to have sufficient humidity levels of 20-80% when applying these products (Bolander, 1999a).

<u>Organic Non-petroleum Products</u> include ligninsulfonate, tall (pine) oil, vegetable derivatives, and molasses. Ligninsulfonate is derived from the sulfite pulping process in

the paper industry where sulfuric acid is used to break down wood fiber. Tall oil is a by-product of the wood pulp industry recovered from pinewood in the sulfate Kraft paper process. Vegetable oils are extracts from the seeds, fruit or nuts of plants and are generally a mixture of glycerides. Molasses is the thick liquid left after sucrose has been removed from the mother liquor in sugar manufacturing. It contains approximately 20% sucrose, 20% reducing sugar, 10% ash, 20% organic non-sugar, and 20% water (Lewis, 1993).

Synthetic Polymer Products comprise many different compounds that promote the binding of soil particles. The exact composition of these products is usually not provided in the Material Safety Data Sheets (MSDS) since the makeup of the product is confidential information of manufacturers.

Organic Petroleum Products are derived from petroleum and include used oils, solvents, cutback solvents, asphalt emulsions, dust oils, and tars. Petroleum-based products are not water-soluble or prone to evaporation, and generally resist being washed away (Travnik, 1991).

Electrochemical dust suppressants are typically derived from sulphonated petroleum and highly ionic products. This group of products includes sulphonated oils, enzymes, and ammonium chloride. A disadvantage of these products is that their effectiveness depends on the clay mineralogy of the site and may only work with certain types of soils.

Clay Additives are composed of silica oxide tetrahedra (SiO_4) and alumina hydroxide octahedra ($Al(OH)_6$) (Scholen, 1995). Clay additives provide some tensile strength in warm dry climates, however, their tensile strength decreases as moisture in the soil increases (Bolander, 1999b).

Mulch and Fiber Mixtures are formulated from waste wood fibers or recycled newspapers, a binding agent (for example, plaster of paris) and a carrier solvent (usually water). They generally work by forming a protective layer or crust over the soil surface instead of by binding soil particulates together.

Table 2-1: Most commonly used dust suppressants (modified from Bolander, 1999a).

Suppressant Type	Products
Water	Fresh and seawater
Salts and brines	Calcium chloride, magnesium chloride
Petroleum-based organics	Asphalt emulsion, cutback solvents, dust oils, modified asphalt emulsions
Non-petroleum based organics	Vegetable oil, molasses, animal fats, ligninsulfonate, tall oil emulsions
Synthetic polymers	Polyvinyl acetate, vinyl acrylic
Electrochemical products	Enzymes, ionic products (e.g. ammonium chloride), sulfonated oils
Clay additives	Bentonite, montmorillonite
Mulch and fiber mixtures	Paper mulch with gypsum binder, wood fiber mulch mixed with brome seed

2.2 Uses of Dust Suppressants

Dust suppressants are used on unpaved roads, road shoulders, construction sites, landfills, mining operations, military sites, animal enclosures, vacant lands and agricultural fields (Expert Panel, 2002). Figure 2-1 presents a conceptual model of major dust suppressant uses. The use of dust suppressants is largely driven by air quality regulations, but other concerns can also motivate their use (Expert Panel, 2002). For instance, transportation agencies may use dust suppressants to reduce the maintenance on unpaved roads. Private property owners may use dust suppressants to reduce nuisance dust.

The selection of a dust suppressant varies for the different uses. For example, magnesium chloride and petroleum-based products would not be suitable for agricultural use because they could affect crops grown on the fields after application. A fiber mulch might be more appropriate for use in agriculture areas. For an unpaved road, the dust suppressant needs to be more durable and a fiber mulch would not be appropriate to use. Instead, a petroleum-based product may hold up better under traffic conditions.

There is significant regional variation in the use of dust suppressants (Expert Panel, 2002). In Pennsylvania, the major use is on unpaved roads. In other parts of the eastern United States, dust suppressants are used on landfills, coal fields, steel mills, and mines. They are also used as temporary covers on lands that are disturbed for short periods, such as slopes exposed during road construction that are eventually revegetated. In Texas, dust suppressants are used largely on construction sites with disturbed lands and haul roads. In Clark County, Nevada, and other parts of the southwest, 90% of the use is on disturbed vacant land – land that has been cleared for residential or commercial development but on which construction has not yet begun. In some cases, disturbed land can remain vacant for several years. In eastern Oregon and Washington, dust suppressants are used on fallow agriculture fields. The United States Department of Agriculture (USDA) Forest Service also uses dust suppressants on unpaved roads.

2.3 Current and Potential Magnitude of Use

An important consideration is the current magnitude of chemical dust suppressant usage. An unpublished 2001 analysis by the dust suppressant manufacturer, Midwest Industrial Supply, Inc., summarized existing and potential markets for chemical dust suppressants. Some of the study's key findings are noted below.

1. There are over 2,500,000 km of public unpaved roads in the United States. It is estimated that 25% (625,000 km) of these roads are treated with a chemical dust suppressant. In addition, there are over 340,000 km of private unpaved roads of which 22% (74,000 km) are treated with a chemical dust suppressant.
2. Globally, there are over 8,000,000 km of unpaved roads. On the South American continent, over 2,000,000 km of unpaved roads is estimated to exist. A small portion (less than 1%) of these unpaved roads in South America is currently treated with dust suppressants.
3. The United States constitutes about 63% of the global market for chemical dust suppressants and has a current annual market value of approximately $300,000,000.
4. The existing global annual application rate of chemical dust suppressant concentrate is approximately 483,000 tons. This could increase to over 1,200,000 tons if markets in other regions of the world (particularly South America) are developed to the extent of the U.S. market.

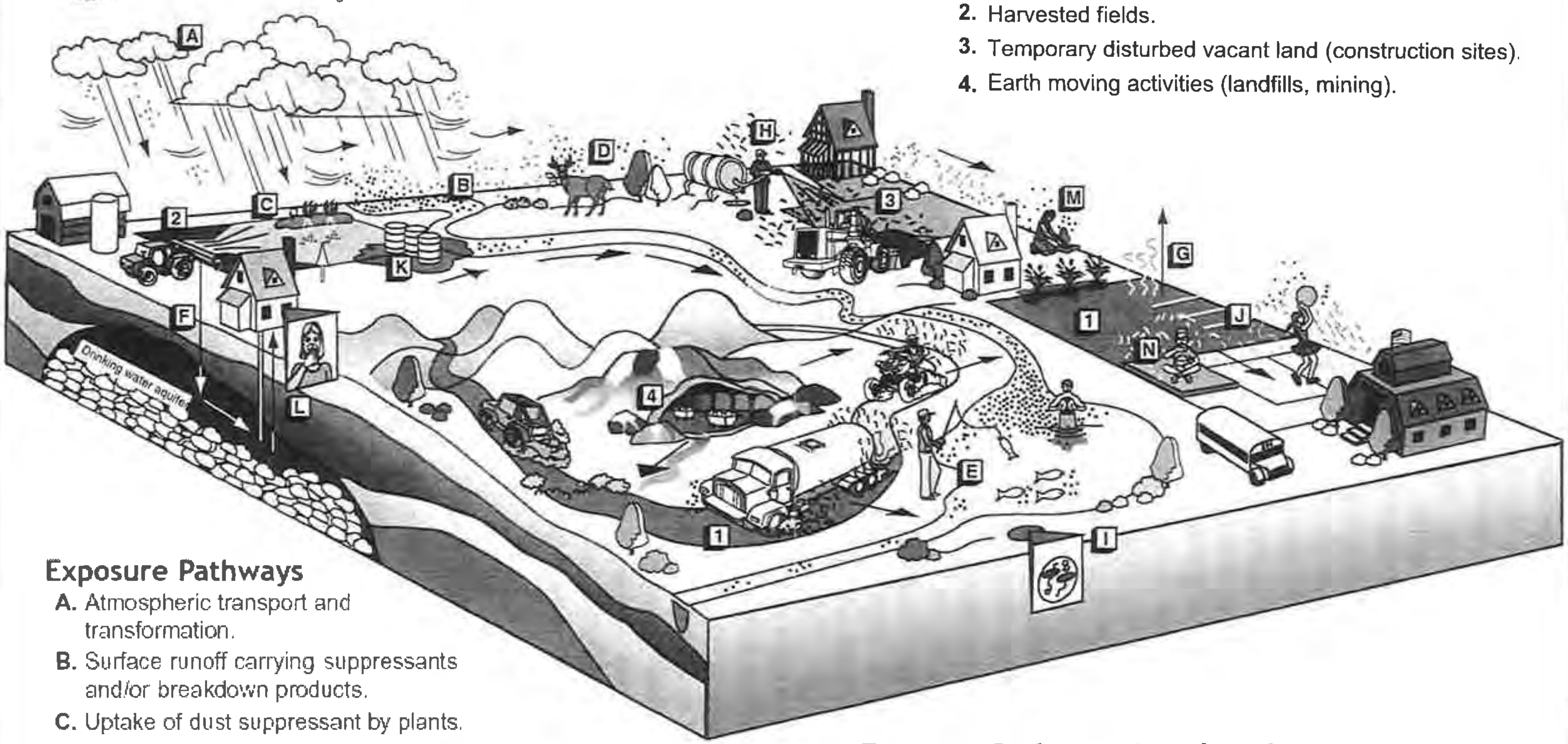
Potential Environmental Consequences of Dust Suppressants

U.S. Environmental Protection Agency
Office of Research and Development
National Exposure Research Laboratory
Environmental Sciences Division
Characterization and Monitoring Branch

UNLV

Example Uses

1. Unpaved roads and parking areas.
2. Harvested fields.
3. Temporary disturbed vacant land (construction sites).
4. Earth moving activities (landfills, mining).



Exposure Pathways

A. Atmospheric transport and transformation.

B. Surface runoff carrying suppressants and/or breakdown products.

C. Uptake of dust suppressant by plants.

D. Ingestion of dust suppressant constituents by animals.

E. Ingestion of exposed animals by humans.

F. Infiltration conveying suppressants to vadose zone and ground-water table.

G. Volatilization.

H. Occupational contact by applicators: dermally, orally or by inhalation.

I. Potential impacts on soil microbial ecology.

Exposure Pathways *(continued)*

J. Transport of suppressant particulates by wind erosion to unintended areas.

K. Off-site runoff of dust suppressant and carrier solvent.

L. Consumption of contaminated groundwater.

M. Downwind drift of spray off-site during application.

N. Ingestion of dust suppressant constituents by humans.

Figure 2-1: Conceptual model of the various uses of dust suppressants and the potential environmental consequences.

It is also important to note the potential uses at a regional scale. Pennsylvania, for example, has over 33,000 km of public unpaved roads that could potentially be treated with dust suppressants (Expert Panel, 2002). In Maricopa County, Arizona, the Department of Transportation applies ligninsulfonate to 92 miles of road shoulders three times a year (Arizona Department of Transportation, personal communication). Clark County, Nevada, has 100-200 km of unpaved roads and approximately 150,000 acres (60,000 hectares) of vacant land in the urban core of the Las Vegas Valley (James *et al.*, 1999). Of these 150,000 acres, 10-20% (15,000-30,000 acres, or 6,000-12,000 hectares) are estimated to have a high potential to emit PM-10 (particulate matter less than 10 µm), and could be stabilized through physical cover (vegetation, aggregate) or via application of chemical dust suppressants. Clark County has decided to pave high-use public roads instead of treating them with chemical dust suppressants (CCCP, 2001). It was reported in Pennsylvania that long term environmental and maintenance costs are set in motion by public pressure to pave roads before a proper road base and drainage system is in place. Paved road failures in even the first year have occurred. However, haul roads at construction and mining sites are often treated with chemical dust suppressants.

2.4 How Dust Suppressants Work

Dust suppressants abate dust by changing the physical properties of the soil surface. When a dust suppressant is applied the soil particles become coated and bound together, making them heavier. Some products form a crust on the surface and others penetrate through the surface. Water and petroleum-based products form a crust by agglomerating the soil particles. The formation of a crust with adequate thickness with petroleum-based products reduces the amount of immediate maintenance that is required on unpaved roads, however, in the long term, when failures such as potholes occur, there is no way to repair them using normal low cost techniques, such as grading. Unless these roads are milled to return them to unsealed status, the structural failures get paved over, again setting in motion the long-term maintenance and environmental costs referenced earlier (Expert Panel, 2002). Many of the synthetic organic materials are derived from petroleum products and are mixed with a binding agent that glues the particles together (Expert Panel, 2002). Salts absorb moisture from the air and retain it by resisting evaporation (Foley *et al.*, 1996). Organic non-petroleum and synthetic polymer products act as a weak cement by binding the soil particles together or weighing down and agglomerating particles. The electrochemical stabilizers work by expelling adsorbed water from the soil, which decreases air voids and increases compaction (Foley *et al.*, 1996).

2.5 How Dust Suppressants are Applied

Dust suppressants are applied either topically or mixed into the top layer of the soil. Topical application is with a spray bar on the back of a truck or through a large hose with a nozzle on the end (See Figures 2-2 and 2-3). On vacant lands, dust suppressants are applied topically. On small plots, application is by hand-directed hoses (Figure 2-2). On larger properties, application is by truck-mounted spray bars (Figure 2-3) and modified water cannons (Figure 2-4). A less common type of application is when the dry products (flakes) are spread on the surface and the product is mixed into the soil (Expert Panel, 2002).

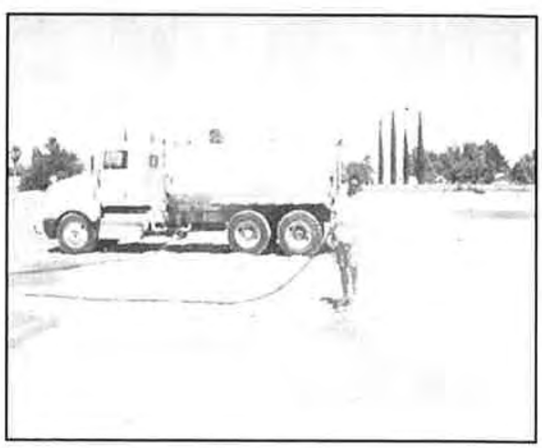


Figure 2-2: Topical application of a dust suppressant using a spray hose.

Figure 2-3: Topical application of a dust suppressant using a spray bar.

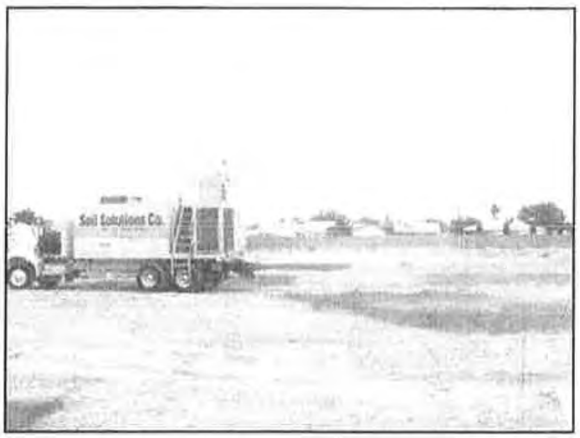


Figure 2-4: Topical application of a dust suppressant using a spray gun.

Another application method is to mix the dust suppressant into the travel surface by a sequence of steps comprising, 1) grading the road surface to remove a windrow of earth from the travel lane, 2) application of dust suppressant, 3) grading the earth windrow back onto the travel lane and compaction to maximum density, and 4) a second topical application on top of the graded earth. Mixing the dust suppressant into the soil is more difficult, but it tends to last longer since the product is exposed to more soil particles.

Some dust suppressant vendors have software available to make recommendations to customers based on traffic conditions, vehicle speed, and other site conditions. However, a major factor that impacts the application rate for many situations is the amount of funding available for dust suppression. For instance, a heavier application often increases the durability of the dust suppressant and reduces the need for repeated applications (Expert Panel, 2002). Seldom are analysis made of the soil types, which may change numerous times on one road in some geographic areas.

2.5.1 Typical Application Rates of Dust Suppressants

Typical liquid application rates vary from 0.3 to 1.0 gallons per sq yard (1.4 to 4.5 liter/m^2) and will depend on site-specific conditions (e.g., soil type, land use, weather during application, and weather after application). For liquid emulsions, dust suppressant concentrates are mixed with diluent (usually water) to give the correct mass application rate of solids for the desired application. For example, solids application rates for acrylic polymer emulsions are usually 0.20 to 1.00 pounds per square yard (0.11 - 0.54 kg/m^2) at liquid application rates of 0.50 to 1.00 gallons per square yard (2.26-4.53 liter/m^2). It is generally better to apply multiple light applications rather than a single heavy application, as the light applications generally allow for better penetration into the surface soil and also reduce the fraction of dust suppressant that may run off the target area.

The performance of a dust suppressant is determined by the mass of applied solids per unit volume of treated soil. Mass of applied solids per unit volume of soil will be the product of the mass application rate, and the penetration depth of solids into the soil. The mass application rate of a dust suppressant is computed as the liquid application rate times the mass concentration of bulk suppressant in applied liquid.

For example, if the liquid application rate is 0.50 gallon/yd^2 (2.26 liter/m^2) and the solids concentration is 1.00 lb / gallon (0.120 kg/ liter), then the mass application rate of the dust suppressant is 0.50 gallon / yd^2 x 1.00 lb/gallon = 0.50 lb/ yd^2 (0.271 kg/m^2). If the penetration of the suppressant material was uniform to a depth of 2 inches (0.05 meters), then the bulk concentration of the suppressant in the surface layer of soil would be 0.50 lb/yd^2 / (9 ft^2/yd^2) / 0.167 ft = 0.336 lb/ft^3 (or, 2.71 kg/m^2 / 0.05 meters = 5.40 kg/m^3). This bulk concentration is about 1/300 the mass density of typical soils (~100 lb/ft^3 or ~1,560 kg/m^3), so the suppressant solids are present in the soil at a mass fraction of about 1/300. Mass and liquid rate data for typical application rates of dust suppressants are shown in Table 2-2 (James *et al.*, 1999).

Table 2-2: Typical dust suppressant use rates for unpaved roads and vacant lands based on industry data. English and (SI units).

	Unpaved Roads			
	Low Rate		High Rate	
Liquid application rate	0.50 gallon/yd^2	(2.26 l/m^2)	1.00 gallon/yd^2	(4.53 l/m^2)
Solids concentration	0.40 lb/gallon	(0.05 kg/l)	1.00 lb/gallon	(0.12 kg/l)
Solids application rate	0.20 lb/yd^2	(0.11 kg/m^2)	1.00 lb/yd^2	(0.54 kg/m^2)
10 foot (3.05 m)-wide travel lane:				
Topical 1 layer (solids)	1,173 lb/lane-mile	(330 kg/lane-km)	5,867 lb/lane-mile	(1,653 kg/lane-km)
Topical 1 layer (liquid)	2,933 gal/lane-mile	(6,898 l/lane-km)	5,867 gal/lane-mile	(13,799 l/lane-km)
Graded 2 layer (solids)	2,347 lb/lane-mile	(661 kg/lane-km)	11,733 lb/lane-mile	(3,306 kg/lane-km)
Graded 2 layer (liquid)	5,867 gal/lane-mile	(13,799 l/lane-km)	11,733 gal/lane-mile	(27,596 l/lane-km)

	Vacant Lands			
	Low Rate		High Rate	
Liquid application rate	0.50 gallon/yd^2	(2.26 l/m^2)	1.00 gallon/yd^2	(4.52 l/m^2)
Solids concentration	0.40 lb/gallon	(0.05 kg/l)	1.00 lb/gallon	(0.12 kg/l)
Solids application rate	0.20 lb/yd^2	(0.11 kg/m^2)	1.00 lb/yd^2	(0.54 kg/m^2)
Application rate:				
per 100 ft^2 (solids)	2.2 lb/100 ft^2	(10.7 kg/100m^2)	11.1 lb/100 ft^2	(54.2 kg/100 m^2)
per 100 ft^2 (liquid)	5.6 gal/100 ft^2	(228.1 l/100m^2)	11.1 gal/100 ft^2	(452.1 l/100 m^2)
per acre (solids)	968 lb/acre	(1,085 kg/ha)	4,840 lb/acre	(5,426 kg/ha)
per acre (liquid)	2,420 gal/acre	(22,637 l/ha)	4,840 gal/acre	(45,273 l/ha)

2.6 Effectiveness of Dust Suppressants

The majority of research on dust suppressants has been on the effectiveness of the products, where "effectiveness" reflects the ability of the product to keep soil particles on the soil surface when subjected to some erosive force, such as wind. Effectiveness varies with type of use, site condition, and climate. Water has been found to be between 40% and 85% effective in suppressing the suspension of soil particles for short time periods, but not effective over longer time periods (Thompson, 1990; Travnik, 1991; Foley *et al.*, 1996; Kestner, 1989; Cowherd *et al.* 1989). Salts are more effective than water in controlling dust if sufficient moisture is available (Bolander, 1999a). Ligninsulfonates remain effective during long, dry periods with low humidity. They also tend to remain plastic, allowing reshaping and traffic compaction when applied to soils with high amounts of clay. The effectiveness of ligninsulfonates may be reduced or completely destroyed in the presence of heavy rain because of the solubility of these products in water (Bolander, 1999a). Synthetic polymer emulsions increase the tensile strength of clays on typical roads and trails up to ten times. Tests have shown that synthetic polymers applied in wet climates tend to break down if exposed to moisture or freezing for an increased time (Bolander, 1999a). Petroleum-based products generally resist being washed away, but oil is not held tightly by most soils and can be leached away by rain. Under the right conditions, these products can remain 90% effective after a year (Gilles *et al.*, 1997).

The length of time that a dust suppressant is effective varies according to variables such as the type of product, soils, weather, application rate, and traffic conditions. However, many manufacturers advertise that the products will be effective from 6-12 months. Some products will last up to 24 months under certain conditions.

2.7 Current Regulations/ Guidelines

At least six programs in the United States and one in Canada are directly or indirectly developing, or have developed, guidelines for dust suppressant use. Appendix B includes fact sheets for the programs and following is a summary of the key program elements. In the United States, there is the Environmental Protection Agency (EPA) Environmental Technology Verification (ETV) program, three states programs in California (CalCert), Michigan, and Pennsylvania, and a county level program in Clark County, Nevada. In Canada, there is the Canada ETV national program. The Canada ETV, CalCert, and EPA ETV programs are voluntary and available to any developer/vendor of environmental technology, including dust suppressants. All three verification programs (ETV, CalCert, and Canada ETV) were created by partnerships between regulatory environmental agencies and either the private sector or non-profit organizations, with an emphasis on the performance claims and some environmental tests of the products. Other programs that are ancillary to dust suppressants are those that provide specifications for the use of snow and ice control products such as the Pacific Northwest Snowfighters (www.wsdot.wa.gov/partners/pns/default.htm).

The testing program in Pennsylvania was developed by joint efforts of conservation interests, academia and industry and, is used, for all materials, including suppressants, for projects funded by the Dirt and Gravel Roads Maintenance Program under the State of Pennsylvania Conservation Commission (PSCDGRS, 2003). The stringent specifications require product testing by a certified lab and manufacturer guaranteed product uniformity, delivery, application and cure. Results in the program have been so positive, and reception by industry so strong, it has been used voluntarily by others. The Michigan Department of Environmental Quality created specific regulations for the application of oil field brine as a dust suppressant (MDEQ, 2000). Clark County, Nevada has issued detailed interim guidelines for the use of dust suppressants on disturbed lands (CCCP, 2001). The guidelines were drafted by a working group composed of air and water quality professionals from state and local agencies, as directed by the Clark County Commissioners.

In all three voluntary certification programs and in the Pennsylvania Dirt and Gravel Road regulations, it is the responsibility of the technology vendor/developer to provide sufficient performance data and documentation to support the claims of the technology under consideration. While the other programs do not specify what data should be provided to support the technology claim, the Environmental Protection Agency (EPA) ETV and the Pennsylvania programs note specific tests that have to be performed to evaluate the environmental impacts of the products under consideration. In the EPA ETV, ETV Canada, and CalCert voluntary programs, scientists and engineers from regulatory agencies, universities, research laboratories, and the private sector examine the supporting documentation for product verification. However, ETV Canada maintains a list of approved expert entities (e.g. universities, private consultants) to be used to conduct tests to support the verification. An agreement is reached with the vendor/ developer regarding the expert entity to be used in the technology verification process.

In the case of Pennsylvania, the data supporting the claim, issued by EPA certified labs, are evaluated by the State Conservation Commission for authenticity. All three voluntary verification programs, as well as Pennsylvania's, issue a report or certificate as proof of verification. Only the Canada ETV and the California CalCert programs require renewal of the verification after three years.

Michigan's regulations for brine application as a dust suppressant do not specify any specific test methods. Instead, it establishes acceptable application rates and methods, and types of areas where it can and cannot be applied. It also requires the property owner or contractor to maintain detailed record keeping of the specific locations, amount, and source of brine applied. Clark County, Nevada guidelines specify types of areas where the application of specific dust suppressants are discouraged. In addition, they contain recommendations on the types of suppressants, dilution, and application rates to be used in different types of dust control areas (e.g. roads, construction sites). In general, the Clark County guidelines discourage the application of products known to potentially contain specific pollutants near lakes, streams, channels, and flood control channels.

The EPA ETV program requires acute and chronic toxicity tests (EPA/600/4-90/027F and EPA/600/4-91/002), and analyses of biological oxygen demand (BOD), chemical oxygen demand (COD), volatile organic compounds (VOC), toxicity characteristic leaching procedure (TCLP) [EPA Method 1311], inorganics/metals (EPA 6010B), semi-volatile organics (EPA 8270D), volatile organics (EPA 8260B), pesticides/herbicides (EPA 8270D), and PAHs. The Pennsylvania program requires bulk analysis of products using EPA SW-846 tests (originally designed for testing RCRA wastes), leach analysis by EPA Method 1312 (includes metals, volatiles, and semi-volatiles), 7-day survival and growth test for rainbow trout and *Ceriodaphinia dubia*, BOD, and COD.

In addition to the programs noted above, the United States Department of Agriculture (USDA) Forest Service is developing the "Forest Service Specifications for the Construction of Roads and Bridges" that will have new requirements for dust suppressants. These requirements will include a certificate that states that the dust suppressant meets the chemical requirements of the Pacific Northwest Snowfighters, that a toxicity test (ASTM E 729) be submitted, and that the pH of the product be on the certificate as well.

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Section 3

What is Known About Potential Environmental Effects

The majority of research on dust suppressants has been by industry and has focused on the effectiveness (or performance) of dust suppressants to abate dust, however, little information is available on the potential environmental and health impacts of these compounds. The numerous pathways of exposure to dust suppressants for humans, flora, and fauna and how suppressants may migrate through the environment to potentially sensitive recaptors are shown in Figure 2-1. Impacts will depend upon their composition, application rates, and interactions with other environmental components. Potential environmental impacts include: surface and groundwater quality deterioration; soil contamination; toxicity to soil and water biota; toxicity to humans during and after application; air pollution; accumulation in soils; changes in hydrologic characteristics of the soils; and impacts on native flora and fauna populations.

This conceptual model and all of the potential pathways and receptors of concern were presented to the expert panel for their consideration. Following is a brief summary of the literature on known potential effects of dust suppressants. A complete description of the studies is provided in the literature review presented in Appendix A. The views of the Expert Panel on potential environmental effects of dust suppressants are then presented Section 3.2.

3.1 Overview of Scientific Literature

Although there are several noteworthy studies on the effects of dust suppressants to water quality, plants, and fish, the majority of the studies have focused on salts and brines, ligninsulfonates, and a few organic petroleum-based products.

3.1.1 Salts and Brines

The major known effects of salt in the environment relate to its capacity of moving easily with water through soils. Water quality impacts include possible elevated chloride concentrations in streams downstream of application areas (Demers and Sage, 1990) and shallow groundwater contamination (Heffner, 1997). In the area near the application of salts, there have been negative impacts to the growth of fruit trees (RTAC, 1987), pine, poplar, and spruce (Foley *et al.*, 1996, Hanes *et al.*, 1976, and Hanes *et al.*, 1970), and alterations in the plant nutrition due to increases in the osmotic pressure of soils (Sanders and Addo, 1993). Chloride concentrations as low as 40 ppm have been found to be toxic to trout, and concentrations up to 10,000 mg/L have been found to be toxic to other fish species (Foley *et al.*, 1996, Golden, 1991). Salt concentrations greater than 1,800 mg/L have been found to kill daphnia and crustaceans (Sanders and Addo, 1993), and 920 mg/L of calcium chloride has been found to be toxic to daphnia (Anderson, 1984).

3.1.2 Organic Non-petroleum Products

The majority of research in this category has focused on the impacts of ligninsulfonate. The toxicity of ligninsulfonates to rainbow trout and other biota has been investigated (Heffner, 1997). The 48-hour LC_{50} (concentration of ligninsulfonates which would be lethal to 50 percent of the tested population within 48 hours) value for ligninsulfonates was found to be 7,300 mg/L (Roald, 1977a and 1977b). A mortality of 50% was achieved for rainbow trout exposed to 2,500 mg/L ligninsulfonate for 275 hours. For concentrations equal to or higher than 2,500 mg/L, rainbow trout showed loss of reaction to unexpected movements, rapid and irregular breathing, and finally loss of co-ordination before death. It has been found that calcium and sodium ligninsulfonate negatively affect the colon of guinea pigs causing weight gain and producing ulceration in those animals (Watt and Marcus, 1976).

High levels of ligninsulfonate in water bodies have high coloring effects, increase biochemical oxygen demand, reduce biological activity, and retard growth in fish (Raabe, 1968, Heffner, 1997, RTAC, 1987, Bolander, 1999a, Singer *et al.*, 1982). However, ligninsulfonate compounds do not impact seed germination in the areas where applied (Singer *et al.*, 1982).

3.1.3 Organic Petroleum Products

Potential environmental impacts are highest from organic petroleum products. The chemical characteristics of the oil deposit from which the petroleum product originated, results in varied impacts with the potential for high levels of heavy metals from specific oil deposits. Several studies have shown that waste oils may contain known toxic and carcinogenic compounds (e.g. PCBs); therefore EPA prohibits the use of these materials (RTAC, 1987; Metzler, 1985, and USEPA, 1983).

The accidental introduction of a petroleum-based dust suppressant (Coherex) into a stream in Southern Pennsylvania affected fish and benthic macroinvertebrate communities and killed a large number of fish (Ettinger, 1987). Organic petroleum-based products have also been found to be toxic to avian mallard eggs. When the eggs were exposed to a concentration of 0.5 μL/egg, 60% mortality was observed by 18 days of development (Hoffman and Eastin, 1981).

3.1.4 Water Quality Impacts from University of Nevada, Las Vegas (UNLV) Study

A recent UNLV study, funded by several local agencies in the Las Vegas Valley, generated preliminary data highlighting the potential of the major dust suppressant categories. The research focused on the quality of urban runoff and on the changes in the chemical composition of soils where suppressants were applied (Piechota *et al.*, 2002 and Singh *et al.*, 2003). Rainfall events were simulated on the dust-suppressant treated plots and the changes in soil composition and the quality of the runoff emanating from the plots were examined.

In the study, a site was graded and divided into several individual plots. Each plot was 2.4 meters x 2.4 meters. Six categories of dust suppressant (11 individual products) were topically applied to the plots by local dust suppressant applicators. The dust suppressants applied included acrylic polymer emulsion, ligninsulfonate, petroleum-based organic, non-petroleum based organic, fiber mulch, and magnesium chloride salt. Rainfall was simulated using water treated by a reverse osmosis (RO) system. The water supply characteristics were designed to be similar to those of the rainfall in the Las Vegas Valley. An approximate rainfall of 20 mm was generated for a 1-hour period. The first five gallons of runoff emanating from the plots were combined to form a composite sample that was divided into aliquots, preserved, and analyzed for chosen parameters. In addition, the top two-inches of soil from each plot were sampled after the rainfall events to determine remaining levels of different compounds. The soil samples were leached using the EPA Synthetic Precipitation Leaching Procedure (Method 1312). Parameters evaluated in the runoff and soil leachate include 67 toxic volatile and 76 semi-volatile organic compounds, organic pesticides, PCBs, 11 metals, nutrients, biochemical oxygen demand (BOD), total solids (TS), total volatile solids (TVS), total suspended solids (TSS), total dissolved solids (TDS), turbidity, total organic carbon (TOC), pH, alkalinity, chemical oxygen demand (COD), hardness, nitrate, ammonia, phosphate, sulfide, sulfate, cyanide, chloride, and coliform bacteria.

The results show that petroleum-based products had a higher number of potentially toxic contaminants with concentrations greater than the control plot, followed by acrylic polymers and ligninsulfonate. Magnesium chloride presented the lowest number of contaminants with concentrations greater than the control. The majority of the dust suppressants created a surface that is more impermeable than the natural soil surface. This increased the runoff volume similar to that emanating from a developed land surface.

Although several compounds that affect water quality have been detected in the runoff of plots to which dust suppressants were applied, this information alone should not be used to evaluate the impacts of dust suppressants to water quality. The data generated in this study and others should be combined with information on dust suppressant effectiveness, the frequency of application, proximity to water bodies, and cost to thoroughly evaluate the feasibility of using these compounds when water quality is a concern.

3.2 View of the Experts

This section summarizes the expert panel views on potential environmental impacts of dust suppressants, presented during the panel discussions. It is problematic to attribute specific views to a specific expert; therefore, the major points of consensus are noted below and collectively these represent the views of the experts as captured in the Expert Panel and through their review of the document.

3.2.1 Potential Factors Affecting Environmental Impacts of Dust Suppressants

On-site and off-site environmental effects of dust suppressant application depend on many factors including the physical characteristics of the suppressant, its chemical composition, concentration, the form it takes when it migrates, soil composition, and the climate conditions during and after application. From all the aforementioned factors, the lack of knowledge on the chemical composition of the suppressants is of critical importance to the evaluation of the environmental impacts of these compounds.

There is a need to improve information about the chemical composition of suppressants. Although Material Safety Data Sheets (MSDS's) for suppressants include the major components of the dust suppressants, they do not always include adequate details on toxic compounds that may be present and are of environmental concern. Because the vast majority of compounds used as dust suppressants are waste products from the manufacturing industry, their chemical composition is often unknown and complex and may vary widely for each batch. Organic suppressants sometimes contain surfactants or foaming agents that can cause environmental effects. One applicator cited an instance in which they unexpectedly found benzene, a carcinogenic hydrocarbon, in an off-spec water-based paint product sold as a dust suppressant. The compound was detected in tests performed on the dust suppressant prior to application. However, testing of the dust suppressants prior to application is expensive and not a common practice.

3.2.2 Unintended Off-site Environmental Impacts

Dust suppressants can potentially affect the environment beyond the application site. Overspray during application affects land, plants and fauna adjacent to the site. In addition, dust suppressants can be transported onto adjacent lands by surface flow or air. Material can be spilled from application trucks during transport to or from the application site, and commonly during off-loading from tankers to distributor trucks. It is a concern that trucks applying suppressants to roads have been observed to continue spraying when they cross bridges, resulting in dust suppressants being sprayed directly into streams below.

After the application of the dust suppressants it must be borne in mind that suppressants attached to soil particles covered with dust suppressants can be transported due to wind or erosion to off-site areas. In Pennsylvania it has been observed that a farmer's machinery kept under an open-sided shelter was completely rusted from salts carried on the dust from a nearby brine application demonstration.

Humans who are on the site during application (e.g., applicators) or after application could also come in direct contact with the dust suppressant. Road applications bear the additional exposure of suppressant product becoming embedded under the skin of errant runners or cyclers. In addition, there is the potential for deleterious effects of pumping water from remote streams to construction sites for dust control. One instance was reported in Pennsylvania where the contractor pumped a stream dry.

3.2.3 Effects on Soils

Dust suppressants may cause undesired dissolution of some soil constituents. In the simplest case, even water used as a suppressant may cause chemical dissolution of compounds bound to soil particles. In soils from arid regions, which have high salt content, water used as a suppressant can mobilize the salts, increasing the salt concentration in nearby waterbodies or groundwater. In more complex scenarios, the chemical constituents of the suppressant can react with and leach toxic components out of the soils at the application site. The issue of leaching is particularly relevant where dust suppressants are used on coalfields, landfills, and mine tailings piles, which may contain hazardous material.

The constituents of the suppressants may be taken up by plant roots and systemically affect plants. In addition, soil microorganisms may biotransform the suppressants into benign or more toxic compounds depending on the environmental conditions on the site of application.

The application of dust suppressants will have secondary effects on the characteristics of soils to which suppressants are applied including a decrease of surface permeability. Depending on precipitation, the change in surface permeability can lead to increased runoff from the site to adjacent sites and decreased soil moisture. Changes in surface flow can then change patterns of erosion on and off the application site.

3.2.4 Effects on Air Quality

Dust suppressant use can affect air quality characteristics in a number of ways. In arid areas, for example, the use of water may add moisture to air fostering the proliferation of microorganisms. Dust suppressants that adhere to soil particles can be re-entrained into the air with strong winds, potentially adding contaminants to the air in addition to particulate matter. It is noteworthy that dust suppressants have little efficacy at suppressing small respirable dust that have the potential to be inhaled directly into lung parenchyma and cause lung disease (Reilly *et al.*, 2003). Dust suppressants are generally used to comply with PM10 regulations and improve visibility; but could be potentially harmful since smaller dust particles (less than 10 μm) can be inhaled. Lastly, some dust suppressants may have volatile organic compounds in the products that may be dispersed into the air when the product is applied. This is a particular concern in the formation of ozone.

3.2.5 Effects on Flora and Fauna

Dust suppressant application is not limited to the soils on the site. Since dust suppressants are generally applied over the surface, any vegetation or fauna on the site, including soil microorganisms, may also come into direct contact with the suppressant. Application of dust suppressants, especially magnesium chloride, has been associated with the browning of trees along roadways and stunted vegetation growth in forestlands. Effects vary, because different plants have different tolerances.

Aquatic ecosystems are affected by direct contamination from spills or runoff from offsite applications of dust suppressants. Fish may be affected by direct ingestion of toxic constituents or their degradation products. They are also sensitive to increased salinity resulting from salts and brine applications.

Dust suppressants that result in an increase in biochemical oxygen demand (BOD) can result in decreased DO concentrations in nearby streams, which may affect fish health and survival. Dust suppressants that affect macroinvertebrates could cause a decrease in food supplies for fish. Dust suppressants that result in increased suspended solids concentration, either directly or indirectly, via erosion, can potentially degrade aquatic habitat. At the micro level, suppressants can potentially be toxic to soil and water micro-organisms.

There is a chance that reproductive effects for fauna could also be found in these areas. An example of adverse impact of dust suppressants in animals relates to using finely chopped asphalt in feedlots to suppress dust. With time, the animals started having convulsions and high levels of lead were found in their blood. When the animals were moved to another feedlot, the symptoms were reduced.

3.2.6 Effects on Surface and Groundwater

Dust suppressant use can potentially affect both surface and groundwater. Spills directly affect surface water and can impact groundwater depending on site characteristics. Dust suppressants that are water-soluble can be transported into surface waters and materials that are water-soluble but do not bind tenaciously to soil can enter the groundwater. If the soil surface is not bound together well (i.e., chlorides, lignin) or if the rain event is extreme, dust suppressant treated soil particles can be carried by overland flow into streams, rivers, and ditches. Sedimentation and uptake of soil particles could adversely affect aquatic or marine life, if sufficient numbers of treated particles have significant and mobile concentrations of hazardous compounds. Settled particles can also change the composition of the ecological community and the dominant species (Sanders *et al.*, 2003).

3.2.7 What can be done to Avoid Another Times Beach?

To further engage the experts and to work through the scientific and policy issues associated with dust suppressant use, the experts were posed the above question and asked to respond individually. Following is a compilation of the responses.

Primarily, materials that fail existing regulatory thresholds for toxicity and those containing FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act), TSCA (Toxic Substance Control Act), and RCRA (Resource Conservation and Recovery act) regulated compounds should not be used as dust suppressants. Chlorinated compounds and materials containing any paints should be carefully evaluated if used in a dust suppressant. Food products (e.g. soy oil, molasses) could be used, when possible, for they are likely to contain less toxic compounds than the industrial materials and waste products currently used as dust suppressants. Natural products are likely to biodegrade in the environment and therefore toxic effects are expected to be minimal. However, the make up of these products needs to be considered since some biodegradable products can be toxic before degradation occurs.

Application of all types of chemical dust suppressants should not be ruled out or permitted under all conditions. Instead, guidelines should be drafted to indicate where specific dust suppressants should be applied. Application of chemical dust suppressants should be avoided near sensitive environments, near water bodies and fractured rock, in areas with a shallow groundwater table, and other areas where water could quickly reach the saturated zone. Site-specific characteristics should be considered when approving the use of dust suppressants. All of these recommendations would require the screening of suppressants via a certification program, and a proper monitoring program of product make up over time. This would eliminate suppressants that do not meet expected standards. Alternatively, the number of dust suppressants to be applied could be limited to specific types; that would facilitate regulation and monitoring of the environmental impacts.

The public perception of toxicity may be an important component of the acceptance of dust suppressants as a dust abatement technology notwithstanding the actual threat the suppressant may pose. Factors such as the smell and the visual impact of dust suppressants should be considered. Finally, information on environmental impacts and effectiveness of dust suppressants should be used together when determining the type of suppressant to be used. If only environmental concerns are used as guidance to select dust suppressants, one could end-up with the most environmentally friendly suppressants instead of the best suppressant for the application with the least potential environmental risks. Before adopting new regulations, the advantages (e.g., improved air quality) and disadvantages (e.g., contaminated soils) associated with dust suppressant should be considered in risk management analysis.

3.2.8 What would be a Significant Concern that would Limit Use?

The Expert Panel was also presented with the above question on what would constitute a concern for them. The following items would cause the experts to limit the use of dust suppressants:

1. Data indicating a potential ecological impact (e.g., plant stress, isolation of animal communities, habitat disruption).
2. Data indicating carcinogens, toxins in levels that would cause negative impacts in human health.
3. Industrial waste by-product containing potential toxic contaminants.
4. Suppressant containing significant amounts of products regulated under FIFRA, TSCA, and RCRA.
5. Potential or observed negative impacts to adjacent landowners.

3.3 User and Agency Survey Results

To further probe into the current practices used for dust suppressant selections, several agencies and dust suppressant applicators were asked what characteristics in a dust suppressant they felt were important when deciding on the use for a particular situation, and what other factors influence their decisions. The main considerations include:

- Environmental impacts, especially near detention basins/waterways
- Toxicity such as LC50 test of dust suppressant on fish
- Cost of dust suppressant per acre
- Application costs
- Warranty time and durability
- Availability of product
- Type of equipment needed to apply product
- Penetration characteristics
- Past history of dust suppressant use
- Traffic impacts (i.e., different products for different conditions)
- Long term maintenance costs
- Category of dust suppressant

Section 4

Framework for Assessing Potential Environmental Effects

To make decisions about dust suppressant use, managers must evaluate the potential level of concern that use will generate. The level of concern about a given dust suppressant depends on a number of site-, use-, and composition-specific factors. These factors are highly variable and information about many of them is uncertain. The diagram shown in Figure 4-1 presents a framework for assessing the level of concern about the use of a particular dust suppressant. This is not meant to be a comprehensive decision-tree model. Instead, it outlines it identifies the type of information needed to evaluate the product. It also summarizes the relationship between the purpose of application, type of dust suppressant, site conditions, and level of concern. This is intended for managers and/or policy-makers who would use this framework to make a decision about the use of a particular dust suppressant on a specific site. This would guide the person on what information would need to be collected for each of these categories specific to the suppressant and the site in question. An explanation of the diagram from the bottom (endpoint) to the top is provided below.

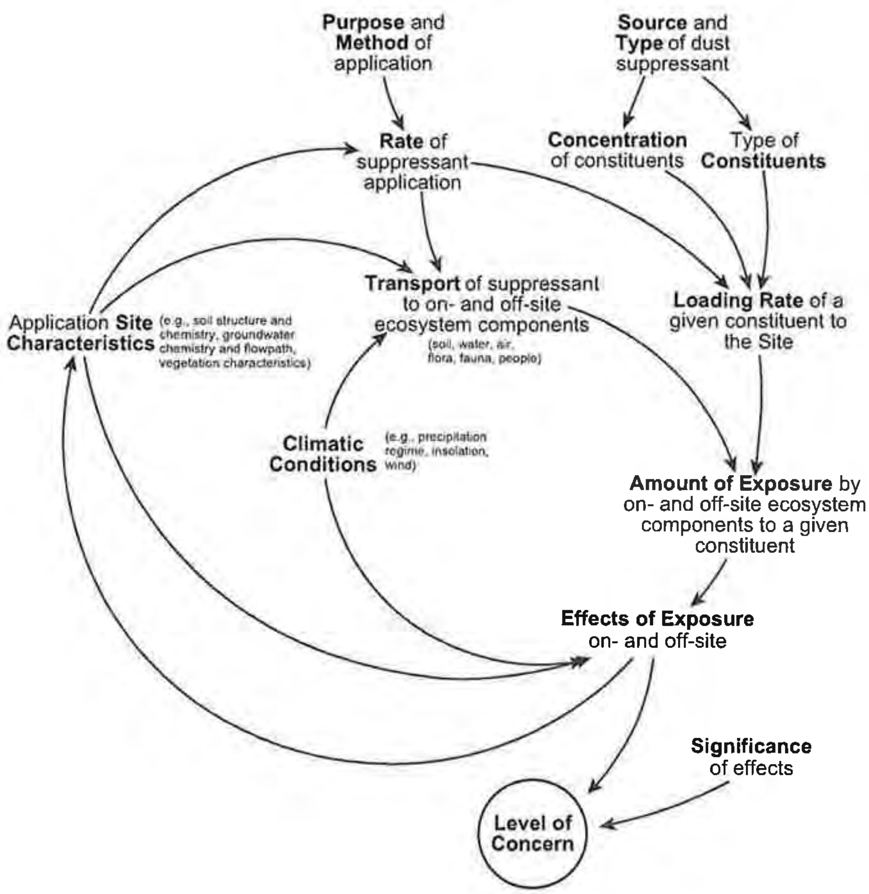

Figure 4-1: Framework for assessing the potential environmental impacts of dust suppressants.

To determine the *level of concern* about a given use, both the *effects of exposure* of the suppressant on a range of ecosystem components and the *significance* of those effects must be considered. If a suppressant applied to a given site were carried off the site and into an adjacent stream, for example, the level of concern would depend on the effect of that suppressant on the aquatic ecosystem – an algal bloom caused by an input of phosphorus, for example – and the significance of that effect. The same effect could be critical in one system and insignificant in another. An algal bloom might be unacceptable in a water body used for swimming but unremarkable in a wastewater treatment plant outfall. The significance of the effect might also be determined by comparing the effect of use with the effect of *not* using the suppressant. Any decision to use or not use a suppressant should be based on an assessment of benefits and risks (Expert Panel, 2002).

The effects of dust suppressant exposure on and off the application site are a function of the *site characteristics*, *amount of exposure* the different ecosystem components receive, and *climatic conditions* at the site. Site characteristics such as topography, soil texture and chemistry, groundwater flow path, vegetation and wildlife types, and distribution set the parameters for environmental responses to dust suppressant exposure. A basic set of ecosystem components whose response to the dust suppressant should be evaluated, include air, soil, water, soil microbes, aquatic organisms, vegetation, fauna, and people (Expert Panel, 2002). Different categories might be more or less important at different sites. One site may contain species sensitive to a particular compound while another may not. Site characteristics can also affect the ecosystem response to a suppressant. Alkaline soils may buffer acidic constituents of a suppressant. Dense vegetation may take up excess nutrients in organic suppressants. Soil microbes may break down potentially toxic suppressant constituents. Climatic conditions at the site, including the precipitation regime, wind exposure, and temperature, also affect the response of ecosystem components to the suppressants. Dust suppressant constituents might react differently under different moisture and temperature conditions, for example. The degradation rates of some constituents of dust suppressants may vary with exposure to ultraviolet radiation. The ecosystem response also depends on the amount of exposure to a given suppressant constituent received by the ecosystem component. The response of any given ecosystem component may be non-linear, or involve thresholds.

The *amount of exposure* received by a given ecosystem component to a given suppressant constituent depends on the rate at which it is applied to the site (*loading rate)* and the *transport* of constituents to each ecosystem component. The constituent loading rate depends on the rate at which the suppressant is applied, the type of constituents in the suppressant, and their concentration. Once the suppressant is applied to the site, its constituents may migrate within the site, from the soil surface to the sub-surface, for example, or to the groundwater or into the air. The pathways and rate at which any given constituent moves within the site or off the site are a function of the site characteristics, climatic conditions, and the characteristics of the constituents. The amount of precipitation a site receives affects the transport of water-soluble constituents, as do its topography, soil, and geologic characteristics. Some constituents are more mobile than others. They may be more soluble, or more likely to be volatilized. Depending on soil chemistry, some may be adsorbed to soil particles. Constituents may be transformed after application, reacting chemically with each other or with components at the site, or being degraded.

The *rate* of suppressant application depends on the *purpose and method* of application. The purpose of application – to stabilize disturbed vacant land or agricultural land or to reduce the dust generated from travel over unpaved roads, for example – together with specific site characteristics and climatic conditions, determine the amount and frequency at which the suppressant is applied. The purpose and site characteristics also influence the method of application. If the surface to be stabilized is not expected to be disturbed, the suppressant may be applied topically. If the surface must withstand vehicle traffic, the suppressant may be mixed into the soil by grading.

The *type* and *concentration* of constituents in the suppressant are a function of the *type and source* of the suppressant. Dust suppressants can be water, brines, lignin-sulfonates, petroleum-based products, or other types, as discussed in Section 2.1. Dust suppressants may contain components other than the primary suppressant, depending on the source of the suppressant (Expert Panel, 2002). Most suppressants are derived from waste materials from manufacturing processes. Even the source water (e.g., reclaimed water, groundwater) may contain additional constituents. The composition of the suppressant, together with the rate of application determines the amount (mass) of each constituent applied to the site.

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Section 5

Path Forward – Issues and Potential Solutions

There are a significant number of "data gaps" that need to be filled to more adequately address environmental and regulatory issues (Expert Panel, 2002). Research questions range from "What is the national scale of the problem?"; "How much is being applied and where?"; "What tests should one run to determine the chemicals leached into soil and the biological impacts of dust suppressants after they are applied?" These types of questions must be answered before a decision can be made about whether or not more federal regulation is needed. This section focuses on the scientific and regulatory issues, and then provides suggestions for a path forward.

5.1 Scientific Issues

5.1.1 Better Definition of What is Meant by "Effective" Dust Suppressant

As noted earlier, there is no standard definition of a dust suppressant. Current usage of the term "dust suppressant" implies that it can be any chemical formulation applied to the ground to control emission of dust. Furthermore, the term "effective" dust suppressant is not well defined. Currently, the definition of an effective dust suppressant focuses on the ability (efficiency) of the product to suppress particulate matter from becoming air borne over a period of time (Expert Panel, 2002). To support this, Industry has developed data on the performance of dust suppressants on various types of land surfaces (see Literature Review in Appendix A).

A more comprehensive definition of an effective dust suppressant is needed to consider the overall impacts of using the products. A comprehensive definition of an "effective" dust suppressant might consider the following (Expert Panel, 2002):

1. The efficiency and durability of the product
2. The costs and benefits associated with the use of the product
3. The potential environmental impacts

In making the determination of what dust suppressant to use, it is also important to select the proper dust suppressant based on soil characteristics. Soil characterization tests are not always performed on sites when selecting a dust suppressant; however, several experts were asked what tests they would recommend. Recommendations included gradation tests (AASHTO T-11 and T-27), plasticity tests (AASHTO T-89 and T-90), pH tests of the soil, tests for the ability of soil to attract of bind a particular dust suppressant, particle size distribution, moisture content, and a visual survey of the site (Expert Panel, 2002). A thorough description of soils tests necessary to determine the optimum product performance has been prepared by the US EPA ETV Generic Verification Protocol for Dust Suppression and Soil Stabilization Products.

5.1.2 Better Understanding of Dust Characteristics as an Air Pollutant

To properly evaluate the impacts of dust suppressants one must understand the characteristics of dust. One key factor is the size of the particle matter. Airborne particle size fractions are classified as either Particulate Matter (PM) 2.5 or PM10, based on their aerodynamic diameter, when they are regulated under the Clean Air Act. Airborne fugitive dust entrained from road surfaces and wind-eroded from construction sites, agricultural fields and vacant lands span a physical size range from less than 1 micron to about 100 microns; this range includes (and exceeds, on the large end) the PM2.5 and PM10 size fractions. There is a need for proper characterization of particle size distribution and mineralogy related to variables such as vehicle tire loading and speeds on unpaved roads in different regions (Expert Panel, 2002). As noted earlier, the smaller PM2.5 particles may be more harmful from a human health perspective if inhaled.

The soil surface chemistry, moisture content, and shapes of dust particles can affect the ability of different suppressant formulations to adhere to the particles. The particle size, shape, surface chemistry, and soil moisture content are seldom used to assist in the selection of an appropriate suppressant. In some cases, the soil silt content (given as percent passing a #200 screen) and moisture content may be obtained prior to dust suppressant application. Many of the standard soil characterization tests are time-consuming and not well suited to the daily exigencies of field operations. Development of simple, robust field apparatus and rapid methods for characterization of relevant soil properties could assist in the selection of the right type of suppressant and the appropriate application rate for a particular region.

5.1.3 Better Understanding of How Dust Suppressants Change After Application

The fundamental mechanisms of how the dust suppressants work, break down, degrade, and move in the environment are not well understood at this time. "Degradation" includes effects of solar radiation, abiotic oxidation, biological transformations, dissolution, and physical weathering. In addition, the soils characteristics will influence how the suppressants are degraded (Expert Panel, 2002). Mechanisms of how dust suppressants work are well established and based on research and industry development. However, it is not known what happens to the products after they are applied and weathering occurs. What daughter products are produced as dust suppressants break down? Are they benign or toxic, mobile or immobile? Answers to these questions can only be obtained from long-term testing of dust suppressants under field conditions.

5.1.4 Better Definition of Current and Potential Problems/Uses

Preliminary data was provided in Section 2.3 on the current and potential uses of dust suppressants; however, this issue should be further explored. If national regulations/ guidelines are considered for the use of dust suppressants, then there needs to be a better understanding of the scale of current and potential usage of dust suppressants. Answers to the following questions are needed:

1. In what regions of the United States are dust suppressants currently being applied?
2. How much dust suppressant is being applied nationwide?
3. Have there been adverse environmental impacts in regions where dust suppressants were applied?
4. What is the potential use of dust suppressants on unpaved roads and disturbed lands?
5. Do local and state agencies track the use of dust suppressants?

5.1.5 Source of Dust Suppressants and Dilution Water

A major concern is the current lack of information on the chemical composition of dust suppressants. Material Safety Data Sheets (MSDS's) are commonly provided for dust suppressant products; however, since proprietary information may be involved, MSDS's do not necessarily provide information about all the chemicals present in the products. Major manufacturers (e.g., Midwest Industrial Supply and Pennzoil Products) will provide results of environmental tests if the customer asks for the information, or post the information on the Internet (Expert Panel, 2002). Manufacturers' environmental testing data, while valuable, is currently not standardized. As an example, several vendors provide reports containing bioassay data, but it is sometimes difficult to compare results among different products because different test species (e.g. fathead minnows or water fleas) and different test protocols may be used.

Chemical properties, particularly toxic contaminants, can vary significantly depending on the product. Constituents can also vary from batch to batch (Expert Panel, 2002). The environmental impacts of dust suppressants cannot be adequately identified until concentration ranges for major and trace chemical constituents are known for the most common products. Most experts in soil science, ecology, and biology can estimate potential environmental impacts in their field of expertise if they know the chemical composition of the product and the site-specific conditions (Expert Panel, 2002). However, that information is not fully available.

There is also a concern regarding the sources of the products used in the dust suppressants. Although some manufacturers formulate suppressants from virgin materials, a majority of commercial products are reformulated by-products or brines from industries that would otherwise dispose of these materials as wastes. Several examples of waste products reformulated as dust suppressants include lignin sulfonates and magnesium chloride brines. In effect, unpaved roads have become disposal system for these by-products that are reformulated and used as dust suppressants. The chemical composition of broad categories of by-products, such as lignin sulfonates, oils, and brines will depend on the original source of the by-products and also on the chemical processes that generated them. For example, the waste oils originating from California crude oils may contain more metals than waste oils originating from Pennsylvania crudes (Expert Panel, 2002). Used oils and solvents may have even higher toxic concentrations.

It is also noteworthy that the use of toxic by-products in dust suppressants is a recycling process. The recycling of non-hazardous waste products into dust suppressants reduces the cost of the dust suppressant and eliminates the need for disposal in landfills. Depending on the by-product, recycling and reuse into dust suppressants may be the best way to dispose of some non-hazardous wastes (Expert Panel, 2002). For example, some mulch-type suppressants are formulated with non-hazardous wood fiber or paper pulp, and large volume use of mulch-type suppressants can significantly reduce the volume of waste pulp that must either be landfilled or incinerated.

The sources of the water used for dust suppressants should also be considered in assessing the potential impacts. The majority of suppressants require dilution and typically applicators will use the water that is most readily available. Tap water, untreated surface or ground water or reclaimed municipal or industrial wastewater could all be used. Reclaimed wastewater may have higher levels of nutrients and pathogens than ordinary tap water or some surface or groundwaters. In some areas, contaminated groundwater could inadvertently be used for mixing of the dust suppressants (Expert Panel, 2002). Minimum quality standards for water used directly as a dust suppressant or as a dilution product should be established to prevent inadvertent contamination of lands treated with dust suppressants.

5.1.6 Clearinghouse for Dust Suppressant Information

There is a need for more information about the chemicals and formulations used in dust suppressants (Expert Panel, 2002). Regulators, applicators, and the public don't have easy access to information that would help them to decide which dust suppressant types are safe and effective for specific applications. An easily-accessible information center, a "clearinghouse", could help applicators, regulators, and the public acquire the information needed to make good dust control decisions. The recommended form of this clearinghouse is as a World Wide Web site. EPA maintains several web sites that could serve as models for a dust suppressant clearinghouse. An example is the

CHIEF bulletin board that serves the needs of state and local air quality regulators. The clearinghouse could be maintained by EPA or by another public agency or university. Content categories for this clearinghouse could include (Expert Panel, 2002):

1. Information on composition of dust suppressants
2. Easy to follow guidelines for selection and application
3. List of products not to use
4. Occupational and environmental toxicity information for different types of dust suppressants
5. Applicable state and local ordinances regulating dust suppressant application
6. Information about what happens after application, both in terms of suppressant performance and environmental impacts
7. Information for the affected public as well as for regulators/manufacturers/applicators, including:
    a. Contact information for federal, local, and state agencies regulating use of dust suppressants
    b. Contact information for dust suppressant manufacturers

Complete disclosure by dust suppressant manufacturers, formulators, and vendors would be needed in order to address all the items shown above. Some manufacturers, formulators, and vendors might be reluctant to release exact formulation information, since they could consider the information to be proprietary. The model for disclosure of pesticide formulations, where only "active" ingredients are specifically listed, might prove useful. However, in the case of dust suppressants the definition of an "active" ingredient should include both those constituents that control dust and any other trace constituent, which when applied to the land surface at the intended application rate, has the potential for environmental impact. However, the lack of complete cooperation from vendors should not delay the creation of the clearinghouse.

5.1.7 Risk Assessment and How to Decide What to Test For

When making the determination on which dust suppressant should be used, a robust risk assessment framework is needed along with the identification of which test should be performed. In Section 4, a framework was provided that outlines the considerations that one might use to make an assessment. There are several detailed risk assessment frameworks available to the industry that could be used as models.

- The American Society of Testing and Materials (ASTM)'s Risk-Based Corrective Action (RBCA) is one of the standard frameworks for assessing the extent of petroleum contamination and developing remedial measures for contaminated lands (ASTM, 1999)
- ASTM also publishes guides and standards for ecological considerations for the use of chemical dispersants in oil spill response that may provide insight into development of standards for dust suppressants (ASTM, 2003)
- EPA has also published guidelines for remediation of hazardous waste sites (EPA, 2002)

Unfortunately, these frameworks for risk assessment were developed for cases where contamination had already occurred. One proprietary general guideline exists for evaluating potential environmental impacts of release of chemicals to the environment (see Rohm and Haas Consumer and Industrial Specialties' Risk Assessment Flow Chart for Safe Product Use, available at http://www.rohmhaas.com/rhcis/environmental/safeproduct.html).

There are no relevant guidelines available for minimizing environmental and human health risk from intentional application of dust suppressants to roads construction sites, agricultural fields, and vacant lands. Guidelines do exist for:

- Intentional application of fertilizers to crops and turf, and

- Intentional application of pesticides to croplands, turf, and residences

However, in both of these cases, the active ingredients are well known and impacts have been fairly well studied. The situation with dust suppressants is much more ambiguous, as in many cases, data about their chemical composition and biological impacts are lacking.

It is recommended that tests performed, as part of a risk assessment for dust suppressants should focus on the constituents in the dust suppressant concentrate, in runoff, and in the soil after application. It is very likely that no dust suppressants will be free of every potential harmful chemical; however, it is important that guidance documents and initial recommended threshold levels be developed to reduce risk. Relevant EPA methods, compiled from both Expert Panel recommendations and from the literature review, are summarized in Table 5-1. These tests could be applied to the raw product, the collected runoff, and/or the soils.

Table 5-1: Relevant EPA and Standard test to be considered in assessing impacts of dust suppressants.

	Analytical Method	EPA/ASTM Number
Organic	Volatile organic compounds	8260B
	Semi-volatile organic compounds	8270D
	Pesticides and herbicides	8270D
	Chlorinated hydrocarbons	8121
	Petroleum hydrocarbons	8440
	PAHs	Tentatively identified compounds (TIC)
Inorganics/Metals	Inductively Coupled Plasma-Atomic Emission Spectrometry	6010B
Toxicity	Terrestrial bird toxicity	850.2200
	Insect toxicity	850.3020
	Vegetation toxicity	850.4000
	Algal Toxicity	850.4400
	Acute to fishes and microinvertebrates	ASTM E-1192-88
	Marine and Estuary organisms	EPA/600/4-85-013 and EPA 600/4-87-028
	Chronic to fishes and microinvertebrates	EPA/600/4-89-001
	Dredge material chemical and biological evaluation	U.S. Corps. Engr. Rep-D90
	Bioconcentration	ASTM E-1022-84
Biodegradability	Soluble Chemical Oxygen Demand	410.4
	Biochemical Oxygen Demand	405.1

5.1.8 Example of a Standardized Assessment Methodology

As part of an initial risk assessment for this report, a proposed standardized methodology for estimating soil mass fractions of dust suppressant constituents is shown below in Tables 5-2 and 5-3. The worksheets use known information about a dust suppressant constituent concentration, the application rate, the soil penetration, and soil density to estimate a dust suppressant constituent concentration in soil. Table 5-2 is provided as a blank worksheet for vendors, applicators, regulators, and investigators to use in their risk assessments. Table 5-3 shows an example calculation for a constituent present at a 50 mg/L in a dust suppressant concentrate.

Table 5-2: Blank Worksheet A – Estimation of soil mass fraction from suppressant constituent concentration.

Blank Worksheet A: Calculation of constituent concentration in soil

Fill in shaded blanks with your data and complete calculations in other rows per Calculation Instructions

User-supplied	Row #	Data Entry or Calculation Instruction	Value	Units
*	1	Concentrate constituent concentration		mg/L
*	2	Dilution: volume water/volume concentrate		
	3	Mixed constituent concentration = concentrate concentration / (1 + dilution)		mg/L
*	4	Liquid mixture application rate per pass		gallon/yd2
*	5	Number of passes		
	6	Total liquid mixture application rate/yd2 = rate/pass x number passes		gallon/yd2
	7	Land area conversion	1.20	yd2/m2
	8	Converted total liquid mixture application rate per m2 = row 6 x row 7		gallon/m2
	9	Mixture volume conversion	3.78	liter/gallon
	10	Total Liquid mixture application rate (metric) = row 8 x row 9		liter/m2
*	11	Runoff fraction (fraction leaving site before infiltration into soil)		
	12	Retained liquid application rate = Total rate x (1 - runoff fraction)		
	13	Mixture liquid depth applied to soil = (row 12 x (1 meter3/1000 liter) x 100cm/meter x 1 inch/2.54 cm		inches
	14	Constituent application rate as mass/area soil = mixed constituent concentration (row 3) x liquid mixture rate (row 12)		mg/m2
*	15	Diluted mixture penetration (inches)		inches
	16	Length conversion	2.54	cm/inch
	17	Diluted mixture penetration (centimeters) = row 15 x row 16		centimeters
	18	Diluted mixture penetration (meters) = row 17 / 100		meters
	19	Constituent soil concentration as mass constituent/volume soil = constituent application rate (row 14) / diluted mixture penetration (row 18)		mg/m3
*	20	Soil bulk density		kg/m3
	21	Initial constituent mass fraction in soil = constituent soil concentration (row 19) / soil bulk density (row 20)		mg/kg = ppm

Table 5-3: Example calculation using Worksheet A. Soil mass fraction resulting from application of dust suppressant with constituent concentration of 50 mg/L. Assumes 1,600 kg/m^3 soil bulk density, 0.45 inch (1.14 cm) suppressant penetration into soil, 2 suppressant applications at 0.50 gallon/yd^2, no runoff of liquid suppressant, and mixing of 1 volume of suppressant concentrate with 1 volume of water.

Worksheet A Example 1: Estimation of constituent soil mass fraction based on constituent concentration in suppressant as supplied (concentrate)

User-supplied	Row #	Data Entry or Calculation Instruction	Value	Units
*	1	Concentrate constituent concentration	50	mg/L
*	2	Dilution: volume water/volume concentrate	1	
	3	Mixed constituent concentration = concentrate concentration / (1 + dilution)	25	mg/L
*	4	Liquid mixture application rate per pass	0.50	gallon/yd2
*	5	Number of passes	2	
	6	Total liquid mixture application rate/yd2 = rate/pass x number passes	1.00	gallon/yd2
	7	Land area conversion	1.20	yd2/m2
	8	Converted total liquid mixture application rate per m2 = row 6 x row 7	1.20	gallon/m2
	9	Mixture volume conversion	3.78	liter/gallon
	10	Total Liquid mixture application rate (metric) = row 8 x row 9	4.53	liter/m2
*	11	Runoff fraction (fraction leaving site before infiltration into soil)	0.00	
	12	Retained liquid application rate = Total rate x (1 - runoff fraction)	4.53	liter/m2
	13	Mixture liquid depth applied to soil = (row 12 x (1 meter3/1000 liter) x 100cm/meter x 1 inch/2.54 cm	0.18	inches
	14	Constituent application rate as mass/area soil = mixed constituent concentration (row 3) x liquid mixture rate (row 12)	113	mg/m2
*	15	Diluted mixture penetration (inches)	0.45	inches
	16	Length conversion	2.54	cm/inch
	17	Diluted mixture penetration (centimeters) = row 15 x row 16	1.14	centimeters
	18	Diluted mixture penetration (meters) = row 17 / 100	0.0114	meters
	19	Constituent soil concentration as mass constituent/volume soil = constituent application rate (row 14) / diluted mixture penetration (row 18)	9,900	mg/m3
*	20	Soil bulk density	1,600	kg/m3
	21	Initial constituent mass fraction in soil = constituent soil concentration (row 19) / soil bulk density (row 20)	6.19	mg/kg = ppm

Environmental regulations establish action levels for contaminants or contaminant classes in soils. Remediation is usually required if values above these levels are recorded for a contaminated site. Tables 5-4, 5-5, and 5-6 show a proposed calculation methodology for using an action level in soil to estimate the maximum allowable constituent concentration in a formulated dust suppressant concentrate. Table 5-4 is provided as a blank worksheet for interested parties to use in risk assessments involving suppressants. Table 5-5 shows a sample calculation for a RCRA-based action level of 100 ppm for total petroleum hydrocarbons (TPH). Table 5-6 shows a sample calculation for a CERCLA-based action level of 1 ppb for tetrachlorodibenzodioxin (TCDD). The final result computed at the bottom of Tables 5-5 and 5-6 should not be considered as a fixed "not to exceed" value for TPH or TCDD, as the numerical result depends on dust suppressant liquid application rate, penetration depth into the soil, fraction suppressant retained on the target surface, suppressant dilution, and soil bulk density. However, the results are instructive, and the accompanying blank worksheet (Table 5-4) could be used with site-specific data to compute maximum allowable constituent (or contaminant) concentrations for other combinations of site conditions, suppressant dilutions, and application rates.

Table 5-4: Blank Worksheet B – Estimation of maximum allowable dust suppressant constituent concentration from risk-based limit in soil.

Blank Worksheet B: Calculation of maximum suppressant contaminant concentration based on maximum allowed soil contaminant mass fraction

Fill in shaded blanks with your data and complete calculations in other rows per Calculation Instructions

User-supplied	Row #	Data Entry or Calculation Instruction	Value	Units
*	1	Initial constituent mass fraction in soil		mg/kg = ppm
*	2	Soil bulk density		kg/m3
	3	Constituent soil concentration as mass constituent/volume soil = constituent soil mass fraction (row 1) x soil bulk density (row 2)		mg/m3
*	4	Diluted mixture penetration (inches)		inches
	5	Length conversion	2.54	cm/inch
	6	Diluted mixture penetration (centimeters) = row 4 * row 5		centimeters
	7	Diluted mixture penetration (meters) = row 6 / 100		meters
	8	Constituent application rate as mass/area soil = constituent soil concentration (row 3) x diluted mixture penetration (row 7)		mg/m2
*	9	Liquid mixture application rate per pass		gallon/yd2
*	10	Number of passes		
	11	Total liquid mixture application rate/yd2 = row 9 x row 10		gallon/yd2
	12	Land area conversion	1.20	yd2/m2
	13	Converted total liquid mixture application rate per m2 = row 11 x row 12		gallon/m2
	14	Mixture volume conversion	3.78	liter/gallon
	15	Total liquid mixture application rate (metric) = row 13 x row 14		liter/m2
*	16	Runoff fraction (fraction leaving site before infiltration into soil)		
	17	Net liquid application rate = row 15 x (1 - row 16) as volume/ area soil		liter/m2
	18	Mixture liquid depth applied to soil = (row 17 x (1 meter3/1000 liter) x 100cm/meter x 1 inch/2.54 cm		inches
	19	Max allowed concentration in diluted mixture = row 8 / row 17		mg/L
*	20	Intended dilution: volume water / volume concentrate		
	21	Maximum allowed concentration in suppressant concentrate as supplied = row 19 x (1 + row 20)		mg/L

Table 5-5: Example calculation of maximum allowable suppressant concentration based on RCRA 100 ppm action level for Total Petroleum Hydrocarbons (TPH) in soil as determined using EPA Method 8015. Assumes 1,600 kg/m^3 soil bulk density, 0.45 inch (1.14 cm) suppressant penetration into soil, 2 suppressant applications at 0.50 gallon/yd^2, no runoff of liquid suppressant, and mixing of 1 volume of suppressant concentrate with 1 volume of water.

Worksheet B Example #2: Calculation of maximum allowable suppressant contaminant concentration based on maximum allowed soil contaminant mass fraction. RCRA soil limit of 100 ppm maximum allowable TPH in soil from EPA Method 8015

User-supplied	Row #	Data Entry or Calculation Instruction	Value	Units
*	1	Initial constituent mass fraction in soil	100.00	mg/kg = ppm
*	2	Soil bulk density	1,600	kg/m3
	3	Constituent soil concentration as mass constituent/volume soil = constituent soil mass fraction (row 1) x soil bulk density (row 2)	160,000	mg/m3
*	4	Diluted mixture penetration (inches)	0.45	inches
	5	Length conversion	2.54	cm/inch
	6	Diluted mixture penetration (centimeters) = row 4 * row 5	1.14	centimeters
	7	Diluted mixture penetration (meters) = row 6 / 100	0.0114	meters
	8	Constituent application rate as mass/area soil = constituent soil concentration (row 3) x diluted mixture penetration (row 7)	1829	mg/m2
*	9	Liquid mixture application rate per pass	0.50	gallon/yd2
*	10	Number of passes	2	
	11	Total liquid mixture application rate/yd2 = row 9 x row 10	1.00	gallon/yd2
	12	Land area conversion	1.20	yd2/m2
	13	Converted total liquid mixture application rate per m2 = row 11 x row 12	1.20	gallon/m2
	14	Mixture volume conversion	3.78	liter/gallon
	15	Total liquid mixture application rate (metric) = row 13 x row 14	4.53	liter/m2
*	16	Runoff fraction (fraction leaving site before infiltration into soil)	0.00	
	17	Net liquid application rate = row 15 x (1 - row 16) as volume/ area soil	4.53	liter/m2
	18	Mixture liquid depth applied to soil = (row 17 x (1 meter3/1000 liter) x 100cm/meter x 1 inch/2.54 cm	0.18	inches
	19	Max allowed concentration in diluted mixture = row 8 / row 17	404	mg/L
*	20	Intended dilution: volume water / volume concentrate	1	
	21	Maximum allowed concentration in suppressant concentrate as supplied = row 19 x (1 + row 20)	808	mg/L

Table 5-6: Example calculation of maximum allowable suppressant concentration based on CERCLA 1 ppb action level for TCDD. Assumes 1,600 kg/m^3 soil bulk density, 0.45 inch (1.14 cm) suppressant penetration into soil, 2 suppressant applications at 0.50 gallon/yd^2, no runoff of liquid suppressant, and application of undiluted suppressant to land surface.

Worksheet B Example #3: Calculation of maximum allowable suppressant contaminant concentration based on maximum allowed soil contaminant mass fraction. CERCLA limit of 1 ppm maximum allowable dioxin in soil.

User-supplied	Row #	Data Entry or Calculation Instruction	Value	Units
*	1	Initial constituent mass fraction in soil	0.001	mg/kg = ppm
*	2	Soil bulk density	1,600	kg/m3
	3	Constituent soil concentration as mass constituent/volume soil = constituent soil mass fraction (row 1) x soil bulk density (row 2)	1.60	mg/m3
*	4	Diluted mixture penetration (inches)	0.45	inches
	5	Length conversion	2.54	cm/inch
	6	Diluted mixture penetration (centimeters) = row 4 * row 5	1.14	centimeters
	7	Diluted mixture penetration (meters) = row 6 / 100	0.0114	meters
	8	Constituent application rate as mass/area soil = constituent soil concentration (row 3) x diluted mixture penetration (row 7)	1.83E-02	mg/m2
*	9	Liquid mixture application rate per pass	0.50	gallon/yd2
*	10	Number of passes	2	
	11	Total liquid mixture application rate/yd2 = row 9 x row 10	1.00	gallon/yd2
	12	Land area conversion	1.20	yd2/m2
	13	Converted total liquid mixture application rate per m2 = row 11 x row 12	1.20	gallon/m2
	14	Mixture volume conversion	3.78	liter/gallon
	15	Total liquid mixture application rate (metric) = row 13 x row 14	4.53	liter/m2
*	16	Runoff fraction (fraction leaving site before infiltration into soil)	0.00	
	17	Net liquid application rate = row 15 x (1 - row 16) as volume/ area soil	4.53	liter/m2
	18	Mixture liquid depth applied to soil = (row 17 x (1 meter3/1000 liter) x 100cm/meter x 1 inch/2.54 cm	0.18	inches
	19	Max allowed concentration in diluted mixture = row 8 / row 17	4.04E-03	mg/L
*	20	Intended dilution: volume water / volume concentrate	0	
	21	Maximum allowed concentration in suppressant concentrate as supplied = row 19 x (1 + row 20)	4.04E-03	mg/L
	22	Maximum allowed concentration (ppb) = row 21 x 1000	4.04	µg/L (ppb)

5.2 Regulatory Issues

5.2.1 Gaps in Existing Regulations

At present, few specific regulations for dust suppressants exist. Decision-makers currently rely on emerging voluntary certification programs (Section 2.7), and a limited number of state and local guidelines to screen the different types of dust suppressants for a variety of application scenarios. Current state, local, and national guidelines are not uniform. While current voluntary certification programs have merit, they need to be expanded to incorporate a majority of dust suppressants in commerce. Dust suppressants should be evaluated not only for their effectiveness in suppressing dust but also for their potential toxicological and environmental effects.

Regulations to support existing environmental laws (e.g., RCRA, CERCLA/SARA guidelines, as were used to clean up the Superfund site at Times Beach) may apply at some point after a dust suppressant has been applied. However, existing regulations are not applicable to the production and application of dust suppressant. RCRA rules were not written with dust suppressants in mind. Although they allow for waste exchanges and other waste reprocessing steps, their principal intent is to regulate the treatment, storage, and disposal of municipal and hazardous wastes. CERCLA/SARA rules are intended to finance and guide the clean up of contaminated sites. In contrast, the major regulatory need for dust suppressants is to develop guidelines that will prevent the creation of hazardous waste sites from the inappropriate use of dust suppressants. The Toxic Substance Control Act (TOSCA) is intended to regulate hazardous substances prior to them becoming hazardous waste.

5.2.2 Filling the Regulatory Gaps – What's Available in Existing Regulations?

Is the current regulatory environment for dust suppressants adequate to ensure that the risks have been considered and their use is acceptable? It was the opinion of the Expert Panel that it is not adequate. The Expert Panel generally agreed that more research is needed to answer questions about the potential environmental impacts of dust suppressants, but also agreed that development of regulations should not wait for all the science to be completed (Expert Panel, 2002).

A complication in developing new regulations is that the composition of dust suppressants may not be adequately known and components or byproducts of the suppressants may have potentially harmful environmental impacts. Although existing regulations are not intended to regulate the flows of Industrial wastes into the formulation of dust suppressants and thence to the environment, the existing regulations do contain limits on contaminant concentrations in soil that could be used as a starting point for regulations and guidelines for dust suppressants. For instance, a similar approach may be considered as that for the land application sludges. The regulations currently in place for the land application of sewage sludge and wastewater on agricultural fields limits the loading rate of metals based on land use.

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), Resource Conservation Recovery Act (RCRA), Comprehensive Environmental Response Compensation and Liability Act (CERCLA), Superfund Amendments and Reauthorization Act (SARA), Ecological Soil Screening Level (Eco-SSL) guidance with supporting regulations and guidelines collectively restrict the environmental concentrations of hundreds or thousands of chemicals. Many of these programs are good models for identifying potential problems; however, they need to be followed up with site-specific studies. It is recommended that:

1. State and federal regulatory databases for these compounds be reviewed, and the results organized to produce a database of compounds whose use would be restricted or prohibited in dust suppressants (Expert Panel, 2002).
2. Contaminant concentrations of modeled dust suppressant constituents and by-

products in water should be compared against action levels used in the Clean Water Act and Safe Drinking Water Act since dust suppressants could eventually be transported into surface and ground waters. Any dust suppressant compound that could reasonably be expected to exceed existing regulatory-based action levels or thresholds would need to be examined in detail to determine whether additional regulatory controls were needed to prevent unreasonable risks to human health and the environment.

Regarding regulating dust suppressant application practices, some guidance might be found in U.S. Department of Agriculture (USDA) regulations that control the application of chemical fertilizers and also in regulations that control the application of pesticides under FIFRA. As noted earlier, there are also state programs being developed. These state programs may be the most appropriate since they can better address regional issues related to dust suppressant use than a "one size fits all" federal program.

5.2.3 What's Next for Regulations?

New regulations must be developed to deal with the variety of compounds, application scenarios, and potential receptors that are involved with the growing use of dust suppressants. A variety of potential regulatory approaches specifically focused on dust suppressants exist, ranging from extending the current patchwork approach of local and state regulations to development of a comprehensive national program enforcement of which would likely be delegated to the states. An alternative to a comprehensive national program might be a basic national program that specifically makes dust suppressant products subject to other existing regulatory thresholds for toxicity and requires some type of testing and/or certification to validate that these limits are met. States could be encouraged to develop a more comprehensive regulatory program for dust suppressant products and their use based on regional topography, hydrology, soil types, ecosystems, and material availability.

The range of regulatory topics could include:

1. Limiting the types and number of suppressants allowed, and
2. Regulating the locations and application practices of specific types of dust suppressants (Expert Panel, 2002).
3. Regulating the exposure of workers to dust suppressants.

An effort to limit and specify which dust suppressants could be applied for dust control would be challenging because of the broad variety of products used as dust suppressants, their complex chemistry, and the increasing number of products and industrial by-products regularly introduced to the market. However, limiting the types of dust suppressants allowed for use would make enforcement of environmental regulations much simpler (Expert Panel, 2002). A regulatory-derived list of acceptable dust suppressants would bar access of several vendors to the market and would not be well received. In addition, there was concern that such an approach would discourage the development of more effective and more environmentally benign suppressants (Expert Panel, 2002).

Regulating dust suppressant application locations and application practices, rather than the types and number of suppressants, would allow for the varying sensitivities of different ecosystems to different dust suppressant formulations (See framework proposed in Section 4). For example, a dust suppressant with relatively insignificant impacts in one area (an arid flatland system with no perennial surface water flows and deep groundwater) might have significant impacts in another area (a humid mountainous system with significant perennial surface water flows and shallow groundwater). In the flat arid land case, the suppressant is likely to stay put in the soil for a long time, with minimal aquatic impacts. In the mountainous humid case, significant portions of the suppressant may rapidly reach surface and ground waters and could have significant aquatic impact.

Also, application rates and practices are important since dust suppressants with seemingly benign characteristics when applied at a rate of 1,000 mg/kg soil might produce significant impacts on the environment or human health if it is applied at 10 times the rate (10,000 mg/kg soil) or if the surrounding environment and individuals are particularly sensitive. High soil mass fractions could inadvertently develop if there is significant overspray onto previously treated surfaces during application.

The effectiveness of a suppressant should be considered in any evaluation of the application and potential impacts of dust suppressants. A short-lived, easily weathered dust suppressant requiring frequent re-application could have more significant environmental impacts than a long-lived, weather-resistant suppressant, when both contain the same concentration of a mobile trace contaminant. Frequent reapplication of the easily weathered suppressant would produce higher soil and aquatic concentrations of the trace contaminant than infrequent applications of the weather-resistant suppressant. If effectiveness is not considered, decision-makers might choose the "most environmentally friendly suppressant" rather than select a more effective dust suppressant that is just as environmentally benign for one application and more benign over the long term (Expert Panel, 2002).

The evaluation and/or certification of specific dust suppressants should not be a one-time process, but should instead be subject to periodic renewal. Waste products that are recycled into dust suppressants can vary in composition through time, and this variability must be considered in any comparison of a dust suppressant batch to a fixed set of environmental criteria. Out-of-specification products should not be considered bad, but they should be scrutinized (Expert Panel, 2002).

If additional regulations are developed for dust suppressants, certain criteria should be met (Expert Panel, 2002):

1. Regulations should be practical.
2. A regulatory program to track dust suppressants should not be overwhelming in amount of required information.
3. Regulatory guidelines should benefit governments who rely on dust control in preparing State Implementation Plans (SIPs) for PM10.
4. Training needs to accompany the regulations.
5. A model, decision-tree, or expert system is needed to help decide: what to use, how much to use, for different dust applications and environmental situations (e.g., Figure 4-1).
6. Sufficient EPA-approved and standard analytical testing methods to evaluate suppressant chemical characteristics exist (Table 5-1); however, as part of the regulatory process, the types of tests to be used should be specified. Tests should be carefully selected to provide the information that is necessary to assess potential exposures to critical receptors through those media that are of concern in the area where the suppressant will be applied. The EPA's Data Quality Objective process provides the framework for assessing the type of information that is critically needed to assess the data that are required to evaluate potential exposures.
7. In addition to the tests to determine the potential environmental impacts, the regulations should contain Application Practice Guidelines (APGs). Application Practice Guidelines should include information about the types of areas where specific suppressants can be applied (predominant biota and soil types), wind velocity limitations at the time of application, specific limitations on application in proximity to water bodies, runoff channels, and residential areas, regulations on the types of containers that may be used to transport suppressants [some of this may already be in place in RCRA-inspired rules promulgated by EPA and the U.S. Department of Transportation (DOT)].

Among the questions that applicators and regulators would need answered in order to establish a list of prohibited categories of dust suppressants are (Expert Panel, 2002):

1. What formulated and in-soil concentrations should not be exceeded for specific compounds?
2. If some formulations are already known to contain harmful contaminants (such as TCDD), one could start by prohibiting or restricting suppressant formulations containing those harmful compounds. Additional detailed discussion of this approach, using restrictions found in existing environmental regulations, can be found in Section 5.2.2 above.
3. Can obviously ineffective chemical formulations, passed off as dust suppressants, be prohibited? For example, could a 5% sodium hydroxide NAOH solution in water, be applied to soil and be labeled as a dust suppressant? What can be done to prevent this? Does any existing legislation cover this situation?
4. Should there be a required consistency of dust suppressant composition? A public right-to-know may lead to a requirement for batch-to-batch consistency of composition.
5. How does one develop a reliable testing process to determine if industrial wastes or byproducts, not originally formulated for use as dust suppressants, can be effective suppressants and safely applied? Currently, manufacturers do "in-house" or contracted testing of performance and toxicity.

Additional Recommendations by the Expert Panel included the following:

1. Regulatory exclusions for certain classes of compounds should be re-examined. For example, the RCRA petroleum exclusion allows reintroduction of oily wastes into the marketplace and some of these could cycle back into the environment in dust suppressant formulations (Expert Panel, 2002).
2. Information contained in the MSDS is not sufficient to evaluate the potential environmental impacts of suppressants. Manufacturers should transparently and completely report the chemical compositions of their dust suppressant formulations. (Expert Panel, 2002). Regulations requiring more information on an MSDS should be considered.
3. Finally, regulations should prevent entry of "rogue" dust suppressants into the marketplace. A reputable dust suppressant should have a consistent formulation and independently verifiable test results demonstrating product effectiveness and low environmental impacts, and will be made by manufacturers with consistent track records in the dust suppressant business. Rogue products will typically come without test results from one-time manufacturers that are looking to get rid of a waste product. Certification and regulation are the best ways to prevent entry of rogue products into the marketplace and the environment. Reputable manufacturers would welcome a certification program (Expert Panel, 2002).

5.2.4 Response to Regulatory Uncertainty – Risk Driven Regulatory Response

While current certification and testing protocols focus on evaluating the effectiveness of a dust suppressant, more needs to be done to assess potential adverse impacts from dust suppressants and to estimate risks. Regulatory efforts should be focused first on those compounds and applications that pose the greatest risks to human health and the environment.

A risk assessment model combined with a transport and fate model is required to evaluate potential exposures and adverse risks. For the decision-maker or regulator, a decision-making model or expert system to assist in making site-specific decisions would be of value. Without these models or tools, a decision-maker could either make decisions or develop regulations that are very conservative in the use of dust suppressants. Excessively conservative regulation may not maximize the benefits to be gained from using dust suppressant products and could be challenged in the courts. Conversely, the decision-maker could allow widespread use of dust suppressants with the potential for unintended consequences. Sufficient information already exists to make a start at preventing either of the above two scenarios. After 25 years of environmental remediation efforts, risk-based concentration limits have been established for a number of compounds and compound classes. Additionally, risk assessment frameworks, such as ATSM's RBCA guidelines, may prove instructive.

An example of this approach would be a risk-benefit analysis to determine how much PM10, and PM2.5 dust is suppressed with each suppressant. Information that would be needed include the potential environmental impacts, the costs associated with the using or not using dust suppressants, the potential environmental benefits associated using dust suppressants. There also needs to be a consideration that many regions are rapidly moving toward a PM2.5 standard and away from a PM10 standard. This is due to the emerging cancer issues and cardiopulmonary disease. However, tighter standards will raise the quality of the environment and the cost associated with that environment.

5.3 Final Recommendations

The additional environmental regulations that have been developed since the 1970's when the Times Beach situation occurred have reduced the chances that dioxin-contaminated waste oil be used as dust suppressants. However, dust suppressants are not specifically regulated under any major federal legislation and there is still significant potential for other environmentally hazardous materials to be used.

1. In the SHORT TERM, the chances that hazardous materials are used can be reduced by:
   a. Establishing an interagency working group that evaluates the cross media and cross jurisdictional issues associated with the use of dust suppressants.
   b. Closing regulatory loopholes that allow entry of unlimited industrial wastes into the environment when they are classified as dust suppressants. All industrial waste must be sampled prior to use.
   c. Requiring complete disclosure of all dust suppressant constituents through independent standardized testing of dust suppressant formulations. Testing should recur periodically and whenever the formulation changes manufacturers using waste products must test each batch.
   d. Developing and employ a risk-based expert system (or decision tree) to prohibit or severely restrict the concentrations of environmental contaminants known to be persistent and harmful.
   e. Developing conservative guidelines (APGs) for application of different types of dust suppressants in major broad ecosystem categories.
   f. Requiring standardized biological toxicity testing for major dust suppressant types.
   g. Requiring training for all personnel who use and regulate dust suppressants.
2. The risks associated with dust suppressant use can be reduced in the LONG TERM by:
   a. Encouraging the development of dust suppressant formulations that are long-lived and environmentally benign.
   b. Continuing to develop scientific information about the environmental impacts of dust suppressants.
   c. Using information developed in 2a and 2b to update risk-based regulations and application and management practices.

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Appendix A

Literature Review

u n i v e r s i t y   o f   n e v a d a ,   l a s   v e g a s

Literature Review

Dust Suppression and Its Environmental Impacts

Prepared for the Expert Panel on

Potential Environmental Impacts of Dust Suppressants:

"Avoiding Another Times Beach"

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Dust Suppression and Its Environmental Impacts

In recent years, studies on fugitive dust control have significantly increased in the United States. This literature review summarizes the current status of the use of dust suppressants with respect to types of materials used, application rates, effectiveness, environmental impacts, and costs. In 1991, 75-80% of all dust suppressants used were chlorides and salt brine products, 5-10% were ligninsulfonates, and 10-15% were petroleum-based products (Travnik, 1991). There has been much research on the effectiveness of dust suppressants; however, little information is available on the potential environmental impacts and costs of these compounds. The categories of dust suppressants most frequently used to control fugitive dust are listed in Table 1.

Table 1 – Most commonly used dust suppressants (modified from Bolander, 1999a)

Suppressant Type	Products
Water	Fresh, reclaimed, and seawater
Salts and brines	Calcium chloride, and magnesium chloride
Petroleum-based organics	Asphalt emulsion, cutback solvents, dust oils, modified asphalt emulsions
Non-petroleum based organics	Vegetable oil, molasses, animal fats, ligninsulfonate, and tall oil emulsions
Synthetic polymers	Polyvinyl acetate, vinyl acrylic
Electrochemical products	Enzymes, ionic products (e.g. ammonium chloride), sulfonated oils
Clay additives	Bentonite, montmorillonite
Mulch and fiber mixtures	Paper mulch with gypsum binder, wood fiber mulch mixed with brome seed

Water

Surface watering is an immediate, inexpensive short-term solution to control dust (Gebhart *et al.*, 1999). Water suppresses dust by agglomerating surface particles. However, the effectiveness depends upon temperature and humidity. Water can be effective for a period as short as half an hour and as long as twelve hours (Foley *et al.*, 1996, Schwendeman, 1981). Thompson (1990) found water was 85% effective in controlling dust in coal mines. Water effectiveness in controlling dust in roads and dirty beds has been estimated to be 40% (Travnik, 1991, Foley *et al.*, 1996). Water has little residual effect. Once applied it evaporates quickly, especially in hot, dry climates (Kestner, 1989a). Cowherd *et al.* (1989) reports that dust suppression efficiency decays from 100% to 0% in a very short time. Water is most efficient on sites where vehicular traffic is limited. Seawater is more effective than fresh water as a suppressant owing to the presence of salts.

Salts and Brines

The most widely used compounds in this category of suppressants are magnesium chloride ($MgCl_2$), and calcium chloride ($CaCl_2$) (Sanders and Addo, 1993). Salts suppress dust by attracting moisture from the air, which keeps the surface humid (Foley *et al.*, 1996). Sodium chloride is not a very useful suppressant in arid regions because it only absorbs water when the humidity exceeds 75%.

Calcium chloride is a by-product of the ammonia-soda (Solvay) process and a joint product from natural salt brines. The ability of calcium chloride to absorb water from the air is a function of the relative humidity and ambient temperature. Calcium chloride is more effective in places that have high humidity and low temperatures (Foley *et al.,* 1996). Bolander (1999a) reports that calcium chloride at a temperature of 25°C, for example, starts to absorb water at 29% relative humidity, and at 38°C it starts to absorb water at 20% relative humidity.

Magnesium chloride is created either from seawater evaporation or from industrial by-products prepared from magnesium ammonium chloride hexahydrate in the presence of HCl. It is a more effective salt than calcium chloride because it increases the surface tension and has a harder surface when it is dry (Foley *et al.*, 1996). It has a low freezing point (-34°C) and serves as a de-icing agent. Magnesium chloride needs a minimum of 32% humidity to absorb water from the air independent of the temperature. It remains more hygroscopic at higher temperature than calcium chloride and is therefore more suitable to dry climates (Langdon and Williamson, 1983). Compared to water, salts are more effective in controlling dust if sufficient moisture is available. The effectiveness of salts to control dust significantly decreases with time. The dust abatement properties of magnesium chloride have been found to last about 12 weeks (Monlux, 1993). Another problem with salts is that they migrate readily in the environment. DeCastro *et al.* (1996) modeled the movement of road stabilization additives of road surface to determine how long the additives remained effective. They found that calcium and magnesium chlorides are easily carried from the soil. Table 2 summarizes several studies on the effectiveness of salts in minimizing fugitive dust.

Table 2 - Effectiveness of salts as dust suppressants

Suppressant Type	Effectiveness	Reference
Calcium chloride	55% aggregate retention as compared to control.	Sanders and Addo, 1993
Magnesium chloride	Compared to control, retained 77% of the aggregates.	Sanders and Addo, 1993
Magnesium chloride sprayed during street sweeping	26% $MgCl_2$ solution reduced dust by 92%. 60% $MgCl_2$ solution reduced dust by 58%.	Satterfield and Ono, 1996
Calcium chloride, magnesium chloride, and ligninsulfonate	Reduced fugitive dust by 50-70% Increased aggregate retention by 42-61%. Under low humidity and high temperatures ligninsulfonate was more effective than salts.	Sanders *et al.*, 1997
Petro-tac, Coherex, Soil-Sement Generic Petroleum Resin, and Calcium chloride	95% effective after application to control dust particles < 15, 10, and 2.5 μm. Over a 30-day period, effectiveness decreased as much as 50% and as little as 10%.	Muleski and Cowherd, 1987

Organic Non-Petroleum Products

Organic non-petroleum products include ligninsulfonate, tall (pine) oil, vegetable derivatives, and molasses. Table 3 lists major studies performed on the effectiveness of non-petroleum based products and polymers to abate dust.

Ligninsulfonate is derived from the sulfite pulping process in the paper industry where wood is processed using sulfuric acid to break down the wood fiber. Lignin is a complex amorphous aromatic polymer that acts as a binder for the cellulose fibers in wood. It represents 17-33% dry weight of the wood and is resistant to hydrolysis (Kirk *et al.*, 1980). In the wood pulping process, the wood fiber is the valuable product and the pulp liquor, which contains lignin, is wasted. This waste liquor is processed further and neutralized prior to being used as a dust palliative. Ligninsulfonates act as a weak cement by binding the soil particles together. Ligninsulfonates remains effective during long dry periods with low humidity. They also tend to remain plastic, allowing reshaping and traffic compaction when applied to soils with high amounts of clay. The effectiveness of ligninsulfonates may be reduced or completely destroyed in the presence of heavy rain because of the solubility of these products in water (Bolander, 1999a).

Table 3 – Effectiveness of non-petroleum based and polymer products as dust suppressants

Suppressant Type	Effectiveness	Reference
Sprinkling of 40 ml/m^2/day of canola oil on swine barns	Reduction of 84% in dust concentration	Senthilselvan *et al.*, 1997
Lignin used on unpaved roads	63% more aggregates retained as compared to untreated sections.	Sanders and Addo, 1993
Ligninsulfonate used to control dust fungi and endotoxins in livestock housing facilities	Mass of dust, fungi, and endotoxins were reduced 6, 4, and 3 fold respectively, when ligninsulfonate solutions (27-39%) were applied.	Breum *et al.*, 1999
Synthetic polymer and tall oil	Increased tensile strength of soil. Strength dependent upon curing time.	Bolander, 1999b
Polymer emulsion (PE)	Initial = 94%, After 3 months = 96% After 11 months = 85%	Gilles *et al.*, 1997
Polymer Emulsion (PEP)	Initial = 99%, After 3 months = 72% After 11 months = 49%	Gilles *et al.*, 1997
Biocatalyst stabilizer (BS)	Initial = 33% - 5%, After 3 months = 0% After 11 months = 0%	Gilles *et al.*, 1997

Tall oil is a by-product of the wood pulp industry recovered from pinewood in the sulfate Kraft paper process. It contains rosin, oleic and linoleic acids. Tall oil is used in flotation agents, greases, paint alkyd resins, linoleum, soaps, fungicides, asphalt emulsions, rubber formulations, cutting oils, and sulfonated oils (Merck Index, 1989). Tall oil promotes adherence between soil particles, however, its surface binding actions can be limited or destroyed if this product is exposed to long–term rainfall. Increasing the residual content of tall oil was found to promote an increase in the tensile strength and resistance to periodic wetting or wet freeze of these products (Bolander, 1999a).

Vegetable oils are extracts from the seeds, fruit, or nuts of plants and are generally a mixture of glycerides (Lewis, 1993). Some examples of vegetable oils are canola oil, soybean oil, cottonseed oil, and linseed oil. Vegetable oils abate dust by promoting agglomeration of the surface particles.

Molasses is the thick liquid left after sucrose has been removed from the mother liquor in sugar manufacturing. It contains approximately 20% sucrose, 20% reducing sugar, 10% ash, 20% organic non-sugar, and 20 % water (Lewis, 1993). This type of dust suppressant provides temporary binding to the surface particles (Bolander, 1999a). Additional applications are necessary during the year, mainly after heavy rains, because molasses will dissolve in water (Sanders and Addo, 1993).

Synthetic Polymer Products

The adhesive property of synthetic polymers promotes the binding of soil particles. Products such as polyvinyl acetate and vinyl acrylic are used in synthetic polymers. In the laboratory, Bolander (1999b) investigated the effect of adding synthetic polymers to dense-graded aggregate. The results show that polymers increased the tensile strength of clays on typical roads and trails up to ten times. Synthetic polymer emulsions did not change the compacted dry density. The tests showed that synthetic polymers applied in wet climates would tend to break down if exposed to moisture or freezing for an increased time.

Organic Petroleum Products

Organic petroleum-based materials consist of products derived from petroleum. These include used oils, solvents, cutback solvents, asphalt emulsions, dust oils, and tars. These products agglomerate fine particles, generally forming a coherent surface that holds the soil particles in place. Petroleum-based products are not water-soluble or prone to evaporation (Travnik, 1991). They generally resist being washed away, but oil is not held tightly by most soils and can be leached away by rain. Langdon and Williamson (1983) divided petroleum based products into different categories: cutbacks (e.g. DO-1, DO-2, DO-3, and DO-6KF), emulsions (e.g. DO-8, Coherex, and CSS-1), and others (e.g. DO-4, DO-6, DO-6P). Table 4 lists studies on the effectiveness of petroleum-based products.

Table 4 – Effectiveness of petroleum-based products as dust suppressants

Suppressant Type	Effectiveness	Reference
Oiling (petroleum-based)	50 to 98%	Foley *et al.*, 1996
Water (0.44 gal/yd^2), petroleum resin (0.84 gal/yd^2), and emulsified asphalt (0.71 gal/yd^2).	50% reduction in particulate emissions for at least one month. Reapplication increased suppressant lifetime. Lifetime decreased with decreasing particle size.	Muleski *et al.*, 1983
Emulsion of hydrocarbon-based textile oil applied to bulk-stored wheat, corn, and soybeans	50% reduction (0.04%emulsion) 92% reduction (0.07% emulsion) Similar results found for rapeseed and oils.	Jayas *et al.*, 1992
Emulsified petroleum resin, petroleum residue,	In general, an increase in water content during suppressant application improved cohesive strength of the aggregates	Lane *et al.*, 1983
Non-hazardous crude oil (NHCO)	Very effective in suppressing dust for a long period; after 11 months = 92% effective	Gilles *et al.*, 1997

Electro-Chemical Products

These suppressants are usually derived from sulphonated petroleum and highly ionic products. This group of products includes sulphonated oils, enzymes, and ammonium chloride. The electro-chemical stabilizers work by expelling adsorbed water from the soil which decreases air voids and increases compaction (Foley *et al.*, 1996). A disadvantage of these products is the dependence upon the clay mineralogy and therefore they are only effective when specific minerals are present.

Clay Additives

Clay additives are composed of silica oxide tetrahedra (SiO_4) and alumina hydroxide octahedra ($Al(OH)_6$) (Scholen, 1995). This type of dust suppressant agglomerates fine dust particles and increases the strength of the material under dry conditions. Clay additives provide some tensile strength in warm dry climates; however, increasing the moisture contents promotes loss of their tensile strength (Bolander, 1999b).

Others

In addition to the categories listed in Table 1, several other suppressants and technologies have been used to abate dust. Foley *et al.* (1996) reported that dust emissions on unpaved roads could be reduced significantly even with small reductions in vehicle speed. Over 40% of the dust was reduced when vehicle speed was decreased from 47 to 31 miles per hour and over 50% was reduced by decreasing vehicle speed from 40 to19 miles per hour. Applying an asphalt emulsion (sealing) or paving roads has been shown to reduce dust by 95-100%. Table 5 reports various treatments that have been successfully applied to unpaved roads to reduce dust.

Table 5 – Effectiveness of various treatments used to suppress dust

Suppressant Type	Effectiveness	Reference
Sealing or bound paving	95-100%	Foley *et al.*, 1996
Chemical dust suppression	High initial efficiency; it decays to zero after several months.	Cowherd *et al.*, 1989
Clay additive, chlorides, enzymes, and sulfonate	Increased tensile strength for moisture contents less than 5%.	Bolander, 1999b
Chemical dust suppression	40-98%	Foley *et al.*, 1996
Reduction of vehicle speed: from 47 mile/h to 31 mile/h from 40 mile/h to 19 mile/h	 40-75% 50-85%	Foley *et al.*, 1996

Application Rates

Table 6 shows typical application rates for several types of suppressants. Typical application frequency for most suppressants is 1-2 times per year, except for clay additives for which the application rate is every 5 years.

Table 6 – Application rates and frequencies of dust suppressants

Suppressant	Range of Application Rate	Application Frequency	Reference
Calcium chloride	0.8-2.0 lbs/yd^2 (dry salt) 0.2 –0.5 gal/yd^2 (solution)	1-2 times per year	Hoover, 1981; Bolander, 1999a, RTAC, 1987; Heffner, 1997, DeCastro *et al.*, 1996 Sanders and Addo, 1993
Mg chloride	0.3-0.5 gal/yd^2	1-2 times per year	Bolander, 1999a; RTAC, 1987 Heffner, 1997, DeCastro *et al.*, 1996 Sanders and Addo, 1993
Ligninsulfonate	0.2 – 1.5 gal/yd^2 (liquid) 1.0-2.0 lbs/yd ^{2} (powder)	1-2 times per year	Langdon and Williamson, 1983, Hoover, 1981; Bolander, 1999a, RTAC, 1987, Sanders and Addo, 1993
	40-50% residual concentrate applied diluted 1:4 w/water at 5.1 gal/yd^2	every two years	Bolander, 1999a
Vegetable oils	Typically 0.24-0.5 gal/yd^2	1 time per year	Bolander, 1999a
Oils	0.1-1.0 gal/yd^2	1 time per year	Hoover, 1981; Bolander, 1999a RTAC, 1987
Arcadias (DO-1, 2, 3), DO-4, DO-6PA, DO-8, CSS-1	0.2 – 0.5 gal/yd^2	--------	Langdon and Williamson, 1983
Coherex	0.5-1.5 gal/yd^2	--------	Langdon and Williamson, 1983 Hoover, 1981
Organic Binders application rate	Liquid: 0.5 gal/yd^2 Dry powder: 1-2 lb/yd^2	--------	Hoover, 1981
Polybind Acrylic (co-polymer resin emulsion)	40 gal/acre of a 1:20 water dilution.	--------	Hoover, 1981
Synthetic polymer derivatives	40-50% residual concentrate applied diluted 1:9 w/water at 0.50 gal/yd^2.	Once every two years	Bolander, 1999a
Clay additives	Typical application rate is 1-3% by dry weight.	Once every 5 years	Bolander, 1999a
Water	0.5-4% water applied to conveyor belt systems.	As often as needed	Goldbeck, 1997
Bituminous and tars or resinous adhesives	0.1-1.0 gal/yd^2 depending on road surface condition and dilution.	1-2 times per year	Sanders and Addo, 1993

Environmental Impacts

Salts and Brines

The potential environmental impacts of salts and brines include corrosion of vehicles and concrete and creation of a slippery surfaces when wet (Foley *et al.*, 1996). Calcium and magnesium chloride are highly soluble and are capable of moving with water through soil as a leachate contaminating groundwater (Heffner, 1997). They can also move as runoff and the dissociated calcium, magnesium and chloride ions can drain into lakes, rivers, streams, and ponds (Demers and Sage, 1990). High concentrations of salts cause high soil salinity and may be toxic to plants (Hanes *et al.*, 1970 and 1976); Sanders and Addo; 1993, Foley *et al.* 1996; RTAC, 1987). However, no conclusive studies have been performed to evaluate the effects of calcium and magnesium chloride on plants. Salts concentrations greater than 400 ppm have been found to be toxic to trout (Golden, 1991 and Foley *et al.*, 1996). Concentrations greater than 1,830 mg/L killed Daphnia and crustaceans fish (Sanders and Addo, 1993; Anderson, 1984).

Organic Non-Petroleum Products

The toxicity of ligninsulfonates to rainbow trout has been investigated. The 48-hour LC_{50} (concentration of ligninsulfonates which would be lethal to 50 percent of the tested population within 48 hours) value for ligninsulfonates was found to be 7,300 mg/L. A mortality of 50% was achieved for rainbow trout exposed to 2,500 mg/L ligninsulfonate for 275 hours. For concentrations equal to or higher than 2,500 mg/L rainbow trout showed loss of reaction to unexpected movements, rapid and irregular breathing, and finally loss of coordination before death (Roald, 1977a; Roald, 1977b). It has been found that calcium and sodium ligninsulfonate negatively affect the colon of guinea pigs causing weight gain and producing ulceration in those animals (Watt and Marcus, 1974 and 1976). Reduced biological activity has been observed in water due to excessive discoloration caused by the introduction of ligninsulfonates (Singer *et al.*, 1982; Raabe, 1968; Heffner, 1997; Foley *et al.*, 1996). Ligninsulfonate compounds were reported not to prevent seed germination in the areas where it was applied (Singer *et al.*, 1982). It has been suggested that ligninsulfonate is the most environmentally compatible dust suppressant (Schwendeman, 1981).

Organic Petroleum Products

Organic petroleum based products are considered long lasting products for dust suppression. However, since some of them are oil waste, their environmental impacts may be high. Waste oil used as dust suppressant is typically associated with contaminants that are known to be either toxic or carcinogenic (RTAC, 1987; Metzler, 1985; USEPA 1984, Foley *et al.*, 1996). The accidental introduction of a petroleum based dust suppressant (Coherex) into a stream in Southern Pennsylvania was found to affect fish and benthic macroinvertebrate communities and to kill an unknown number of fish (Ettinger, 1987). Organic petroleum-based products have also been found to be toxic to avian Mallard eggs. When the eggs were exposed to a concentration of 0.5 μL/egg of the product 60% mortality was observed by 18 days of development (Hoffman and Eastin, 1981).

Electro-Chemical Product

Electro-chemical products are thought to have minimum impact in the environment when used in their diluted form. However, it has been observed that vegetation could not be established in areas treated with sulfonated petroleum products (Foley *et al.*, 1996).

Costs

Reported costs for bulk dust suppressants and dust suppressant application are shown in Table 7. It is difficult to compare application costs of dust suppressants because of the different materials and dilution ratios used. From the data reported in the literature, bulk ligninsulfonate is about five times less expensive than Arcadias, Coherex, and CSS-1. The reported cost per acre for dust suppressant application reveals a wide range for different products used. In general, Chlortex (magnesium chloride) is the least expensive dust suppressant followed by ligninsulfonate, Pennzsuppress D (petroleum resin), and Plastex (paper mulch + gypsum binder).

Table 7 – Reported dust suppressant costs

Suppressants	Bulk Product Cost	Reference
Calcium Chloride	$114.00/ton-$273.00/ton $195 per dry ton	Langdon and Williams, 1983 Hoover, 1981
Magnesium chloride	$67.00/ton-182 gal/ton	Langdon and Williams, 1983
Ligninsulfonate	$40.00/ton	Langdon and Williams, 1983
Arcadia DO-1 Arcadia DO-2 Arcadia DO-4 Arcadia DO-6KF Arcadia DO-6PA Arcadia DO-8 Coherex (concentrate) CSS-1	$210.00/ton $210.00/ton $175.00/ton $215.00/ton $152.75/ton $150.00/ton $285.60/ton $150.00/ton	Langdon and Williams, 1983 Langdon and Williams, 1983 Langdon and Williams, 1983 Langdon and Williams, 1983 Langdon and Williams, 1983 Langdon and Williams, 1983 Langdon and Williams, 1983 Langdon and Williams, 1983

Suppressants	$ Cost/acre	Reference
Chlorides	$283-$2,023/ acre	Foley *et al.*, 1996
Calcium chloride cost/mile at a 21-ft width and 2 lb/yd^2	£165	Hoover, 1981
Chlortex ($MgCl_2$)	$600/acre	James *et al.*, 1999
ESI-Duster Dustac (Ligninsulfonate) Ligninsulfonate cost/mile length and 21-ft width	$9800 (bag of 50 lbs) $750/acre £350 ($800-$900)	Langdon and Williams, 1983 James *et al.*, 1999 Hoover, 1981
Organic Binders Petroleum Binder PennzsuppressD (petroleum resin)	$1011-$24282/acre $2023-$5261/acre $800/acre	Foley *et al.*, 1996 Foley *et al.*, 1996 James *et al.*, 1999
Surfactants Polymeric Binders Polytex (acrylic polymer emulsion) Soil-Sement (acrylic polymer emulsion)	< $1619/acre $6475/acre $700/acre $1050/acre	Foley *et al.*, 1996 Foley *et al.*, 1996 James *et al.*, 1999 James *et al.*, 1999
Plastex (paper mulch + gypsum binder) Hydroseed (wood fiber mulch + brome seed) Recycled Aggregate	$850/acre $1,200/acre $13,500/acre	James *et al.*, 1999 James *et al.*, 1999 James *et al.*, 1999
Ionic Stabilizers	$1,214-$4,047/acre	Foley *et al.*, 1996
Microbiological Binders	$3,642/acre	Foley *et al.*, 1996

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Appendix B

Fact Sheets for Verification Programs and Guidelines

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Environmental Technology Verification Program

California Environmental Technology Certification Program (CalCert)

May 2002

Responsible Agency

California Environmental Protection Agency

Environmental Technology Certification Program

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References

www.calepa.ca.gov/calcert

Disclaimer: This fact sheet was prepared by the UNLV organizing committee of the "Expert Panel on Environmental Impacts of Dust Suppressants" based on information contained in the above reference.

What are the goals of CalCert?

The California Environmental Technology Certification Program (CalCert) is the umbrella program for all technology certifications within the California Environmental Protection Agency (Cal/EPA). CalCert is a voluntary program for manufacturers seeking independent evaluation and certification of the performance of their environmental technology including dust suppressants. Certification efforts within the California Environmental Protection Agency (Cal/EPA) are authorized under section 71031 of the California Public Resources Code.

Who created CalCert?

In 1993, Cal/EPA and the Trade and Commerce Agency created the California Environmental Technology Partnership (CETP), a public-private partnership comprising of representatives from the financial and legal communities, public interest groups, the technology industry, laboratories, academia, and others. Among several strategies to strengthen California's environmental technology industry, CETP recommended Cal/EPA institute a voluntary statewide certification program for environmental technologies. Following enactment of Assembly Bill 2060 (Chapter 429, Statutes of 1993) and Assembly Bill 3215 (Chapter 412, Statutes of 1994), Cal/EPA implemented two voluntary pilot certification projects: one for hazardous waste-related technologies at the Department of Toxic Substances Control and another for air pollution control at the Air Resources Board. After two successful pilot programs, and enactment of Assembly Bill 1943 (Chapter 367, Statutes of 1996), CalCert expanded to address a broad array of technologies that prevent, treat, or cleanup pollution in air, water, and soil. The program seeks to maintain and advance high environmental standards by assuring that the best possible environmental technology is available to meet those high standards.

Who provides the performance verification?

Technology developers and manufactures define their performance claims and provide supporting documentation; Cal/EPA reviews that information and, where necessary, requires additional testing to verify the claims. Participation in the program generally involves four stages: eligibility request, application and data review, evaluation of test data, evaluation report, certification decision or statement, and certificate issuance.

Who may apply for verification?

Equipment, processes or products eligible for certification must have an environmental benefit, be commonly used or readily available, and not pose a significant potential hazard to public safety and the environment. Furthermore, applicants for the program must demonstrate that they can consistently and reliably produce technologies that perform at least as well as those previously considered in the CalCert evaluations.

What is needed to apply?

To apply to the program the applicant should hold manufacturing rights to the technology. The technology should be commercially ready with available quality testing data to support performance claim. The first step to have a technology certified is to request for a determination of eligibility. After CalCert has received the Eligibility Request and determined that the technology is eligible for California Certification, the applicant will receive an Application for Certification and will be invited to meet the Cal/EPA evaluation team in a scoping meeting. The evaluation team will meet with the applicant to discuss the scope, duration, and cost of the evaluation. The cost of evaluating the technology will vary depending on the scope of effort needed to evaluate it.

Who evaluates the application for verification?

Cal/EPA's staff which consist of scientists and engineers from the Air Resources Board, State Water Resources Control Board, Department of Toxic Substances Control, Integrated Waste Management Board, Department of Pesticide Regulation, and Office of Environmental Health Hazard Assessment evaluate the technologies. When necessary, CalCert also partners with California's universities and laboratories.

What are the criteria for verification?

The products eligible for certification must have an environmental benefit, be commonly-used or ready available, and not pose a significant potential hazard to public safety and the environment. The evaluation is based on a detailed review of validation materials submitted by the manufacturer, including original data generated by independent and in-house laboratories, whose findings are considered reliable by Cal/EPA staff.

What is the proof of verification?

A certificate signed by California's Secretary for Environmental Protection is awarded. The issuance of the evaluation report and certificate authorizes the use of the certified technology seal on certified products. The CalCert's certification is valid for three years. Certification does not imply that the technology has been permitted by any application.

What dust suppressants have been certified by CalCert?

In January, 2001 the California Environmental Protection Agency staff recommended certification of PennzSuppress® D, an organic based product from the Pennzoil–Quaker State Company, as a dust suppressant. The certification is valid for three years.

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Application of Oil Field Brine Regulations

Michigan

May 2002

Responsible Agency

Michigan Department of Environmental Quality Waste Management Division

Contacts

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References

www.deq.state.mi.us/documents/deq-wmd-gwp-Rule2215OilFieldBrine-1.pdf

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What are oil field brines?

Brines that are produced at oil and gas well facilities. These brines are used for dust control and soil stabilization.

How does Michigan regulate the application of oil field brines?

The Michigan Department of Environmental Quality through regulation R324.705 (3), Part 615, Supervisor of Wells, of Act 451 requires a permit for the application of brines for ice and dust control and soil stabilization. Pursuant to this general permit, applicant of brine may begin as soon as the conditions of the general permit have been met. All maintenance, operations, and monitoring of brine application must comply with the conditions set forth in this general permit by the Department. Failure to comply with the terms and provisions of this general permit may result in civil and/or criminal penalties as provided in Part 31.

What are the requirements of the Michigan oil field brine regulations?

The requirements for oil field application as a dust suppressant and road stabilizers include:

1. No application can occur until a certificate of authorization of coverage on a form approved by the Department is issued.
2. Only brine that meets the requirements of R 324.705 (3) of Part 615, as amended, may be used for ice and dust control and soil stabilization on land, such as roads, parking lots and other land.
3. To prevent other contaminants from becoming part of the brine discharge, brine shall be applied with vehicular equipment dedicated to this use or hauling fresh water.
4. Brine shall be applied for dust control and soil stabilization in accordance with the following criteria: (a) brine may be applied to the surface of roads, parking lots, and other land up to four applications each year south of the southern county lines of Madison, Lake, Osceola, Clare, Cladwin, and Arenac Counties. Counties north of this line may apply only three times per year; (b) brine may be applied to the surface of roads being used as a detour and on other areas during construction as necessary to control dust up to six applications each year; (c) brine must be applied to roads and parking areas with equipment described by the term "spreader bar". This device shall be constructed to deliver a uniform application of brine over a width of at least eight feet; (d) brine may be applied at a maximum rate of 1,500 gallons per lane mile of road or 1,250 gallons per acre of land, provided runoff does not occur; (e) Brine shall be applied in a manner to prevent runoff.

5. Brine shall be applied for dust control and soil stabilization in accordance with the following criteria: (a) brine may be applied to the surface of roads, parking lots, and other land up to four applications each year south of the southern county lines of Madison, Lake, Osceola, Clare, Cladwin, and Arenac Counties. Counties north of this line may apply only three times per year; (b) brine may be applied to the surface of roads being used as a detour and on other areas during construction as necessary to control dust up to six applications each year; (c) brine must be applied to roads and parking areas with equipment described by the term "spreader bar". This device shall be constructed to deliver a uniform application of brine over a width of at least eight feet; (d) brine may be applied at a maximum rate of 1,500 gallons per lane mile of road or 1,250 gallons per acre of land, provided runoff does not occur; (e) Brine shall be applied in a manner to prevent runoff.
6. Brine shall be applied for ice control in accordance with the following criteria: (a) brine shall be applied only on paved roads or paved parking lots; (b) brine shall be applied at a maximum rate of 500 gallons per lane mile of road or 400 gallons per acre of land; (c) brine must be applied only when the air temperature is above 20°F, unless used for pre-wetting solid salt; (d) brine must be applied with equipment designed to direct the discharge to the center of the pavement or high sides of curves.
7. Brine application measurement methods must be used to ensure that the brine application rates are within described in this general permit.
8. Brine shall not be applied at a location determined to be a site of environmental contamination for chlorides.
9. Records shall be kept of the use of brine and should contain driver's name, location, loading date, source of brine, date of brine, application, and gallons applied. Records should be kept by the application for a period of three calendar years after application and should be available for inspection by the Department or a peace officer.

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Interim Guidelines for Dust Palliative Use in Clark County

Nevada

May, 2002

Responsible Agency

Clark County Department of Air Quality Management

Nevada Department of Environmental Protection (NDEP)

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What are the goals of the Interim Guidelines?

The Interim Guidelines aim to facilitate the implementation of air quality fugitive dust controls in a manner that prevents human exposure to harmful constituents and protects soil and water resources while achieving air quality objectives. The guidelines outline practices and procedures that should be followed to ensure compliance with the new Clark County Air Quality regulations (effective January 1, 2001) in a manner that minimizes environmental impacts.

Who created the Interim Guidelines?

A working group was formed in 2000 to draft interim guidelines for the use of dust palliatives in Clark County, Nevada. The working group, formed in response to direction from the Nevada Legislature to provide recommendations regarding the use of dust suppressants in the Las Vegas Valley, was composed of air and water quality professionals from state and local agencies including the Southern Nevada Water Authority, Clark County Health District, Clark County Comprehensive Planning, Clark County Regional Flood Control District, City of Las Vegas, UNLV Department of Civil and Environmental Engineering and the Nevada Department of Environmental Protection (NDEP).

What were the bases for the guidelines?

The working group considered existing state regulations and codes that could apply to the use of dust palliatives and the protection of human health and environment. However, because the environmental impacts of the various dust suppressant products have not been fully evaluated, the working group decided that it would not be prudent to recommend or deny the use of dust palliatives based solely on these regulations. Thus, the group also considered currently available scientific information. The guidelines are expected to be revised in the future to reflect public comments, advanced thinking of the working group, and changing technology of the construction industry. A research project, currently underway at UNLV and funded by local agencies, will provide additional scientific evaluation of the water quality impacts of dust palliatives. The Dust Palliative Working group will continue to meet on a regular basis to evaluate pertinent information relating to the environmental impacts of dust palliative use. It is envisioned that a permanent policy or set of regulations will be developed if such action is deemed necessary and that this policy/set of regulations will be more comprehensive in scope.

What is the content of the guidelines?

(a) The use of organic petroleum products, deliquescent/hygroscopic salts, and lignin-based palliatives are highly discouraged within twenty (20) yards of open bodies of water, including lakes, streams, canals, natural wastes and flood control channels, and drinking water well-heads. This buffer zone is intended to prevent leachate from these palliatives from reaching an open body of water or a ground water aquifer;

(b) The use of surfactants containing phosphates is highly discouraged because of adverse impacts on water quality. Surfactants by themselves are not allowed for use as a dust palliative because they do not form a durable soil surface. Non-phosphate surfactants may be combined with dust palliatives to assist penetration of dust palliatives into hydrophobic soils;

(c) Any person who applies any pesticide material with a dust palliative is required to hold a valid pesticide applicators license issued by the State of Nevada;

(d) Fiber mulch products should not be used for use as a dust palliative in traffic areas. These products do not hold up well for traffic use;

(e) Use of deliquescent/hygroscopic salts should be limited to magnesium chloride and only used for short-term (less than one year) stabilization of unpaved roads. Treated unpaved roads must be periodically maintained with additional applications of water and magnesium chloride as needed to maintain effectiveness. Magnesium chloride is not effective, even with product reapplication, for periods of more than one year. Magnesium chloride should not be used on trafficked areas within twenty (20) yards of an open body of water, a drinking water well-head, natural or artificial drainage channel, or other surface water feature;

(f) Organic petroleum products, including modified and unmodified asphalt emulsions, should not be used on non-traffic areas;

(g) Use of deliquescent/hygroscopic salts is highly discouraged for non-traffic stabilization. These salts require frequent re-watering to be effective in the Las Vegas Valley;

(h) Lignin-based palliatives are not recommended for non-traffic stabilization. Surface binding action of lignin-based palliatives may be reduced or completely destroyed when heavy rains occur;

(i) Suppressants containing banned pesticides, restricted pesticides, dioxin, PCBs, and asbestos should never be applied.

The guidelines also contain recommendations on the types of suppressants to be applied to specific areas as well as dilution and application rates.

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Dirt & Gravel Roads Maintenance (DGRM) Program

Pennsylvania

Responsible Agency

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References

www.mri.psu.edu

Disclaimer: This fact sheet was prepared by the UNLV organizing committee of the "Expert Panel on Environmental Impacts of Dust Suppressants" based on information contained in the above reference.

What is the DGRP Program?

Pennsylvania's State Conservation Commission Dirt & Gravel Roads Pollution Prevention Program is a grant program. It is an innovative effort to educate the public about pollution problems from roads and fund "environmentally sound" maintenance of unpaved roadways that have been identified as sources of dust and sediment pollution. Signed into law in April 1997 as Section 9106 of the PA Vehicle Code (§ 9106), the program is based on the principle that informed local control is the most effective way to stop pollution. The program created a dedicated, non-lapsing fund - $4 million per year – to provide money to local communities for education and local road maintenance by way of streamlined appropriations to local conservation districts for use by local road maintenance entities under the environmental guidance of a local Quality Assurance Boards (QABs). Section 91060(f) (7) of the Vehicle code requires Quality Assurance Boards to adopt standards that prohibit the use of environmentally harmful materials and practices in dirt and gravel road maintenance. Implicit in these standards, are regulations for the control of dust suppressant application. Local municipalities and state agencies that maintain public dirt or gravel roads are eligible to receive the grant funds.

What are the goals of the DGRM Program?

The Pennsylvania Protocol has four main objectives:

1. To prohibit the use of environmental harmful materials or practices on Dirt and Gravel Roads Maintenance Program projects.
2. To recommend procedures that will satisfy the program's non-pollution requirement with a minimum of paperwork.
3. To provide Conservation Districts with a statewide information exchange system which will allow them to establish eligibility of local products.
4. To employ a product clearance system and notify conservation districts of products determined to be eligible for statewide use.

What are the provisions of the program?

The Interim program's requirements for compliance with the non-pollution criteria are currently in the draft form. In general, the guidelines call for compliance with all existing laws and conditions via a purchase contracting process, rather than a regulatory process. Vendors would comply voluntarily as part of their sales agreement. It is anticipated that such an approach would minimize challenges in court by products manufacturers.

The program places the responsibility of proving that a product meets Pennsylvania's existing laws on the manufacturer. It is expected that the adoption of such practice will minimize paperwork because it will be done once for each covered product. Participants may purchase products, listed as eligible and be reimbursed provided they have an active liability contract with the manufacturer and the conservation districts establishes that the product is approved. The program will be applied statewide to insure that individual QABs will not be sued for refusal to buy certain products.

Who provides the performance verification?

It is the responsibility of the vendor, as a condition of sale, to prove that the commercial product does not degrade the environment or create hazards in accordance with the standards of the DGRP program. The vendor has to have an EPA-Certified laboratory test the product according to the specified test procedures. Laboratory personnel complete the tests, certify the results, and report the eligibility of the product for program funding in writing. The Conservation Commission (SCC) will review the submission to confirm the certificate as authentic. The manufacturer must also (a) certify that the product submitted for testing is representative of the product as marked, (b) provide a copy of the certificate of eligibility to the conservation district, (c) provide the participant with a signed copy of a liability contract assuming all liability for supply, transport, application and curing of the product. The product must also comply with Pennsylvania's environmental laws: 25 PA Code 93.6 - Waste Discharge to Water; 25 PA Code 93.7c - Water Quality Criteria by Substance; 25 PA Code - Criteria by Toxic Substances; 25 PA Code 121.1 – Air Quality Criteria; 25 PA Code 124 - Air Quality Hazardous; 25 PA Code 129.64 Air Quality Cut Back Asphalts. In addition, the program encourages the use of by- and co-products if they are deemed to have non-pollution characteristics. Co-products that have "beneficial use" permits issued are considered as effective as commercial products if they meet the non-pollution criteria.

What tests are required from the applicant?

Labeled products, such as herbicides, do not require further testing and are acceptable according to the label restrictions. Plant and seeds are covered by both, the State and Federal Noxious weed laws. All other commercial products, which are not inert, must be certified. The guidelines divide the products used in dirt and gravel roads into solids (e.g. stone, geotextile, salts as crystals) and aqueous (e.g. brines, emulsions). Aqueous products must undergo the following required tests: a 7-day rainbow trout survival and growth test, and a 7-day cladoceran (*Ceriodaphinia dubia*) survival and reproduction test. Each product tested must report the NOEC, LOEC, LC50 and CHV values for the survival and growth of rainbow trout and one for the survival and reproduction of cladocerans. An MSDS sheet for each product should accompany the application. In addition, the materials have to undergo bulk and leach analysis. Bulk analysis should follow methods established in EPA SW-846 and leach analysis should be performed according to EPA Method 1312. Components analyzed in these tests include: pH, major, minor, and trace components, radionuclides, moisture content, loss of ignition (LOI) at 1000°C, metals, cyanide, volatile, and non-volatile organic compounds. The laboratory has to report each constituent that exceeds the trigger levels (50% of SPLP limits, as set forth in current PA DEP Mining Regulations Module 25). If any trigger level (s) is exceeded, a second sample of the material should be tested.

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Environmental Technology Verification Program

ETV Canada Inc.

May 2002

Responsible Agency

ETV Canada Inc.

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What are the goals of the ETV Canada Program?

The main objective of the ETV Canada Program is to provide validation and independent verification of environmental technology performance, including that of dust suppressants. This program has been developed to promote the commercialization of new environmental technologies into the market place and thus provide industry with a tool to address environmental challenges efficiently, effectively and economically.

Who created the ETV Canada?

Environment Canada was the lead department in the development of the ETV program in cooperation with Industry Canada and with direction from the ETV Steering Committee. ETV Canada, Inc., a private sector company that operates under a license agreement with Environment Canada, was created to deliver the ETV program. The ETV Canada, Inc. is owned by the Ontario Centre for Environmental Technology Advancement (OCETA).

What is needed to apply?

The technology vendor must provide sufficient, acceptable documentation and data to support the performance claim of the technology being verified. ETV Canada reviews the Formal Application for completeness and determines if it can be accepted into the verification process. If the application is not acceptable, the applicant may choose to modify and resubmit it. Similarly, at this application review stage, ETV Canada may determine that the data supporting the claim is inadequate. If the applicant wishes to continue, it is their responsibility to first arrange and pay for the generation of the necessary data. Alternatively, the applicant may choose to modify their claim to align it with supporting data. Although ETV Canada would not be directly involved in the testing to develop additional data, it may outline the data requirements within the context of the General Verification Protocol. The formal application should be accompanied with the supporting data that is to be used in the verification process. Before confidential information or data can be passed to ETV Canada, a Confidentiality Agreement is signed. ETV Canada reviews the information and proposes a verification process for the claim, including identification of a Verification Entity and a cost estimate for the verification program. The cost of verification will include the administration and management of the application process by ETV Canada and the actual validation by the Verification Entity of the claim, using the supporting data. The cost will vary from application to application, and will depend on the scope of effort involved in the verification process. ETV Canada discusses the scope and cost of the proposed program with the applicant, and reaches agreement on the Verification Entity, including resolution of any conflict of interest between the applicant and the Verification Entity. ETV Canada keeps a list of approved Expert Entities, which include private consultants, universities, and research institutes that can conduct tests to support the verification of the technology.

Who provides the performance verification?

A formal application must be submitted to ETV Canada, Inc. for review in order to obtain technology verification. If the technology and performance claim are eligible for the ETV program, the applicant submits a Formal Application and a non-refundable $1,000.00 application fee. The Formal Application requests additional information about the technology, the claim to be verified, and the data and information that is available to support the claim. The Formal Application is available either by regular mail or electronically by e-mail and can be faxed back to ETV Canada with a signature. An original should follow by regular mail or by courier with the $1,000.00 fee.

Who may apply for verification?

Environmental technology vendors can apply to the ETV program for verification of the claims concerning the performance of their environmental technologies. For a technology to be eligible for the ETV program, it must be an environmental technology or an equipment-based environmental service, where equipment performance can be verified. The technology must offer an environmental benefit or address an environmental problem. It must also meet minimum Canadian standards and/or national guidelines for the specific technology or claim, as specified by ETV Canada, and be currently commercially available or commercially ready for full-scale application.

Who evaluates the application for verification?

ETV Canada reviews the Formal Application for completeness and determines if it can be accepted into the verification process. Verification Entities, which are approved by ETV Canada, provide the technical expertise to evaluate the technology.

What are the criteria for verification?

The claim must specify the minimum performance that is achievable by the technology and must be unambiguous. It must meet minimum standards and guidelines for the technology. Where federal standards are not available, the least stringent provincial standard shall apply. Technology must achieve federal, provincial, and/or municipal regulations or guidelines for discharge waters or treated effluents, soils, sediments, sludge or other solid-phase materials. ETV Canada will refer to such appropriate standards when assessing the claim. The claim must be measurable using acceptable test procedures and analytical techniques. It is essential that adequate, relevant, reliable data and information be provided to support the verification of the environmental technology performance claim.

What is the proof of verification?

If the claim is verified successfully, the company is issued three documents: a Verification Certificate, a Technology Fact Sheet, and a Final Verification Report.

What dust suppressants have been certified by ETV Canada?

In March 1999 Soil Sement®, a synthetic polymer emulsion, was certified by ETV Canada. Three years after approval, the verification should be renewed and a license renewal fee should be applied.

Appendix C

Expert Panel Agenda

THURSDAY, MAY 30TH, 2002	
8:00 – 8:30 AM	REGISTRATION
8:30 – 9:00 AM	INTRODUCTIONS Welcome and Logistics (Thomas Piechota, UNLV) Importance of issue to EPA (Jeff van Ee, U.S. EPA)
9:00 – 9:45 AM	FRAMING THE PROBLEM Introduction of Conceptual Model (David James, UNLV) Summary of Literature Review (UNLV) Fact Sheets from other relevant activities, programs, and/or protocols.
9:45 – 10:15 AM	PANEL I: WHAT ARE WE DEALING WITH? What is the composition of the dust suppressant and what are the sources of these compounds? How are the dust suppressants applied and at what rates? Where are dust suppressants applied?
10:15 – 10:30 AM	BREAK
10:30 AM – 12:00 PM	PANEL I (continued) What is the potential for trace levels of contaminants given the source and composition? Does the Conceptual Diagram outline all the possible pathways of exposure? What is known about the fate and transport of various dust suppressants? Are some pathways relatively more significant sources of exposure than others? How does the composition of the various dust suppressants change once they are in the environment? What is the potential magnitude of dust suppressant application in urban or rural areas?
12:00 – 1:00 PM	LUNCH (hosted by UNLV/EPA in Richard Tam Alumni Center)
1:00 – 2:45 PM	PANEL II: WATER PATHWAY How are dust suppressants likely to impact surface waters? What are potential impacts of runoff contaminated with dust suppressants to surface water quality and human health? What are potential impacts of runoff contaminated with dust suppressants to aquatic ecosystems? What is known about movement of dust suppressants in the vadose zone? Are dust suppressants likely to impact groundwater? Does Conceptual Model identify all receptors to water quality?
2:45 – 3:15 PM	BREAK
3:15 – 5:00 PM	PANEL III: SOIL AND LANDSCAPE PATHWAY What are the possible human health or ecological impacts related to soils contaminated with dust suppressants? How might application of dust suppressants alter soil properties and effect runoff and erosion? How might dust suppressants impact ecological patterns? How might different dust suppressants change the microbial ecology of local soils? Does the conceptual model clearly identify all pathways and receptors in the terrestrial environment?
5:00 – 7:00 PM	RECEPTION WITH YUCCA MOUNTAIN BOYS (hosted by UNLV/EPA in Alumni Center)

FRIDAY, MAY 31TH, 2002	
8:30 – 8:45 AM	FRAMING THE DAY
8:45 – 9:45 AM	PANEL IV: MAGNITUDE OF USE (GROUP DISCUSSION)
9:45 – 10:00 AM	BREAK
10:00 – 11:30 AM	WORKING GROUPS (See handout)
11:30 AM – 12:30 PM	PRESENTATION OF WORKING GROUPS Designated spokesperson to summarize working groups findings.
12:30 – 2:45 PM	PANEL V: QUESTION AND ANSWER WITH EXPERTS (What do they think?)
2:45 – 3:00 PM	BREAK
3:00 – 4:00 PM	PANEL VI: DEVELOPING GUIDELINES AND REGULATIONS Are current regulations adequate for permitting dust suppressants? Are existing regulations and test methods adequate to address potential effects of dust suppressants? Who should be responsible for tracking use of suppressants? Should long-term monitoring be conducted to evaluate dust suppressant impacts? PANEL VII: PATH FORWARD Recommendations on how best to summarize meeting. What are the follow-up actions from this meeting?
4:00 PM	ADJOURN

Appendix D

Organizing Committee and Expert Panel

Organizing Committee

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EPA/600/R-04/031
March 2004

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Print Page

Protecting unfragmented habitats, minimizing habitat loss, and maintaining, enhancing or restoring conditions that meet life-history needs

Keeping things connected

The BLM grants rights-of-way (ROWs) for many different uses of public lands. Many energy-related projects — wind power, solar energy, pipelines and power transmission lines — are accomplished using ROWs on BLM-managed lands. ROWs usually consist of strips or corridors of land that may themselves be limited in size but which can nonetheless fragment the land through which they run.

The BLM and the U.S. Fish & Wildlife Service have identified fragmentation as a primary threat to sage-grouse and their habitat. So, current BLM policy addresses the authorization of ROWs in priority sage-grouse habitat.

:: Avoid :: Minimize :: Mitigate

When processing a ROW application, the BLM works with the applicant on a number of issues, including how best to avoid or minimize loss or fragmentation of sage-grouse habitat. Reasonable possibilities for siting the project outside of priority habitat areas or within a designated ROW corridor are part of the NEPA analysis for the proposal.

For ROWs less than 1 mile in length or which disturb less than 2 surface acres, the BLM develops mitigation measures in cooperation with the applicant and state wildlife managers that would cumulatively *maintain or enhance* sage-grouse habitat.

For larger ROWs – those longer than 1 mile or which would disturb more than 2 surface acres – the BLM requires measures that *minimize impacts* to sage-grouse habitat. In addition to this kind of onsite mitigation, the BLM will develop and consider offsite mitigation measures, in cooperation with the applicant and state wildlife managers.

Unless the BLM and state wildlife agency staff determine that a proposed ROW (1+ miles long or 2+ acres of disturbance) and associated mitigation measures would *cumulatively maintain or enhance* sage-grouse habitat, the decision on the proposed ROW is forwarded to a group composed of the appropriate BLM State Director, the Director of the relevant state wildlife agency and a representative of the U.S. Fish and Wildlife Service.

If this group cannot agree on appropriate mitigation for the proposed ROW, then the decision goes to the BLM sage-grouse National Policy Team for their review. The Team may also involve the State wildlife agency Director, if appropriate.

If this group cannot agree on appropriate mitigation, the Team will seek a final decision from the BLM Director in the absence of consensus.

Last updated: 11-16-2012

EXHIBIT B

SWAPE Technical Consultation, Data Analysis and Litigation Support for the Environment

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Subject: **Comments on the Draft Environmental Impact Report for the Casa Diablo IV Geothermal Development Project, Mono County, California**

Dear Mr. Reinhardt and Ms. Sudoimer:

We have reviewed the November 2012 Draft Environmental Impact Statement and Draft Environmental Impact Report (herein referred to as "DEIS/R") for the Casa Diablo IV geothermal project ("CD-IV Project") in the vicinity of Mammoth Lakes in Mono County, California. The Project would include the following:

- A new 33-megawatt (MW) geothermal power plant will be comprised of two binary generating units, turbines, condensers, pumps, piping, ancillary equipment, and an underground electric transmission line to interconnect to the Southern California Edison substation;
- Up to 16 geothermal wells will be drilled ranging from depths of 1,500 to 2,500 feet with each well on a 0.4-acre well pad and include a small pump building; and
- Pipelines to bring the geothermal brine to the power plant and take cooled brine to the injection wells.

Our review has focused potential impacts to geothermal resources in the Casa Diablo area and issues associated with stormwater. We have found the DEIS/R fails to adequately identify impacts to high-value natural resources, including a fish hatchery and hot springs, which offer unique recreational **I9-126** activities and ecological habitat. Mitigation measures proposed in the DEIS/R will not reduce Project impacts to a less than significant level as stated in the DEIS/R. A revised DEIS/R should be prepared to fully disclose all impacts and provide adequate mitigation to ensure impacts to natural resources are minimized. I9-126 cont.

Project will greatly expand use of geothermal resources

Currently, 40 MW of power is being produced at the MP I project located on 90 acres in the Casa Diablo area. MP I commenced operation in 1984 with a capacity of producing 10 MW. Two additional units, PLES I and MP II, each producing 15 MW, began operation in 1990. Mono County recently approved an application to replace the existing MP I power plant with a newer facility (M1 Replacement Project) capable of producing 18.8 MW.

The proposed Project would generate an additional 33 MW of power on 80 additional acres of land and increase power production in the Casa Diablo area by 83%. Project construction will greatly increase the use of geothermal resources in the area. The Mammoth Hot Creek is within the Hot Creek Geological Area, under U.S. Forest Service Administration,[1] and contains over a dozen steam vents and bubbling blue pools, some of which occasionally erupt to form geysers.[2]

The Mammoth Hot Creek is a unique geothermal resource with a finite amount of energy stored in its springs. The Project will increase the existing extraction of geothermal fluid from the reservoir by 50% and expand production by 6,000 gallons per minute (DEIS/R, p. 4.7-3). The reservoir is connected to Hot Creek Springs and other geothermal resources. Hot Creek Springs is an irreplaceable and high-value resource and any related development and increased heat extraction may pose a significant impact on geothermal resources.

Appendix D to the DEIS/R describes the following concerns associated with development of geothermal resources on recreational features and ecologic habitat:

- Hot Creek Springs was identified as a concern because of its high value recreational significance and variations in spring flow;
- Hot Bubbling Pool is potentially sensitive because it is one of the thermal springs closest to Casa Diablo and monitoring records show that water levels in the pool are particularly sensitive to aquifer pressure changes;
- Hot Creek Fish Hatchery was identified as sensitive "because of the small (2-5%) contribution of thermal water that improves spawning conditions at the Hatchery." The thermal water contribution raises water temperatures an average of 5°C (41°F) above background, which supports fish spawning (Appendix D, pp. D-34 – D-35).

The DEIS/R states that the Project will be designed in a way to prevent or mitigate any potential hydrothermal impacts to the hot springs and fish hatchery from geothermal operations (DEIS/R, p. 4.8- I9-127

[1] http://www.fs.usda.gov/recarea/inyo/recarea/?recid=20414
[2] http://pubs.usgs.gov/fs/2007/3045/fs2007-3045.pdf

2). However, the DEIS/R conclusion that Project construction and operation will result in less than significant impacts fails to account for the modeling estimates from the Applicant's own consultants that indicate potentially significant declines in thermal discharge, temperature, and reservoir pressure. These impacts must be fully disclosed and adequately addressed and mitigated in a revised DEIS/R. The impacts, identified in Appendix D, have the potential to degrade geothermal features that provide critical ecological habitat to the Owens tui chub fish population and recreational value to the public. **I9-127**

Impacts on thermal discharge are uncertain and require independent review and monitoring in order to verify their reliability

The production of 33MW from the Project will increase power production in the Casa Diablo area by 83% and increase geothermal fluid extraction by 50% over current production at the site (from the existing facilities). This increase in the energy production and fluid extraction will cause declines in the temperature of the water that is heated by hot rock at depth (thermal water) and a decline in reservoir pressure. On the basis of modeling conducted by the Applicant's consultants, the Project is estimated to cut thermal outflow to Hatchery Springs by about 17% (DEIS/R, p. 4.7-7) and reservoir pressure by up to 10.2 pounds per square inch (DEIS/R, p. 4.7-5). Both these estimates are highly interpretive and have only been evaluated by the Project proponent. An independent review is required to verify the results.

The DEIS/R states:

> Although the CD-IV Project is forecast to reduce the thermal outflow to Hatchery Springs by *about* 17 percent, the thermal water fraction is a very small part (less than 5 percent) of the total flow, so the impact to the combined cold and thermal discharge at the springs is forecast to be reduced by 0.85 percent and is not likely to be measureable relative to climatic effects. In addition, conductive buffering of the temperature would minimize potential temperature changes making such changes difficult to detect (DEIS/R, p. 4.7-7). **I9-128**

There are several unsubstantiated estimates made in this statement that require independent evaluation.

1. "CD-IV Project is forecast to reduce the thermal outflow to Hatchery Springs by about 17 percent"

   The DEIS/R, in making this claim, relies upon Appendix D which, in turn, relies upon numerical computer models developed by the Project consultant. Modeling results, summarized in one paragraph of Appendix D which, paint a significantly less definitive prediction, which is exemplified in this concluding statement:

   > The potential impact at the Fish Hatchery Springs *could* be ~ 17% decline in thermal water input. The thermal water fraction of the Hatchery springs is a very small part of the total flow and spring temperatures have previously been shown to be *primarily*

dependent on seasonal fluctuations in precipitation and not the thermal component of flow (Sorey and Sullivan, 2006) (Appendix D, p. D-46).

The vague statement that there "could be a ~ 17% decline" shows the imprecision in the estimate of thermal discharge. The approximate 17% decline is not presented with a confidence interval to show the uncertainty in the estimate (i.e. +/- 5%). Without quantifying this uncertainty, there is no way to measure with any accuracy what the decline in thermal water output will actually be.

The DEIS/R mischaracterizes this rough estimate by stating that the "CD-IV Project is forecast to reduce the thermal outflow to Hatchery Springs by about 17 percent" (p. 4.7-7). This is a very important distinction that is not just semantic: "could be a ~17% decline" is a statement without any real limits whereas the DEIS/R makes a much more affirmative – and misleading – statement that the reduction is forecast to be "about 17%," upon which it bases its finding that there would be no significant impact.

I9-128 cont.

The optimal temperature range for the Owens tui chub is 15-20 degrees Celsius[3] with 13-17 degrees Celsius being the optimal range for spawning.[4] Spawning of the Owens tui chub is triggered by warming water temperatures.[5] The DEIS/R fails to provide the existing water temperature conditions currently reaching Hatchery Springs. The omission of this information is critical. Without this baseline information, it is impossible to gauge if a 17% (or any other percentage) decline in the temperature of the water reaching the fish hatchery would reduce temperature below the optimal range for the Owens tui chub. Therefore, the conclusion that the impacts from reduction in thermal outflow to the fish hatchery, as a result of the Project, are not significant is unsupported. The Project's potential to result in reduced spawning and negative impacts to the ecological habitat of the Owens tui chub remains unaddressed.

A revised DEIS/R should be prepared to include an accurate estimate of the percent reduction in temperature in thermal water input from the Project, to include the methodology and model inputs used to calculate the estimate. The current temperature of water reaching the fish hatchery and the estimated reduction in temperature from the Project should be quantified and disclosed. The DEIS/R should include a discussion on whether this reduction will adversely impact the ecological habitat and spawning conditions for the Owens tui chub.

2. "thermal water fraction is a very small part (less than 5 percent) of the total flow and thermal discharge at the springs is forecast to be reduced by 0.85 percent"

I9-129

This claim relies on an unsubstantiated estimate of the thermal water fraction of the total discharge to make a conclusion that thermal discharge at the springs will be reduced by less than 1%. The conclusion that thermal water is less 5% of the total discharge is not supported by

[3] http://calfish.ucdavis.edu/species/?uid=104&ds=241

[4] http://hegel.lewiscenter.org/users/mhuffine/subprojects/Student%20Led%20Research/chubworld/pdfs/tuichubgeologica03.pdf, p. 8

[5] http://www.drecp.org/meetings/linkdocs/2012-02-24_meeting/species_profiles/Owens_Tui_Chub.pdf, p. 6

any analysis in Appendix D and the there is no reference to any other report that makes this conclusion.

A revised DEIS/R needs to be prepared to provide scientific evidence (i.e. peer-reviewed articles or surveys undertaken by the U.S. Geological Survey) that support the claim that thermal water fraction is less than 5% of total flows. If this estimate is not supported, the Applicant should revise the thermal discharge reduction to the springs and discuss the subsequent impacts to the hot springs and fish hatchery. I9-129 cont.

3. "conductive buffering of the temperature would minimize potential temperature changes making such changes difficult to detect"

The DEIS/R makes this claim without defining what conductive buffering is or how it would occur in the Project area. Appendix D also does not include a discussion on conductive buffering. The Applicant must show that conductive buffering can occur in the Project area in a method that would minimize temperature changes, as the DEIS/R claims. If conductive buffering can minimize potential temperature changes, effects should be quantified. The impact of buffering on temperature in waters reaching the springs and hatchery should be discussed. I9-130

The DEIS/R's finding that thermal water temperature and pressure declines are insignificant is the lynchpin to its conclusion that Project construction and operation will not have an adverse impact on hydrothermal resources in the Casa Diablo area. The DEIS/R concludes, "Based on this assessment there would be limited potential for adverse impacts on the Owens tui chub or its critical habitat as a result of operation of the Proposed Action" (DEIS/R, p. 4.4-14). I9-131

However, as our comments have explained, this assessment is baseless or, at best, fraught with uncertainty. The DEIS/R does not provide any reliable quantified information that would provide assurance that temperature declines will be insignificant and will not harm the invaluable downgradient resources. The DEIS/R needs to be revised to include an independent review, preferably by the U.S. Geological Survey, of the modeling estimates for reservoir temperature and pressure declines. Requests for independent reviews of the technological analysis and modeling provided in Appendix D has been made by other agencies, including the Sierra Club and the Mammoth Community Water District (Appendix A, pp. A-125, A-162). The focus of the review should be to assess the validity of the findings in Appendix D as well as the identification of a credible "worst-case" scenario for thermal water and pressure declines. The worst-case scenario should then be incorporated into a revised DEIS/R to predict hydrothermal impacts to the Owens tui chub critical habitat, Hot Creek Hatchery and Hot Creek Springs. I9-132

In addition, enhanced monitoring provisions should be incorporated into a revised DEIS/R. Defined management actions tied to observations of critical temperature or pressure changes and reductions should be identified. Enhanced monitoring is especially important because temperature and pressure changes are difficult to detect. Even if detected, impacts to recreational features and habitat cannot be simply reversed; instead, a period of recovery would be necessary. Construction of 16 additional wells will increase heat extraction in the Casa Diablo area by 50%. A finite amount of energy, in the form of heat, is stored in the hot springs. If extraction occurs too rapidly, without consideration for temperature I9-133 or pressure changes, the hot springs would need time to recover and calibrate to equilibrium pressure and temperature. Without adequate and vigilant monitoring, pressure and temperature changes may go unnoticed and mitigation necessary to reverse any impacts may not be implemented in a timely manner. If heat extraction resulting in temperature and pressure declines is continued without mitigation or allowing for a period of recovery, there may be permanent and irreversible damages to geothermal resources. I9-133 cont.

The need for prescriptive monitoring is critical given that the U.S. Fish and Wildlife Service has identified habitat destruction as a major threat to the Owens tui chub and that reductions in flows from springs can result in habitat destruction.[6] Monitoring is necessary to ensure that the Project does not result in habitat destruction of the Owens tui chub.

To ensure protection of resources upon detection of a trigger event, such as a drop in temperature or pressure by some defined amount, management actions should be included in a memorandum of understanding (MOU) to be signed by the applicant and the County. For example, if triggers for temperature are exceeded then a reduction in power would result until temperature declines are reversed. A MOU was prepared for a groundwater extraction project in Cadiz Valley and the County of San Bernardino.[7] The MOU defined the terms of the activity (water drawdown), agreed-upon limitations (drawdown is limited to 80 feet at the wellfield), and measures to implement if limitations are breached (reduce pumping to maintain elevation about 80 feet). A similarly structured MOU should be drafted and included in a revised DEIS/R to show the Applicant's commitment to protection of the Project area's geothermal resources. I9-134

Specific mitigation measures, such as reservoir pressure monitoring methodologies and locations, that would enhance monitoring are not included in the DEIS/R. Instead, the DEIS/R states that existing monitoring programs would be expanded to include monitoring for the Project. Mitigation Measure GEO-5 states that the monitoring programs would be in accordance with the Mono County General Plan (DEIS/R/S, p. 4.7-1). However, there is no explanation or details provided that explain how monitoring will be expanded and conform to the County General Plan. Furthermore, the Mitigation Measure GEO-5 makes no reference to any specific hydrologic monitoring. Mitigation Measure GEO-4 does state that the Project will be operated in conformance with monitoring through the Long Valley Hydrologic Advisory Committee and with remedial action programs designed "to prevent, or mitigate, potential hydrothermal impacts to the Owens tui chub critical habitat, Hot Creek Hatchery and Hot Creek Gorge springs from geothermal operations" (DEIS/R, p. 4.8-2). But again, no specifics are provided in the DEIS/R that would identify monitoring measures or demonstrate their effectiveness, i.e. how the Project will conform to monitoring and remedial programs to prevent impacts to the hydrothermal resources and dependent habitat. I9-135

A revised DEIS/R needs to be prepared to include adequate monitoring measures (such as performance criteria and triggering benchmarks) that will ensure negative impacts to geothermal resources from Project construction and operation can be detected in a timely manner. In order for the mitigation to be

[6] http://www.drecp.org/meetings/linkdocs/2012-02-24_meeting/species_profiles/Owens_Tui_Chub.pdf, p. 8
[7] *See* Attachment A.

effective in ensuring the health and existence of the fish hatchery and ecological habitat of the Owens tui chub, monitoring needs to be tied to a MOU that will identify management actions that will be implemented if monitoring data shows critical changes thermal water temperatures and pressures. I9-135 cont.

Potential Impact from construction and operation of injection wells

Up to 16 wells are to be constructed for the Project and half of these wells will be constructed as injection wells. The wells will reach depths of nearly a half mile (DEIS/R, p. 4.7-9). The DEIS/R fails to discuss the potential for the construction and operation of the wells to impact downgradient geothermal resources and ecological habitat.

Chemicals used during well drilling, construction, development, and production, including those used to enhance production or injection of geothermal fluids (i.e. fracking chemicals), are not disclosed in the DEIS/R. The DEIS/R only states, in Mitigation Measure HAZ-1, that the Project will comply with all local, state, and federal regulations regarding the use, transport, storage, and disposal of hazardous materials and wastes and that a Hazardous Materials Business Plan will be updated.

I9-136

However, the DEIS/R does not address the potential for these chemicals to flow into the subsurface toward geothermal features, including Hot Creek Gorge springs and Hot Creek Hatchery. The potential interconnection has been demonstrated in monitoring that was conducted in association with operation of the MP-II and the PLES-I within the Mammoth Pacific geothermal complex.[8] The motive fluid currently used at the Mammoth Pacific geothermal complex, isobutane, has been detected by the U.S. Geological Survey in downgradient surface water, in fumaroles at Casa Diablo and in the Hot Bubbling Pool, 3 miles to the east of the project area.[9] These geothermal plants use a closed-loop system which is intended to isolate the isobutane from the injection wells; however, the presence of the isobutane has led the U.S. Geological Survey to conclude that inadvertent leaks to the injection system occur and that a hydrologic interconnection exists between the injection wells and downgradient surface water.[10]

The detections of isobutane at downgradient springs, coupled with the documentation of releases to isobutane into the aquifer, demonstrate a connection between the injection wells and surface water. The U.S. Geological Survey concluded that less than 10% of the fluid injected at Casa Diablo moves into the production zone and that most flows away from the well field within the injection reservoir.[11] This conclusion means that injection fluid, including spent brine and any chemical additives, can move downgradient with the flow of groundwater to degrade groundwater resources and interconnected surface water bodies, including springs. I9-137

Appendix D indirectly acknowledges this interconnection by stating that isobutane leaks have travelled to the Long Valley geothermal system (Appendix D, p. D-33). There is a clear connection and pathway between injection wells and surface water for chemicals used in well drilling, construction, and

[8] Letter from Mammoth Pacific, LLP to Great Basin Unified Air Pollution Control District, July 21, 1998 and April 17, 2000. *See* Attachment B.
[9] http://www.geothermal-energy.org/pdf/IGAstandard/WGC/2000/R0149.PDF, p. 706.
[10] *Ibid.*, p. 706
[11] *Ibid.*, p. 706

operation to travel and reach the hot springs and fish hatchery. Injection wells at geothermal plants carry not only spent brine but may include chemicals used to prevent biofouling, corrosion, and scaling of the plant equipment. The chemicals and the composition of the spent brine injected at the Mammoth-Pacific complex are not described in the DEIS/R. However, at other geothermal power plants, chemicals that are injected are known. For example, according to the U.S. EPA, chemicals injected at a geothermal plant in Hawaii include: sodium sulfite, benzoic acid, sodium hydroxide, sodium gluconate, dimethyldioctylammonium chloride, soya amine polyethoxylate, cychlohexlamine, polyamidoamino acetate, POE (15) tallow amine, sodium metabisulfite, cobalt compounds, sodium chloride, phosphoric acid derivative, magnesium nitrate, 5-chloro-2-methyl-4-isothiazoline-3-one, magnesium chloride, 2-methyl-4-isothiazolin-3-one, cupric nitrate, disodium ethylenebis-dithiocarbamate, dimethylamine, ethylene diamine, ethylene thiourea, and sulfuric acid.[12] The U.S. EPA has also documented that naturally occurring components of injected spent brine -- including total dissolved soilds, arsenic, chloride, fluoride, manganese, aluminum, lead, mercury, selenium, iron, cadmium, and zinc – may exceed drinking water standards. I9-137 cont.

All injected fluids, including any fracking chemicals, spent brine, chemical additives, and motive fluids should be disclosed in a revised DEIS/R and evaluated for the potential to degrade groundwater quality and in interconnected spring water and surface water. If unmitigated, the release of spent brine, motive fluid and other chemicals to the aquifer and in turn to surface water is a significant unmitigated impact which would pose potential ecologic risk to aquatic resources. Chemicals used for drilling and operations may travel through interconnected pathways and reach the fish hatchery and Hot Creek. An ecological risk assessment should be conducted to evaluate this potential pathway to ensure protection of aquatic resources from any exposure to chemicals or to components of the spent brine.

Stormwater discharge issues

Well construction and drilling would require surfacing of drilling mud, drill cuttings, and water and geothermal fluid. Pipeline construction, to receive and deliver brine, would require trenching, grading, and disturbance of surface sediments. The DEIS/R notes that pollutants related to these activities can be entrained in stormwater and flow offsite, resulting in degradation of water quality (DEIR, p. 4.19-4). The DEIS/R does not analyze the impacts from such pollution on water quality. I9-138

Mitigation measure SW-2 states that all containment basins and sumps will be constructed to contain flows from a 100-year storm event with sufficient freeboard (DEIR, p. 4.19-22). The DEIR's claim of construction of "sufficient freeboard" is vague. Hydrologic and engineering calculations should be used to determine the amount of freeboard necessary to contain any overtopping from flows anticipated from a 100-year storm event. Peak discharge flows during a 100-year storm event should be calculated and used to identify the size of containment basins and freeboard. I9-139

Mitigation measure SW-1 states that a drainage plan will be prepared, to include location and sizing of stormwater retention facilities and on-site drainages. Stormwater facilities will be designed with the I9-140

[12] http://www.epa.gov/ogwdw/uic/class5/pdf/study_uic-class5_classvstudy_volume17-geothermalelectricpower.pdf, p. 45 (attached as Exhibit 3).

capacity to retain a 20-year, 24-hour storm event. Figure 3.19-1 shows that the well sites will be located just outside a 100-year flood zone. Wells 35-31, 55-31, 55-32 and 65-32 are proposed to be located a few hundred feet north of the 100-year flood zone (DEIS/R, Figure 3.19-1). Wells 55-32 and 65-32 are located in areas that are tributaries to Hot Creek (DEIR, p. 4.19-3). Hot Creek, in turn, feeds into Mammoth Creek. I9-140 cont.

Mammoth Creek is impaired for total dissolved solids and is on the 303(d) List of Impaired Water Bodies (DEIS/R, p. 3.19-2). In the event that a 100-year flood event occurs and overflows the proposed retention facilities, stormwater runoff, contaminated from well construction and operation, may flow into the creek and further degrade water quality. The proposed containment basins and sumps for the Project are to be built with a capacity to contain flows from a 100-year storm event. To be conservative, the Applicant should require that stormwater retention facilities also be constructed to contain flows from a 100-year flood event. I9-141

A revised DEIS/R should be prepared to evaluate the potential for failure of the stormwater retention facilities and containment basins and sumps and the resulting water quality impacts. The drainage plan should be prepared prior to construction and included in a revised DEIS/R to ensure that adequate sizing and best management practices for managing stormwater runoff during Project construction and operation are in place. I9-142

Adequate sizing and implementation of best management practices to minimize impacts from stormwater runoff should be discussed and identified in a Stormwater Pollution Prevention Plan (SWPPP). Appendix A to the DEIS/R shows that the Regional Water Quality Control Board required the Applicant to prepare a SWPPP if Project construction would disturb more than one acre (Appendix A, p. A-122). The Project proposes to construct 16 wells, each with a 0.4-acre well pad (for a possible total amount of 6.4 acres), and therefore, will disturb more than one acre of land. The DEIS/R states that appropriate measures such as preparation of a SWPPP will be used to control offsite discharges (DEIS/R, p. 4.3-3). A SWPPP should be prepared now and included with a revised DEIS/R to allow for independent review. The SWPPP should identify all construction activities, pollutants that may be generated during those activities, and best management practices to prevent contamination of stormwater runoff during well construction and operation. I9-143

Sincerely,

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Uma Bhandaram

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Industrial Stormwater Compliance
Investigation and Remediation Strategies
Litigation Support and Testifying Expert
CEQA Review

Education:

M.S. Degree, Geology, California State University Los Angeles, Los Angeles, CA, 1984.
B.A. Degree, Geology, Humboldt State University, Arcata, CA, 1982.

Professional Certification:

California Professional Geologist
California Certified Hydrogeologist
Qualified SSWPP Developer and Practitioner

Professional Experience:

Matt has 25 years of experience in environmental policy, assessment and remediation. He spent nine years with the U.S. EPA in the RCRA and Superfund programs and served as EPA's Senior Science Policy Advisor in the Western Regional Office where he identified emerging threats to groundwater from perchlorate and MTBE. While with EPA, Matt also served as a Senior Hydrogeologist in the oversight of the assessment of seven major military facilities undergoing base closure. He led numerous enforcement actions under provisions of the Resource Conservation and Recovery Act (RCRA) while also working with permit holders to improve hydrogeologic characterization and water quality monitoring.

Matt has worked closely with U.S. EPA legal counsel and the technical staff of several states in the application and enforcement of RCRA, Safe Drinking Water Act and Clean Water Act regulations. Matt has trained the technical staff in the States of California, Hawaii, Nevada, Arizona and the Territory of Guam in the conduct of investigations, groundwater fundamentals, and sampling techniques.

Positions Matt has held include:

- Founding Partner, Soil/Water/Air Protection Enterprise (SWAPE) (2003 – present);
- Geology Instructor, Golden West College, 2010 – present;
- Senior Environmental Analyst, Komex H2O Science, Inc (2000 -- 2003);

- Executive Director, Orange Coast Watch (2001 – 2004);
- Senior Science Policy Advisor and Hydrogeologist, U.S. Environmental Protection Agency (1989–1998);
- Hydrogeologist, National Park Service, Water Resources Division (1998 – 2000);
- Adjunct Faculty Member, San Francisco State University, Department of Geosciences (1993 – 1998);
- Instructor, College of Marin, Department of Science (1990 – 1995);
- Geologist, U.S. Forest Service (1986 – 1998); and
- Geologist, Dames & Moore (1984 – 1986).

Senior Regulatory and Litigation Support Analyst:

With SWAPE, Matt's responsibilities have included:

- Lead analyst and testifying expert in the review of numerous environmental impact reports under CEQA that identify significant issues with regard to hazardous waste, water resources, water quality, air quality, greenhouse gas emissions and geologic hazards.
- Lead analyst and testifying expert in the review of environmental issues in license applications for large solar power plants before the California Energy Commission.
- Stormwater analysis, sampling and best management practice evaluation at industrial facilities.
- Manager of a project to provide technical assistance to a comunity adjacent to a former Naval shipyard under a grant from the U.S. EPA.
- Technical assistance and litigation support for vapor intrusion concerns.
- Manager of a project to evaluate numerous formerly used military sites in the western U.S.
- Manager of a comprehensive evaluation of potential sources of perchlorate contamination in Southern California drinking water wells.
- Manager and designated expert for litigation support under provisions of Proposition 65 in the review of releases of gasoline to sources drinking water at major refineries and hundreds of gas stations throughout California.
- Expert witness on two cases involving MTBE litigation.
- Expert witness and litigation support on the impact of air toxins and hazards at a school.
- Expert witness in litigation at a former plywood plant.

With Komex H2O Science Inc., Matt's duties included the following:

- Senior author of a report on the extent of perchlorate contamination that was used in testimony by the former U.S. EPA Administrator and General Counsel.
- Senior researcher in the development of a comprehensive, electronically interactive chronology of MTBE use, research, and regulation.
- Senior researcher in the development of a comprehensive, electronically interactive chronology of perchlorate use, research, and regulation.
- Senior researcher in a study that estimates nationwide costs for MTBE remediation and drinking water treatment, results of which were published in newspapers nationwide and in testimony against provisions of an energy bill that would limit liability for oil companies.
- Research to support litigation to restore drinking water supplies that have been contaminated by MTBE in California and New York.
- Expert witness testimony in a case of oil production-related contamination in Mississippi.
- Lead author for a multi-volume remedial investigation report for an operating school in Los Angeles that met strict regulatory requirements and rigorous deadlines.

- Development of strategic approaches for cleanup of contaminated sites in consultation with clients and regulators.

Executive Director:
As Executive Director with Orange Coast Watch, Matt led efforts to restore water quality at Orange County beaches from multiple sources of contamination including urban runoff and the discharge of wastewater. In reporting to a Board of Directors that included representatives from leading Orange County universities and businesses, Matt prepared issue papers in the areas of treatment and disinfection of wastewater and control of the dischrge of grease to sewer systems. Matt actively participated in the development of countywide water quality permits for the control of urban runoff and permits for the discharge of wastewater. Matt worked with other nonprofits to protect and restore water quality, including Surfrider, Natural Resources Defense Council and Orange County CoastKeeper as well as with business institutions including the Orange County Business Council.

Hydrogeology:
As a Senior Hydrogeologist with the U.S. Environmental Protection Agency, Matt led investigations to characterize and cleanup closing military bases, including Mare Island Naval Shipyard, Hunters Point Naval Shipyard, Treasure Island Naval Station, Alameda Naval Station, Moffett Field, Mather Army Airfield, and Sacramento Army Depot. Specific activities were as follows:

- Led efforts to model groundwater flow and contaminant transport, ensured adequacy of monitoring networks, and assessed cleanup alternatives for contaminated sediment, soil, and groundwater.
- Initiated a regional program for evaluation of groundwater sampling practices and laboratory analysis at military bases.
- Identified emerging issues, wrote technical guidance, and assisted in policy and regulation development through work on four national U.S. EPA workgroups, including the Superfund Groundwater Technical Forum and the Federal Facilities Forum.

At the request of the State of Hawaii, Matt developed a methodology to determine the vulnerability of groundwater to contamination on the islands of Maui and Oahu. He used analytical models and a GIS to show zones of vulnerability, and the results were adopted and published by the State of Hawaii and County of Maui.

As a hydrogeologist with the EPA Groundwater Protection Section, Matt worked with provisions of the Safe Drinking Water Act and NEPA to prevent drinking water contamination. Specific activities included the following:

- Received an EPA Bronze Medal for his contribution to the development of national guidance for the protection of drinking water.
- Managed the Sole Source Aquifer Program and protected the drinking water of two communities through designation under the Safe Drinking Water Act. He prepared geologic reports, conducted public hearings, and responded to public comments from residents who were very concerned about the impact of designation.

- Reviewed a number of Environmental Impact Statements for planned major developments, including large hazardous and solid waste disposal facilities, mine reclamation, and water transfer.

Matt served as a hydrogeologist with the RCRA Hazardous Waste program. Duties were as follows:

- Supervised the hydrogeologic investigation of hazardous waste sites to determine compliance with Subtitle C requirements.
- Reviewed and wrote "part B" permits for the disposal of hazardous waste.
- Conducted RCRA Corrective Action investigations of waste sites and led inspections that formed the basis for significant enforcement actions that were developed in close coordination with U.S. EPA legal counsel.
- Wrote contract specifications and supervised contractor's investigations of waste sites.

With the National Park Service, Matt directed service-wide investigations of contaminant sources to prevent degradation of water quality, including the following tasks:

- Applied pertinent laws and regulations including CERCLA, RCRA, NEPA, NRDA, and the Clean Water Act to control military, mining, and landfill contaminants.
- Conducted watershed-scale investigations of contaminants at parks, including Yellowstone and Olympic National Park.
- Identified high-levels of perchlorate in soil adjacent to a national park in New Mexico and advised park superintendent on appropriate response actions under CERCLA.
- Served as a Park Service representative on the Interagency Perchlorate Steering Committee, a national workgroup.
- Developed a program to conduct environmental compliance audits of all National Parks while serving on a national workgroup.
- Co-authored two papers on the potential for water contamination from the operation of personal watercraft and snowmobiles, these papers serving as the basis for the development of nation-wide policy on the use of these vehicles in National Parks.
- Contributed to the Federal Multi-Agency Source Water Agreement under the Clean Water Action Plan.

Policy:

Served senior management as the Senior Science Policy Advisor with the U.S. Environmental Protection Agency, Region 9. Activities included the following:

- Advised the Regional Administrator and senior management on emerging issues such as the potential for the gasoline additive MTBE and ammonium perchlorate to contaminate drinking water supplies.
- Shaped EPA's national response to these threats by serving on workgroups and by contributing to guidance, including the Office of Research and Development publication, Oxygenates in Water: Critical Information and Research Needs.
- Improved the technical training of EPA's scientific and engineering staff.
- Earned an EPA Bronze Medal for representing the region's 300 scientists and engineers in negotiations with the Administrator and senior management to better integrate scientific principles into the policy-making process.
- Established national protocol for the peer review of scientific documents.

Geology:

With the U.S. Forest Service, Matt led investigations to determine hillslope stability of areas proposed for timber harvest in the central Oregon Coast Range. Specific activities were as follows:

- Mapped geology in the field, and used aerial photographic interpretation and mathematical models to determine slope stability.
- Coordinated his research with community members who were concerned with natural resource protection.
- Characterized the geology of an aquifer that serves as the sole source of drinking water for the city of Medford, Oregon.

As a consultant with Dames and Moore, Matt led geologic investigations of two contaminated sites (later listed on the Superfund NPL) in the Portland, Oregon, area and a large hazardous waste site in eastern Oregon. Duties included the following:

- Supervised year-long effort for soil and groundwater sampling.
- Conducted aquifer tests.
- Investigated active faults beneath sites proposed for hazardous waste disposal.

Teaching:

From 1990 to 1998, Matt taught at least one course per semester at the community college and university levels:

- At San Francisco State University, held an adjunct faculty position and taught courses in environmental geology, oceanography (lab and lecture), hydrogeology, and groundwater contamination.
- Served as a committee member for graduate and undergraduate students.
- Taught courses in environmental geology and oceanography at the College of Marin.

Matt currently teaches Physical Geology (lecture and lab) to students at Golden West College in Huntington Beach, California.

Invited Testimony, Reports, Papers and Presentations:

Hagemann, M.F., 2008. Disclosure of Hazardous Waste Issues under CEQA. Presentation to the Public Environmental Law Conference, Eugene, Oregon.

Hagemann, M.F., 2008. Disclosure of Hazardous Waste Issues under CEQA. Invited presentation to U.S. EPA Region 9, San Francisco, California.

Hagemann, M.F., 2005. Use of Electronic Databases in Environmental Regulation, Policy Making and Public Participation. Brownfields 2005, Denver, Coloradao.

Hagemann, M.F., 2004. Perchlorate Contamination of the Colorado River and Impacts to Drinking Water in Nevada and the Southwestern U.S. Presentation to a meeting of the American Groundwater Trust, Las Vegas, NV (served on conference organizing committee).

Hagemann, M.F., 2004. Invited testimony to a California Senate committee hearing on air toxins at schools in Southern California, Los Angeles.

Brown, A., Farrow, J., Gray, A. and **Hagemann, M.**, 2004. An Estimate of Costs to Address MTBE Releases from Underground Storage Tanks and the Resulting Impact to Drinking Water Wells. Presentation to the Ground Water and Environmental Law Conference, National Groundwater Association.

Hagemann, M.F., 2004. Perchlorate Contamination of the Colorado River and Impacts to Drinking Water in Arizona and the Southwestern U.S. Presentation to a meeting of the American Groundwater Trust, Phoenix, AZ (served on conference organizing committee).

Hagemann, M.F., 2003. Perchlorate Contamination of the Colorado River and Impacts to Drinking Water in the Southwestern U.S. Invited presentation to a special committee meeting of the National Academy of Sciences, Irvine, CA.

Hagemann, M.F., 2003. Perchlorate Contamination of the Colorado River. Invited presentation to a tribal EPA meeting, Pechanga, CA.

Hagemann, M.F., 2003. Perchlorate Contamination of the Colorado River. Invited presentation to a meeting of tribal repesentatives, Parker, AZ.

Hagemann, M.F., 2003. Impact of Perchlorate on the Colorado River and Associated Drinking Water Supplies. Invited presentation to the Inter-Tribal Meeting, Torres Martinez Tribe.

Hagemann, M.F., 2003. The Emergence of Perchlorate as a Widespread Drinking Water Contaminant. Invited presentation to the U.S. EPA Region 9.

Hagemann, M.F., 2003. A Deductive Approach to the Assessment of Perchlorate Contamination. Invited presentation to the California Assembly Natural Resources Committee.

Hagemann, M.F., 2003. Perchlorate: A Cold War Legacy in Drinking Water. Presentation to a meeting of the National Groundwater Association.

Hagemann, M.F., 2002. From Tank to Tap: A Chronology of MTBE in Groundwater. Presentation to a meeting of the National Groundwater Association.

Hagemann, M.F., 2002. A Chronology of MTBE in Groundwater and an Estimate of Costs to Address Impacts to Groundwater. Presentation to the annual meeting of the Society of Environmental Journalists.

Hagemann, M.F., 2002. An Estimate of the Cost to Address MTBE Contamination in Groundwater (and Who Will Pay). Presentation to a meeting of the National Groundwater Association.

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Hagemann, M.F., 1992. Dense Nonaqueous Phase Liquid Contamination of Groundwater: An Ounce of Prevention... Proceedings, Association of Engineering Geologists Annual Meeting, v. 35.

Other Experience:

Selected as subject matter expert for the California Professional Geologist licensing examination, 2009-2011.

ATTACHMENT A

Appendix N
Memorandum of Understanding by and among the Santa Margarita Water District, Cadiz Inc., Fenner Valley Mutual Water Company, and the County of San Bernardino

MEMORANDUM OF UNDERSTANDING BY AND AMONG

THE SANTA MARGARITA WATER DISTRICT, CADIZ INC., FENNER VALLEY MUTUAL WATER COMPANY, AND THE COUNTY OF SAN BERNARDINO

Related to County Ordinance for Desert Groundwater Management

This Memorandum of Understanding ("MOU") is made and entered into on May 11, 2012, by and between the Santa Margarita Water District ("SMWD"), Cadiz Inc., a Delaware Corporation ("Cadiz"), Fenner Valley Mutual Water Company, a California nonprofit mutual benefit corporation ("FVMWC"), and the County of San Bernardino, a political subdivision of the State of California ("County"). SMWD, Cadiz, FVMWC, and County are each individually referred to herein as "Party" and collectively referred to herein as "Parties."

RECITALS

A. The County adopted a Desert Groundwater Management Ordinance, San Bernardino County Code Title 3 Division 3 Chapter 6 Article 5 Sections 33.06551, et. seq. ("Ordinance") for the protection of groundwater resources in the County, which is intended to ensure that extraction of groundwater does not exceed the safe yield of affected groundwater aquifers and to protect groundwater sources within the unadjudicated, unincorporated desert regions of the County, including the health of individual aquifers and the continued ability of those aquifers to store and maintain water.

B. The operation of groundwater wells may be excluded from the Ordinance where the operator has developed a Groundwater Management, Monitoring, and Mitigation Plan approved by the County, and the operator and the County have executed a memorandum of understanding that complies with the provisions of the Ordinance and ensures that it remains enforceable by the County.

C. Cadiz is the owner of approximately 45,000 acres of land in eastern San Bernardino County most of which overlies the Fenner Valley aquifer system. Cadiz has proposed the Cadiz Valley Water Conservation, Recovery, and Storage Project ("Project") designed to appropriate groundwater from wells to be located on the Cadiz Property overlying the Orange Blossom Wash, Cadiz, Bristol and Fenner Valley aquifers (hereinafter "Fenner Valley aquifer system"), and to deliver that groundwater for municipal and industrial uses via the Colorado River Aqueduct ("CRA").

D. Cadiz has formed Fenner Valley Mutual Water Company ("FVMWC"), a non-profit entity that will operate the Proposed Project and will be solely comprised of public water systems that will own shares commensurate with their rights to receive water from the Project. Cadiz will not own shares in FVMWC but it is the intention of the Parties to contractually obligate FVMWC to the provisions of this MOU.

E. SMWD is the Lead Agency in the preparation of an Environmental Impact Report ("EIR") for the Project and expects to receive water. SMWD is a California Water District in Orange County, a local agency of the State with broad powers under the California Water District Act. (Cal. Water Code, Section 34000 et. seq.) On June 28, 2011, the County and

SMWD agreed that SMWD would serve as lead agency for the Project through execution of a Memorandum of Understanding. One year prior, SMWD signed an option agreement to participate in the Project which provides that SMWD shall have the option to acquire up to 15,000 acre-feet per year ("afy") of conserved water and to utilize storage in the basin in exchange for paying its fair portion of environmental review costs for the Project. Under the option agreement, SMWD will be the largest Project participant in the conservation phase, and would have the largest agency share in the FVMWC. FVMWC is responsible for operating the Project, and providing water and wholesale delivery services to all of its members. As lead agency, SMWD will be the first agency to act on the Project and has the greatest responsibility for carrying out the Project.

F. A Groundwater Management, Monitoring, and Mitigation Plan ("GMMMP") will be finalized in connection with the preparation of the Final EIR for the Project. The GMMMP will require monitoring of aquifer health and safe yield, groundwater levels, groundwater quality, subsidence, surface vegetation, air quality, third-party wells and springs, and the mitigation of potential undesirable results attributable to the Project set forth in the Mitigation, Monitoring, and Reporting Program ("MMRP") to be adopted by SMWD pursuant to the California Environmental Quality Act ("CEQA"). As lead agency, SMWD has the responsibility to ensure that mitigation measures are implemented in accordance with the MMRP, including any mitigation measures that are also provisions of the GMMMP. The GMMMP and this MOU, together, will allocate complete enforcement authority to the County. Following certification of the Final EIR, the GMMMP will be subject to County approval and a discretionary consistency determination that the GMMMP conforms to this MOU and the County Ordinance including, but not limited to, the exclusion provisions as set forth in Article 5, Section 33.06552 of the County Code.

G. The obligations of the Parties under this MOU are conditioned upon compliance with CEQA. In no event shall SMWD or the County be required to implement any provision of this MOU prior to SMWD's approval of the Project, and the County's taking discretionary action as a responsible agency, other than the County's obligation under Paragraph 4(c) to exercise its discretion within 90 days of certification of the Final EIR.

H. Implementation and compliance with the GMMMP and this MOU are intended to satisfy the requirements of the Ordinance and exclude the Project from the permitting requirements of the Ordinance.

AGREEMENT

NOW, THEREFORE, in consideration of the mutual covenants and conditions contained herein, the Parties agree as follows:

1. Recitals Incorporated. The foregoing Recitals are incorporated herein by this reference.

2. Definitions. The following terms shall have the meanings set forth below.

(a) "Aquifer Health" means the geologic integrity of the aquifer, its storage capacity, and the quality of water within the aquifer.

(b) "Cadiz GMMMP" or "GMMMP" means the Groundwater Management, Monitoring, and Mitigation Plan to be submitted for County review and approval.

(c) "Commencement" means the first production of groundwater from the Cadiz Property for the purposes of delivering water under the Project.

(d) "Groundwater" means all water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water, but does not include water that flows in known and definite channels.

(e) "Groundwater Safe Yield" is the maximum quantity of water that can be annually withdrawn from the groundwater aquifer (i) without resulting in overdraft (ii) without adversely affecting aquifer health, and (iii) without adversely affecting the health of associated lakes, streams, springs, and seeps or their biological resources.

(f) "Ordinance" means the Desert Groundwater Management Ordinance, San Bernardino County Code, Title 3, Division 3, Chapter 6, Article 5, Sections 33.06551 et seq. (the "Ordinance"), effective as of the date of execution of this MOU and attached hereto as Exhibit A.

(g) "Overdraft" means the condition of a groundwater supply in which the average annual amount of water withdrawn by pumping exceeds (i) the average annual amount of water replenishing the aquifer in any ten-year period, and (ii) groundwater that may be available as Temporary Surplus.

(h) "Project" means the Cadiz Valley Water Conservation, Recovery, and Storage Project that proposes to appropriate groundwater from wells to be located on the Cadiz Property overlying the Fenner Valley aquifer system and to convey that water for municipal and industrial uses.

(i) "Technical Review Panel" means the review panel comprised of technical experts to be appointed by the Parties pursuant to the GMMMP to review and analyze data, assess deviations from predicted model results, make findings, and recommend corrective actions and refinements in the ongoing monitoring regime and GMMMP.

(j) "Temporary Surplus" means the planned removal of groundwater from storage pursuant to the GMMMP necessary to create underground storage space for the capture and beneficial use of natural recharge without causing Undesirable Results.

(k) "Undesirable Results" means any of the following: (i) the progressive decline in groundwater levels and freshwater storage below a "floor" to be established by the County through the GMMMP; (ii) the progressive decline in groundwater levels and freshwater storage at a rate greater than the rate of decline to be established by the County through the GMMMP where the decline signifies a threat of other physical impacts enumerated in this sub-paragraph 2(k); (iii) land subsidence, (iv) the progressive migration of hyper-saline water from beneath the Cadiz or Bristol Dry Lakes toward the Project well sites; (v) increases in air quality particulate matter; (vi) loss of surface vegetation; or (vii) decreases in spring flows.

3. Groundwater Management Plan Development and Implementation.

(a) In consultation with the County, SMWD and Cadiz shall develop a Groundwater Management, Mitigation, and Monitoring Plan ("GMMMP") to govern the operation and management of the Project by FVMWC during the operational phase of the Project, the currently anticipated term of which is 50 years. Subject to the County's determinations in Paragraph 4, below, the GMMMP will specify an initial extraction rate of 50,000 afy ("Initial Extraction Rate"). The GMMMP will include groundwater quality and groundwater level monitoring requirements and groundwater management thresholds. The Board of Supervisors of the County will consider whether to approve the GMMMP at a noticed public meeting prior to County's approval of the Project.

(b) To develop the GMMMP's groundwater management thresholds, SMWD's and Cadiz' designated consultant shall work in conjunction with the County's designated consultant to (i) identify the groundwater levels that will serve as monitoring targets and a "floor" for the maximum groundwater drawdown level in the Project wellfield, and (ii) establish a projected rate of decline in the groundwater table. The Parties, as part of that analysis, may rely on existing numerical models and shall develop preliminary mitigation strategies including but not limited to changes in the timing and location of extractions and estimates of the possible future reductions in the extraction rate which may be necessary to avoid Undesirable Results and Overdraft during the remaining operational phase of the Project.

(c) Once the GMMMP is completed and the Project is approved by the County, SMWD and FVMWC shall operate the Project in compliance with the GMMMP subject to continuing assessment, oversight, and enforcement by the County as set forth in this MOU, the Ordinance, and the GMMMP. Specifically, the Initial Extraction Rate specified in sub-paragraph 3(a), above, may be subject to reduction by the County during the operational phase of the Project as necessary to avoid Undesirable Results or Overdraft.

(d) Notwithstanding any other provision of this MOU, SMWD, FVMWC, and Cadiz acknowledge and agree that the County will retain full authority and discretion to modify Project operations (including but not limited to the institution of mitigation measures or the curtailment or cessation of Project-related groundwater pumping) as necessary to avoid Overdraft or Undesirable Results.

(e) The GMMMP will include provisions for the establishment of a Technical Review Panel ("TRP") to be comprised of members appointed by the Parties. The TRP will be responsible for the evaluation of (i) monitoring protocols (including quality assurance and quality control) and methods of data collection and processing; (ii) the rate of decline in the groundwater elevations; (iii) groundwater levels and quality; and (iv) the Project's potential to cause Undesirable Results. The TRP may make recommendations to the County or the County may request recommendations from the TRP that require additional monitoring, mitigation, and changes to Project operations as set forth in the GMMMP.

(f) In the event SMWD, FVMWC, and Cadiz propose to implement Phase 2 of the Project (temporary storage of imported water), the Parties will amend this MOU in compliance with the Ordinance and complete a subsequent or supplemental EIR as may be required by CEQA.

(g) SMWD, FVMWC, and Cadiz will prepare and submit to the County for approval a Closure Plan for the Project no later than 25 years after Project Commencement. The Closure Plan will be developed to ensure that no residual effects of the Project operations will cause Undesirable Results during the post-operational phase of the Project and period of extended monitoring.

(h) SMWD, FVMWC, and Cadiz will initiate monitoring as set forth in the GMMMP upon the initiation of construction and no later than one year before Commencement. SMWD, FVMWC, and Cadiz shall share groundwater monitoring information and coordinate monitoring efforts with the County, including advanced review and approval of any changes in monitoring protocols and frequency.

4. County Ordinance.

(a) The Parties agree and acknowledge that compliance by SMWD, FVMWC, and Cadiz with the provisions of this MOU and the GMMMP will satisfy the requirements for an exclusion from the permitting requirements of the Ordinance, pursuant to the Scope and Exclusions section of the Ordinance, with respect to the Project and related facilities (including but not limited to the design, construction, and operation of groundwater wells and pipelines). The Project shall not proceed and the Project's exclusion from the Ordinance shall not become effective, however, unless and until the Parties have finalized the GMMMP based upon information produced from the CEQA environmental review process and following public review and all legally required procedures. The GMMMP will be subject to enforcement by the County.

(b) This MOU is entered to establish a process for completing a GMMMP that comports with the County Ordinance and CEQA. Pending completion and approval of the GMMMP, the Project remains subject to the County's full exercise of discretion as a Responsible Agency under CEQA to consider the Final EIR certified by SMWD and to approve or disapprove the Project and to require the Project to undertake mitigation measures or alternatives as may be set forth in the Final EIR or under the County's Ordinance. Pursuant to CEQA Guidelines Section 15097(a), SMWD will delegate to the County the reporting and monitoring responsibilities for those mitigation measures in the MMRP that are also included in the GMMMP. The Parties further acknowledge and agree that any modifications to the Project resulting from SMWD's or the County's compliance with CEQA may necessitate amendments to this MOU in a mutually acceptable manner.

(c) The County will conduct all necessary hearings regarding its discretionary approval(s) for the Project within ninety (90) days of SMWD's certification of the Project EIR.

5. Term. This MOU shall be effective from the date first written above and coterminous with schedules included in the approved Closure Plan, unless earlier terminated by the unanimous written agreement of the Parties.

6. Termination. This MOU may be terminated at any time by the mutual and unanimous agreement of SMWD, FVMWC, County, and Cadiz or in the event that all discretionary approvals for the Project are not granted within 60 months from the date of the approval of the GMMMP by the County, except this 60-month period will be tolled during the pendency of any litigation filed by a third party challenging any approvals granted by SMWD or County for the Project.

7. Enforcement. To ensure that the measures identified in the GMMMP are fully implemented and enforced in accordance with Sections 33.06552(b)(2)(A)-(2)(B) of the Ordinance, the County will exercise power of enforcement. The power of enforcement shall include the discretion to, at any and all reasonable times, enter the Cadiz and FVMWC Property and any associated enclosures, structures, and facilities for the purposes of making examinations and investigations to determine whether any provision of this MOU, the GMMMP, or the applicable provisions of the Ordinance are being adhered to.

8. Dispute Resolution. The County, SMWD, FVMWC, and Cadiz will exercise good faith and reasonable efforts to resolve any issues, claims, or disputes that may arise under the GMMMP, the Ordinance, or this MOU (hereinafter collectively "Dispute"). In the event that such efforts are unsuccessful, any Party may commence mediation by providing to Judicial Arbitration and Mediation Services ("JAMS") and the other Parties a written request for mediation setting forth the subject of the Dispute and the relief requested. The Parties will cooperate with JAMS and with one another in selecting a mediator from the JAMS panel of neutrals and in scheduling mediation proceedings. The Parties agree that they will participate in the mediation in good faith and that they will share equally in its costs. The mediation will conclude within 60 days following delivery of the written request for mediation unless such period is extended by the written agreement of all Parties. In the event the mediation is unsuccessful in resolving the Dispute, each Party will retain all rights to seek judicial review of the Dispute in accordance with applicable law. Except for disputes involving immediate or irreparable injury to any Party, compliance with the provisions of this Paragraph 8 will be a pre-requisite to the commencement of judicial proceeding relating to any Dispute. Disputes involving immediate or irreparable injury to any Party, including enforcement actions by the County necessary to avoid Overdraft or Undesirable Results, shall be subject to direct judicial review after prior written notice to the Parties and the expiration of a reasonable cure period without cure.

9. Reimbursements. The County and SMWD shall be reimbursed by Cadiz for the costs of their assigned staff and the fees and costs of their consultants and attorneys reasonably incurred in the oversight and enforcement of the GMMMP or this MOU.

10. County Reserved Water.

(a) FVMWC and Cadiz will reserve twenty-five thousand acre-feet (25,000 af) of groundwater underneath the Cadiz Property until that water can be delivered as designated by the County.

(b) So long as conveyance capacity is available, FVMWC and Cadiz shall deliver any part of the 25,000 af to the Colorado River Aqueduct ("CRA") upon request by the County.

(c) The County shall reimburse FVMWC and Cadiz for the incremental cost of conveying the stored water to the CRA.

(d) If, prior to Commencement, the Inland Empire Utilities Agency ("IEUA") elects to participate in the Project and approves and executes a long-term water purchase agreement with Cadiz or FVMWC for a minimum of five thousand acre-feet per year (5,000 afy), then the County will make this one-time supply of twenty-five thousand acre-feet (25,000 af) available exclusively to IEUA or its designees at a price equal to the County's cost of all "out of pocket costs" plus $100 per acre-foot. If IEUA elects not to participate, then the County may make the water available for any price to any party that it may determine, in its complete discretion.

(e) All deliveries will be made within five (5) years from the date of any County request for delivery that follows the completion of Project construction.

(f) The County shall bear all costs of environmental review and permitting attributable to delivery of this stored groundwater.

11. <u>County Reserved Rights for Future Use</u>. Twenty percent (20%) of the total Project annual yield will be reserved for the benefit of future San Bernardino County users for a period of fifty (50) years.

(a) Upon the five-year anniversary of Commencement and each ten-year anniversary thereafter, the County on behalf of any public water supplier in the County may exercise some or all of its reserved right to the annual yield of the Project (cumulative of all requests). To exercise its reserved right to the Project's annual yield, the County or its designee must submit a written notice to the Parties in accordance with the procedures in Paragraph 23, below, and the notice must be received by the Parties no later than the anniversary dates referenced in this sub-paragraph 11(a). In its discretion upon such a request, the County may assign some or all of its reserved right to the public water supplier.

(b) To obtain the water, the County or its assignee must agree to execute a "take or pay" agreement on terms similar to those of other public water suppliers participating in the Project for the delivery of the water and to agree to reimburse the Project, and specifically the Project Participant(s), for their pro-rata allocated share of capital costs, if any, attributable to that quantity of water requested.

(c) The "take or pay" contract must be coterminous with the remaining years of the Project.

(d) This groundwater will be made available as requested by the County or its assignee within one (1) year of the request, provided that the request is in compliance with all applicable laws, including but not limited to the California Environmental Quality Act. The County or its assignee will bear the full cost of environmental review and permitting.

(e) None of the one-time supply of 25,000 af of stored groundwater delivered to the County, its designee, or IEUA pursuant to Paragraph 10, above, shall be counted towards the twenty percent (20%) of annual Project yield reserved for the County in this Paragraph 11.

(f) If IEUA as a public water supplier within the County elects to participate in the Project under a long-term contract, the amount of annual water delivered to IEUA beyond the one-time water delivered pursuant to Paragraph 10(d), if any, shall count towards the twenty percent (20%) of annual Project yield reserved for the County in this Paragraph 11.

12. Construction and Interpretation. It is agreed and acknowledged by the Parties that this MOU has been arrived at through negotiation, and that each Party has had a full and fair opportunity to revise the terms of this MOU. Consequently, the normal rule of construction that any ambiguities are to be resolved against the drafting Party shall not apply in construing or interpreting this MOU.

13. Severability. The invalidity, illegality, or unenforceability of any provision of this MOU shall not render the other provisions unenforceable, invalid, or illegal.

14. Governing Law and Venue. This MOU shall be interpreted and enforced pursuant to the laws of the State of California and the venue for any dispute shall be in San Bernardino County.

15. Amendments. This MOU can only be modified by a written instrument executed by all Parties.

16. Entire MOU. This MOU contains the entire understanding of the Parties related to their interests. Obligations and rights in connection with the subject matter set forth herein. All prior communications, negotiations, stipulations, and understandings, whether oral or written, are of no force or effect, and are superseded, except as referenced herein.

17. Assigns and Successors. This MOU shall be binding upon and inure to the benefit of the assigns or successors-in-interest of the Parties herein. The assignment of Cadiz' interest in this MOU shall not be assigned unless Cadiz or its assignee(s) provides the Parties thirty (30)-days prior written notice and receives approval by the County, which approval shall not be unreasonably withheld. Cadiz covenants to ensure that FVMWC's governing instruments require compliance with this MOU and the GMMMP.

18. No Third-Party Beneficiary. The Parties to this MOU do not intend to create any third-party beneficiaries to this MOU, and expressly deny the creation of any third-party beneficiary rights hereunder toward any person or entity.

19. Time. Time is of the essence in the performance of each and every term of this MOU.

20. No Waiver. The failure to declare a breach as a result of the violation of any term of this MOU shall not constitute a waiver of that term or condition and shall not provide the basis for a claim of estoppel, forgiveness, or waiver by any Party to that term or condition.

21. Captions. The paragraph captions in this MOU are for convenience only and shall not be used in construing the MOU.

22. Documents. Each Party agrees to make, execute, and deliver any and all documents and to join in any application or other action reasonably required implementing this MOU.

23. Notices. Any and all communications and notices in connection with this MOU shall be hand-delivered or sent by United States first class mail, postage prepaid, and addressed as follows:

To SMWD:

Santa Margarita Water District
Attn: General Manager
Post Office Box 7005
Mission Viejo, CA 92690-7005

To Cadiz:

Cadiz Inc.
Attn: Chief Executive Officer
550 South Hope Street, Suite 2800
Los Angeles, CA 90071

To FVMWC:

Fenner Valley Mutual Water Company
Attn: President
550 South Hope Street, Suite 2850
Los Angeles, CA 90071

To County:

County of San Bernardino
Attn: Chief Executive Officer
385 N. Arrowhead Avenue, Fifth Floor
San Bernardino, CA 92415

The Parties may change the foregoing addresses by providing written notice to the Parties in compliance with this Paragraph 23.

24. Indemnification. Cadiz and FVMWC shall indemnify and hold harmless the County and its agents, officers, and employees from and against all claims, liabilities, damages, or costs arising from or relating to any administrative or judicial action brought by any third party against the County, its agents, officers, or employees, that may arise from or in any manner relate to the County's approval of the Project or this MOU, including the County's determinations as a responsible agency under CEQA. This indemnification shall include, but is

not limited to, damages awarded against the County, if any, costs of suit, attorneys' fees, expert consultant or witness fees, and other expenses incurred in connection with any such action.

Cadiz and FVMWC shall indemnify and hold harmless the SMWD and its agents, officers, and employees from and against all claims, liabilities, damages, or costs arising from or relating to any administrative or judicial action brought by any third party against the SMWD, its agents, officers, or employees, that may arise from or in any manner relate to the SMWD's approval of the Project or this MOU, including the SMWD's determinations as lead agency under CEQA. This indemnification shall include, but is not limited to, damages awarded against the SMWD, if any, costs of suit, attorneys' fees, expert consultant or witness fees, and other expenses incurred in connection with any such action.

25. Binding effect. The Parties acknowledge and agree that this MOU constitutes a binding contract enforceable under California law.

26. Authority. Each Party represents and warrants to the others that: (a) it has the requisite legal capacity and authority to enter into and fully perform each and all of its obligations under this MOU, and (b) this MOU does not in any way violate any covenant, contract, agreement, instrument, or understanding by which such party is bound.

"COUNTY" **COUNTY OF SAN BERNARDINO**

6/27/12
Date

By: [signature]
Title: CEO

Approved As To Form: **DOWNEY BRAND LLP**

May 17, 2012
Date

By: [signature]
Title: County of San Bernardino, Special Counsel

"SMWD" **SANTA MARGARITA WATER DISTRICT**

June 22, 2012
Date

By: [signature]
Title: SMWD Board President

Approved As To Form:

June 15, 2012
Date

By: [signature]
Title: SMWD Special Counsel

"CADIZ"	**CADIZ INC.**
5/30/12 Date	By: [signature] Title: CFO
Approved As To Form:	**BROWNSTEIN HYATT FARBER SCHRECK, LLP**
5/27/12 Date	By: [signature] Title: General Counsel
"FVMWC"	**FENNER VALLEY MUTUAL WATER COMPANY**
5/30/12 Date	By: [signature] Title: Secretary
Approved As To Form:	**BROWNSTEIN HYATT FARBER SCHRECK, LLP**
5/30/12 Date	By: [signature] Title: FVMWC Counsel

Exhibit A

ARTICLE 5: DESERT GROUNDWATER MANAGEMENT

§ 33.0655 Purpose.

(a) The protection of groundwater resources within San Bernardino County is of utmost importance. The public health, safety and general welfare of the people of the State of California and of the County depend upon the continued availability of groundwater through ensuring that extraction of groundwater does not exceed the safe yield of affected groundwater aquifers, considering both the short and long-term impacts of groundwater extraction, including the recovery of groundwater aquifers through natural as well as artificial recharge. The protection of the groundwater resource within San Bernardino County also includes the consideration of the health of individual aquifers and the continued ability of those aquifers to store and maintain water.

(b) The protection of groundwater resources within the unincorporated and unadjudicated desert region of San Bernardino County is of particular importance due to:

(1) The existence of vast aquifers that underlie those areas which have not been overdrafted;

(2) The relative lack of significant natural recharge in those areas when compared to the mountain areas and other less arid areas of the County; and

(3) The lack of regulatory or judicial oversight of the groundwater aquifers within the unadjudicated desert region, which oversight would serve to ensure the groundwater safe yield and health of the aquifers.

(c) This Article protects the groundwater resources of San Bernardino County in order to ensure the health of that resource. This Article is intended to be consistent with the California Constitution, Article 10, Section 2 (water rights), and Article 11, Section 7 (police powers).

(d) This Article augments and supplements the Groundwater Management authority the County may otherwise have pursuant to the Groundwater Management Act, Water Code §§ 10750 *et seq*.

§ 33.06552 Scope and Exclusions.

(a) This Article shall only apply to those groundwater aquifers that have not been adjudicated by judicial decree, which are located outside of the jurisdictional boundaries of the Mojave Water Agency and Public Water Districts within the Morongo Basin and which are situated in the unincorporated desert region of the County, generally described as that area of the County lying west of the Colorado River and the California-Nevada State line, north of the San Bernardino-Riverside County line, south of the San Bernardino-Inyo County line and east of Fort Irwin Military Reservation, the Mojave Water Agency, the Marine Air Ground Task Force Command Center, Twentynine Palms Water District and the City of Twentynine Palms. The area subject to this Article is more specifically identified on the attached Desert Groundwater Ordinance Map.

(b) This Article shall not apply to any well operated by any district or person where the district or person has performed both of the following:

(1) Adopted a groundwater management plan pursuant to Water Code §§ 10750 *et seq.* ("AB 3030 Plan") which adheres to "groundwater safe yield" and "aquifer health" limitations, as those terms are defined in § 33.06553 of this Code or has otherwise developed and instituted a County-approved groundwater management, monitoring and mitigation plan associated with its extraction of water that is consistent with guidelines developed by the County; and

(2) Executed a Memorandum of Understanding ("MOU") or other binding agreement with the County which:

(A) requires the parties to share groundwater monitoring information and data and to coordinate their efforts to monitor groundwater resources in the County; and

(B) ensures that the measures identified in the AB 3030 Plan or County-approved groundwater management, monitoring and mitigation plan are fully implemented and enforced. Such MOU or agreement must remain enforceable in order to provide for an exclusion from this Article.

(c) This Article shall not apply to the following:

(1) Groundwater wells subject to the Lower Colorado Water Supply Project;

(2) Groundwater wells within the jurisdictional boundary of the Mojave Water Agency, including public water agencies within the Morongo Basin;

(3) Groundwater well operations approved before the effective date of this Article as part of a currently valid and complied with Conditional Use Permit or well construction permit. Owner must provide evidence or certification the well was drilled prior to permit requirements or was permitted prior to the effective date of this ordinance;

(4) Groundwater wells used in conjunction with mining operations for which a currently valid and complied with mining reclamation plan has been established;

(5) Groundwater wells associated with an agricultural operation, where the cumulative extraction from all of the agricultural wells from such an operation is less than 1,100 acre-feet per year and where the water is used on site and allowed to percolate into the ground, resulting in some return flow to the underlying aquifer.

(6) Groundwater wells which replace abandoned wells if (i) proof of abandonment for the existing well is shown, (ii) the replacement well casing is not larger in diameter than the abandoned well, and/or (iii) the pumping capacity of the replacement well is no more than the pumping capacity of the abandoned well.

(7) Non-agricultural wells with casings smaller than ten inches in diameter or those to be pumped for less than 30 acre feet per year. Notwithstanding the foregoing exemption, this Article shall apply to a non-agricultural well that is proposed on a parcel

on which other wells are located and where the total production of all wells on-site is greater than 50 acre feet per year. The term ***PARCEL*** shall include all parcels within any one groundwater aquifer in which the same person or persons have a common ownership interest.

(8) Groundwater wells located on Federal lands unless otherwise specified by inter-agency agreement. Notwithstanding the foregoing exclusion, this Article shall apply to groundwater wells located on privately held lands, which are within the boundaries of a National Park, Preserve or Monument or any other Federal designation.

§ 33.06553 Definitions.

The following terms related to groundwater management are defined as follows:

AB 3030 DISTRICT. A district which also has adopted a plan pursuant to the Groundwater Management Act.

AQUIFER. A geologic formation that stores, transmits and yields significant quantities of water to wells and springs.

AQUIFER HEALTH. The geologic integrity of the affected aquifer, its storage capacity and the quality of water within the aquifer, including the quality of water for a drinking water supply.

CODE. The San Bernardino County Code.

DISTRICT. Excluding a city wholly or in part located within the boundaries of the County, any district or political subdivision whose primary function is the irrigation, reclamation or drainage of land or is the diversion, storage, management or distribution of water primarily for domestic, municipal, agricultural, industrial, recreation, fish and wildlife enhancement, flood control or power production purposes.

ENFORCEMENT AGENCY. The Enforcement Agency for San Bernardino County may be the Board of Supervisors or the Director of the Department of Public Health, Environmental Health Services Division.

GROUNDWATER. All water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water, but does not include water which flows in known and definite channels.

GROUNDWATER MANAGEMENT ACT. Water Code §§ 10750 *et seq.*

GROUNDWATER SAFE YIELD. The maximum quantity of water that can be annually withdrawn from a groundwater aquifer (i) without resulting in overdraft (ii) without adversely affecting aquifer health and (iii) without adversely affecting the health of associated lakes, streams, springs and seeps or their biological resources. The safe yield of an aquifer can be increased by management actions such as artificial recharge, including infiltration and other similar actions.

OVERDRAFT. The condition of a groundwater supply in which the average annual amount of water withdrawn by pumping exceeds the average annual amount of water replenishing the aquifer in any ten year period, considering all sources of recharge and withdrawal.

PERSON. Any state or local government agency, private corporation, firm, partnership, individual, group of individuals or, to the extent authorized by law, any Federal agency.

RECHARGE. Flow to groundwater storage from precipitation, irrigation, infiltration from streams, spreading basins and other sources of water.

§ 33.06554 Permits.

(a) *Requirement for Permit.* Except as otherwise excluded from the application of this Article and in addition to any applicable permitting requirements for well construction, reconstruction, abandonment and destruction pursuant to the provisions of the San Bernardino County Code, no person, district or other entity acting as principal, agent or employee, shall locate, construct, operate or maintain any new groundwater well within the desert region of San Bernardino County, as identified in § 33.06552 (a), without first filing a written application to do so with the enforcement agency and receiving and retaining a valid permit as provided herein. This permit is a discretionary permit under the California Environmental Quality Act (CEQA, Public Resources Code §§ 21000 *et seq.*)

(b) *Application for Permit.* Applications for permits under this Article shall be submitted to the enforcement agency in a format prescribed by the enforcement agency, and shall be of sufficient detail to allow the determinations set forth in Subdivisions (c) and (d) of this Section to be made. Applications shall include the following information:

(1) A plot plan depicting the location of the proposed well(s) on a section map depicting the location of the following items within one-half mile of the well(s):

(A) Property lines, location and ownership of all parcels and easements;

(B) All intermittent, perennial, natural or artificial bodies of water or watercourses;

(C) Notable nearby geographic features (faults, etc.);

(D) All other wells; and

(E) Landfills, septic systems or other liquid or solid waste facilities.

(2) Proposed well diameter, depth and completion interval (screen or perforation locations) for proposed well(s);

(3) Well design capacities for proposed well(s);

(4) Anticipated groundwater safe yield of the affected groundwater aquifer;

(5) Anticipated static and pumping levels;

(6) Anticipated water quality;

(7) The intended use of groundwater from the proposed well(s);

(8) The proposed months of operation of the proposed well(s) (year-round, irrigation months, etc.);

(9) The proposed pumping cycles (one eight-hour/day cycle, two six-hour/day cycles, etc.);

(10) Estimated annual pumpage from the proposed well(s) in acre-feet;

(11) System description (irrigation, domestic, etc.);

(12) Anticipated return flows (deep percolation, runoff, etc.);

(13) The estimated rate of natural recharge to the affected groundwater aquifer(s) calculated in accordance with generally accepted scientific methodologies and as deemed appropriate by the enforcement agency;

(14) A description of the affected groundwater aquifer(s) including estimated storage capacity and the overall quality of water within the aquifer;

(15) Other information as may be reasonably necessary for the County to determine the potential effects of the proposed well operations on the groundwater safe yield and aquifer health of the affected aquifer;

(16) Supporting documentation, where available, for all of the foregoing items.

(c) *Permit Review.*

(1) Procedure: administrative review or public hearing.

(2) Reviewing authority: The Director of the Department of Public Health, Environmental Health Services Division, shall be the reviewing authority for Permit applications except in the following circumstances:

(A) Where the Director of the Department of Public Health, Environmental Health Services Division refers the proposal to the Board of Supervisors for Public Hearing.

(B) Where the proposal is filed concurrently with an application subject to Public Hearing review procedures.

(3) Where the Director of the Department of Public Health, Environmental Health Services Division is the reviewing authority, the procedure shall be considered to be Administrative Review and notice shall be provided pursuant to § 33.06555 herein.

(d) *Conditions of Approval.* Plans shall be submitted to the enforcement agency demonstrating compliance with the standards of this Article. No permit shall be issued unless the enforcement agency determines, based upon the available data, that the well(s) constructed and operated as proposed, would not result in exceeding the groundwater safe yield of the relevant aquifers. Permits may include conditions and requirements found by the enforcement agency to be reasonably necessary to accomplish the purposes of this Article, including, but not limited to, conditions requiring groundwater management, mitigation and monitoring by the applicant.

(e) *Environmental Review.* Prior to taking an action to approve an application for a permit, the enforcement agency shall make the environmental findings required under the California Environmental Quality Act.

(f) *Denial.* The enforcement agency shall deny the application where it determines that the standards of this Article have not been met; where the well operations proposed in the application would result in exceeding the groundwater safe yield of the relevant aquifers considered individually or in conjunction with other existing wells.

(g) *Permit Fees.* The hourly rates for administering the provisions of this Article are established under the provisions of the San Bernardino County Code Schedule of Fees.

(h) *Permit Suspension/Revocation or Modification.* Permits may be issued only for so long as the well operations do not exceed the groundwater safe yield of the relevant aquifers. Permits will be suspended, revoked or modified if the enforcement agency determines that continued operations under the permit would result in overdraft of the relevant aquifers.

(i) *Administrative Variances and Special Circumstances.* The County may grant an administrative variance from any provision of this Article due to special circumstances or hardship. The County may describe alternative requirements where submitted documents as may be reasonably required by the County provide substantial evidence that a modification of the requirements in this Article will not endanger the general public health and safety and strict compliance would be unreasonable in view of all of the circumstances.

(j) *Inspection and Monitoring.* The enforcement agency may, with consent or a warrant if required, at any and all reasonable times enter any and all places, property, enclosures and structures for the purposes of making examinations and investigations to determine whether any provision of this Article is being or has been violated.

§ 33.06555 Notice of Pending Decision.

(a) Upon receipt of a request for a decision, the reviewing authority shall cause notice to be given specifying the time and place at least ten calendar days prior to the date of the scheduled decision by the following applicable methods:

(1) Notice shall be published once in a newspaper of general circulation in the respective community of the proposal for decisions using the Public Hearing procedure.

(2) Notice shall be given by first class mail to any person who has filed a written request for a specific application.

(3) Notice shall be given by first class mail or delivery to all property owners within one mile of the external boundaries of the parcel of the proposed extraction for decisions using the public hearing or the administrative review procedures.

(4) Notice may be given in such other manner as is deemed necessary or desirable.

(b) Said notice shall include sufficient information to give those receiving the notice a reasonable opportunity to evaluate the implications of the proposal and to participate in the decision making process.

(c) Ownership and addresses of properties shall be determined from the latest equalized tax assessment role or from other records of the County Assessor or County Tax Collector, whichever contains more recent information.

(d) If during a public hearing, items are continued by the reviewing authority to a specific date, the items shall not be re-noticed unless specifically requested by the reviewing authority.

§ 33.06556 Appeals.

(a) Prior to its effective date, a decision made in accordance with the provisions of this Code by a reviewing authority other than the County Board of Supervisors may be appealed by the applicant or other affected party, as follows:

(1) Applications for an appeal to the Board of Supervisors shall be made on forms supplied by the enforcement agency. Applications for appeals shall be accompanied by a written statement of the grounds upon which the appeal is based. The appeal application shall identify:

(A) The subject permit application;

(B) The specific decision, condition of approval or other matter being appealed;

(C) The date of such action;

(D) The justification for the appeal; and

(E) Any remedy or solution for which the appellant petitions.

(2) A uniform fee established by the Board of Supervisors shall be paid to the County upon the filing of each appeal.

(3) A properly filed application for appeal stays proceedings in the matter appealed until a decision is rendered on the appeal.

(4) An application for an appeal must be submitted to the Clerk of the Board of Supervisors within 15 days after a notice of decision is mailed by the enforcing agency to the applicant.

(5) Within 30 days of the acceptance of an application for an appeal, the Clerk of the Board of Supervisors shall set the matter for hearing and shall give notice of the date, time and place of the hearing to the appellant, the applicant and to any other party who has requested in writing to be so notified.

(6) Upon hearing the appeal, the Board of Supervisors shall consider the record and such additional evidence as may be offered and may affirm, reverse or modify in whole or in part the decision appealed. The Board of Supervisors is subject to all of the criteria, findings and requirements imposed by this Code upon the original decision maker.

§ 33.06557 Violations, Remedies and Penalties.

It shall be unlawful for any person or entity to violate any provision of this Article. All enforcement procedures, remedies and penalties of Chapter 1 of Division 3 of Title 3of this Code shall apply to this Article and are in addition to all others provided by law.

(Ord. 3872, passed -- 2002)

ATTACHMENT B

MAMMOTH-PACIFIC LP
GEOTHERMAL POWER PLANTS
P.O. Box 1584
Mammoth Lakes, CA 93546

Via Fax and Mail

June 12, 1994

Larry Cameron

Great Basin Unified Air
Pollution Control District
157 Short St., Suite 6
Bishop, CA 93514

Mr. Cameron,

Attached is a report concerning a breakdown that occurred at the Mammoth-Pacific LP plant MP-II during May, 1994. This breakdown leaked isobutane into the water system, not to atmosphere.

The emissions estimated in the report will be deducted from the quarterly loss statements as breakdown losses, pursuant to Rule 403, unless Mammoth-Pacific is notified otherwise by the District.

Please call me if you have any questions.

Sincerely,

Delbert T. Cortopassi
Sr. Project Analyst

cc: Jim Anderson
Mike Walker
MP GBUAPCD - Loss Event Notice

MAMMOTH-PACIFIC LP
BREAKDOWN NOTIFICATION

1. The loss event described herein was corrected on June 6, 1994 at about 16:00.
2. The breakdown was caused by the failure of two heat exchanger tubes in the M:E-101A isobutane to water heat exchanger. The cause of the tube failures is unknown at this time. The tubes were removed from the exchanger and found to have one small hole in each tube.
3. Corrective measures taken include the following:
   a. The heat exchangers were isolated and hydrotested to find the bad tubes. The leaking tubes were removed.
4. Estimated emissions
   a. Estimate of breakdown emissions 47,990 lbs

Loss Estimate For MPLP 2nd Quarter 1998 Tube Leaks

Description of Event

After cleaning the PLES-I heat exchangers in early May 1998, a tube leak was discovered on May 13 when the heat exchangers were pressurized in preparation to return them to service. The exchangers were evacuated and the tube was plugged on the morning of May 14.

At 10:37 May 14 the exchangers were again pressurized with isobutane for return to service. At 11:05 another leak became apparent. They were evacuated and the tube was plugged on the morning of May 15. At 9:42 the exchangers were pressurized for return to service.

At 10:17 another leak was detected and the units were isolated and evacuated. At 9:35 on May 16 the tube was plugged and the unit was pressurized for return to service.

A plant load rejection event occurred on May 19 at 07:30. At 16:29 the leak check procedure found isobutane in the brine. The exchangers were isolated, drained and evacuated for repair. Repairs were made on the morning of May 20. At 12:39 the lockout was removed and the units were pressurized for return to service.

The frequency of checks for isobutane in the brine was increased to every 30 minutes until the morning of May 22 and then it was changed to every hour.

At 20:28 on May 23, isobutane was again found in the brine again. The units were isolated drained and evacuated. Repairs were made in the morning of May 24. Another leak was found before the units were put into service. The units were isolated drained and evacuated. Repairs were made in the morning of May 25.

Isobutane liquid levels were not stable during the first week of June. No indication of leaks was provided by the regular high point blow down. Plant surveys were taken to look for ambient leaks. The level sensing transmitters were cleaned and calibrated. Special sample kits for liquids containing non-condensible gas were ordered from a laboratory to take brine samples. Samples were taken June 9 and forwarded to the laborotory for analysis of gases present in the brine.

At 06:54 on June 23, after a plant trip, isobutane was found in the MP-II brine system. The units were removed from service, drained and evacuated. On the morning of June 24, the tube was plugged and the units were returned to service. Inventory levels have been stable since then.

Loss Estimate

Do to the number of times that heat exchangers were taken in and out of service, evacuated and refilled, the isobutane inventory was unclear throughout the course of these events. The inventory is the only possible method of determining loss rates. Before the events and after the events, the lost rate has been approximately 200 lbs/day for each of MP-II and PLES-I. The only way we have to determine the losses is to account for all known losses and purchases and attribute the remainder to the tube failures. The following is the calculations for this process.

Item	MP-II	PLES-I	Combined
Average Liquid Inventory 3/31/98	53,816	50,786	104,602
Isobutane Purchases	194,897	0	194,897
Isobutane Transfers	-105,500	105,500	0
Expected inventory with no losses	143,213	156,286	299,499
Average Ending Inventory 6/30/98	46,523	42,317	88,840
Missing Liquid Inventory	96,690	113,969	210,659
Estimated Change Due To Ambient Temperature	-11,000	-11,000	-22,000
Process Changes	-24,000	-16,000	-40,000
Estimated Fugitive Losses @ 200 lbs/day/plant	-18,200	-18,200	-36,400
			0
Estimated Inventory change due to tube leaks	-43,490	-68,769	-112,259

Comment Letter I9

JUL 28 1998
GREAT BASIN UNIFIED APCD

OK

July 21, 1998

Dr. Ellen Hardebeck
Air Pollution Control Officer
Great Basin Unified Air Pollution Control District
157 Short Street, Suite 6
Bishop, California 93514

Subject: Mammoth-Pacific LP Report of Isobutane Usage In The 2nd Qtr of 1998

Attached for your information are the isobutane loss summaries for the 2nd quarter of 1998. The loss levels at G-1 remained well below the permitted level. MP-II and PLES-I both experienced heat exchanger tube leaks which allowed isobutane to enter the geothermal water and be injected into the Bishop Tuff. We estimate that the breakdown loss at MP-II was approximately 43,490 lbs from a tube leak during June. Six tube leaks occurred in series at PLES-I and transferred an estimated 68,769 lbs of isobutane into the aquifer. We are currently evaluating the cause of the leaks and the failure of our detection methods to limit the losses to smaller quantities.

The reportable loss rates are as follows:

Plant	Loss Rate
G-1 U-100	163 lbs/day
G-1 U-200	163
G-2	200
G-3	200

Attached are copies of the loss calculations. the isobutane delivery tickets. There were no airborne breakdown loss events in this quarter. There were six isobutane deliveries in this quarter: one to MP-I; five to MP-II; and none to PLES-1. A total of 105,500 lbs of isobutane were transferred from MP-II to PLES-1.

Sincerely,

James A. Anderson
General Plant Manager

JAA/dtc

Enclosures

c: Bob Sones
File – JAA/Chron
GBUAPCD

Comment Letter I9

Mammoth-Pacific, L.P.

P. O. Box 1584
Mammoth Lakes, CA 93546
(760) 934-4893

Larry

April 17, 2000

Dr. Ellen Hardebeck
Air Pollution Control Officer
Great Basin Unified Air Pollution Control District
157 Short Street, Suite 6
Bishop, CA 93514

Subject: Mammoth-Pacific Geothermal Power Plant
Report of Isobutane Usage
First Quarter 2000

Dear Dr. Hardebeck,

As required by Permit to Operate No.'s 601 and 602 (MP-I), 575 (PLES-I), 583 (MP-II), the enclosure represents Mammoth-Pacific's report of isobutane usage and backup documentation of the period of January 1, 2000 through March 2000 for Mammoth Pacific Power Plants. This report indicates an average daily loss of isobutane from fugitive emissions for the quarterly reporting period amounting to 243 lb. / day per unit at MP- I. One load of isobutane was received during the period and no breakdown events occurred.

The loss rates at MP-II averaged 238 lb. / day. There were no breakdown events and one load of isobutane was received.

The loss rates at PLES-I averaged 234 lb. / day. There was one breakdown loss and two loads of isobutane were received at PLES-I. During the reporting period, a net amount of 3,880 pounds of isobutane were moved between PLES-I and MP-II.

MP-II and PLES-I both experienced heat exchanger tube leaks which allowed isobutane to enter the geothermal water and be injected into the Bishop Tuff. We estimate that the breakdown loss was approximately 55,954 lbs. of isobutane into the aquifer.

If you have any questions regarding the enclosed information, please let me know.

OK

Sincerely,

Yep, see follow-up correspondence — 5/18/00
letter 5/20/00

James A. Anderson
Facility General Manager

JAA/ejr
Enclosures
cc: Robert Sones, Ogden
Andrew Washington, Ogden

APR 2000
AIR POLLUTION CONTROL DISTRICT

File: D:Reports\ 0100APCD

Mammoth-Pacific, L.P.

P. O. Box 1584
Mammoth Lakes, CA 93546
(760) 934-4893

June 20, 2000

Via Facsimile and Mail

Mr. Larry Cameron
Great Basin Unified Air Pollution Control Board
157 Short Street, Suite 6
Bishop, CA 93514

Dear Mr. Cameron:

This is the supporting work concerning a breakdown that occurred at the Mammoth Pacific LP Plant MP-II(PTO#575) on June 18, 2000. After collecting data we have determined that the amount of isobutane lost was16,261 lbs.

The event was caused by a leaking tube on "A" heat exchanger. This allowed isobutane to escape into the brine re-injection system and into the injection aquifer. This breakdown did not result in losses to atmosphere, but is being reported as such per you instructions in the letter dated May 18, 2000.

The leak was discovered when a drop in accumulator over time was observed. The heat exchanger was suspected and was removed from service. Isobutane was discovered in the brine while draining the heat exchanger. The heat exchanger was evacuated and the tube was plugged.

A copy of the loss event fax is attached for your reference as well as supporting documentation. Please call me if you have any questions.

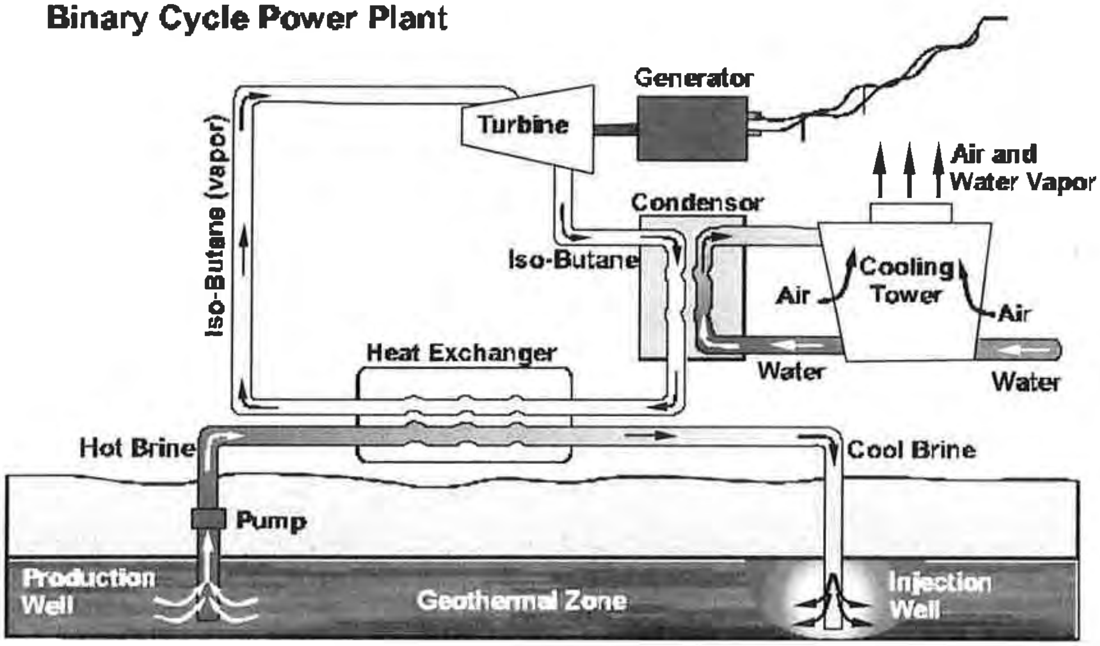
Sincerely,

Bob Sullivan
Plant Manager

cc: Jim Anderson
file: MP GBUAPCD- Loss Event Notice

ATTACHMENT C

Figure A-2. Typical Flow Diagram of a Binary Cycle Power Cycle



Source: U. S. DOE, 1998b

Geothermal Fluid and Gas Treatment Chemicals

Geothermal steam and fluids contain non-condensible gases to varying degrees depending on formation pressure, temperature, and mineralogy (Mahon, 1980). The non-condensible gases most commonly encountered in geothermal fluids are carbon dioxide, hydrogen sulfide, ammonia, hydrogen, nitrogen, oxygen, and methane (Ellis, 1977). Gas handling practices vary by plant and affect injectate gas composition and overall characteristics. At some geothermal power plants, especially binary plants, these gases are not separated from the geothermal fluid and, thus, are reinjected along with the geothermal fluid. At other plants, especially some flash plants, non-condensible gases are collected, repressurized, and reinjected with the geothermal fluids. Other flash plants and steam plants vent non-condensible gases to the atmosphere and/or remove them through treatment . Hydrogen sulfide (H_2S) is the primary target of chemical or biological gas treatment efforts that convert H_2S to elemental sulfur.

Chemicals not native to the formation are introduced into the injected fluids as a result of the use of additives to control biofouling, corrosion, and scaling of the plant equipment. The type of chemicals used for these purposes are illustrated by a list of active ingredients for additives provided in the UIC permit for injection wells at Pahoa, HI, which includes (USEPA Region 9, 1998):

- sodium sulfite,
- benzoic acid,
- sodium hydroxide,
- sodium gluconate,
- dimethyldioctylammonium chloride,
- soya amine polyethoxylate,
- cychlohexlamine,
- polyamidoamino acetate,
- POE (15) tallow amine,
- sodium metabisulfite,
- cobalt compounds,
- sodium chloride,
- phosphoric acid derivative,
- magnesium nitrate,
- 5-chloro-2-methyl-4-isothiazoline-3-one,
- magnesium chloride,
- 2-methyl-4-isothiazolin-3-one,
- cupric nitrate,
- disodium ethylenebis-dithiocarbamate,
- dimethylamine,
- ethylene diamine,
- ethylene thiourea, and
- sulfuric acid.

Supplemental Water Sources

At most geothermal fields used for electric power generation, the injected fluids consist of spent geothermal fluid in combination with other fluids generated onsite by plant operations, such as cooling tower blowdown. At a few geothermal power plants, however, fluids in addition to those produced from geothermal reservoirs are routinely injected along with spent geothermal fluids to supplement fluid recharge in the geothermal resource.

At The Geysers, for example, fluids injected down some of the 29 active injection wells in 1997 (CDOG, 1998a) included storm water runoff from power plant sites, water from Big Sulfur Creek and Clear Lake, treated wastewater effluent from the Lake County Sanitation District (LACOSAN), and treated sanitary wastes generated at the power plant sites (Crocket, 1990; Dellinger, 1998). The largest volume supplemental source of injection water at The Geysers is the 7.8 mgd from Clear Lake and LACOSAN that is delivered to The Geysers through a 29-mile pipeline and then distributed to selected injection wells within the field. Injection of waters from some supplemental sources occurs seasonally (i.e., storm water runoff during the winter "rainy season" and waters from Big Sulfur Creek) while other sources do contribute year round. The relative contribution of the various sources to aggregate characteristics of the injected fluid varies also seasonally because the amount of geothermal

USGS
science for a changing world

U.S. GEOLOGICAL SURVEY and the U.S. FOREST SERVICE—OUR VOLCANIC PUBLIC LANDS

Boiling Water at Hot Creek—The Dangerous and Dynamic Thermal Springs in California's Long Valley Caldera

The beautiful blue pools and impressive boiling fountains along Hot Creek in east-central California have provided enjoyment to generations of visitors, but they have also been the cause of injury or death to some who disregarded warnings and fences. The springs and geysers in the stream bed and along its banks change location, temperature, and flow rates frequently and unpredictably. The hot springs and geysers of Hot Creek are visible signs of dynamic geologic processes in this volcanic region, where underground heat drives thermal spring activity.

Hot Creek flows through the Long Valley Caldera in a volcanically active region of east-central California. This stretch of the creek, looking upstream to the southwest, has long been a popular recreation area because of the warm waters from its thermal springs. These springs, however, are unpredictable and can suddenly erupt with violence and at boiling temperature. Because of this danger, the U.S. Forest Service has had to close parts of the Hot Creek Geologic Site to visitors. (USGS photo by Chris Farrar.)

In the Hot Creek Geologic Site, located in a narrow gorge 8 miles (12 km) east of the town of Mammoth Lakes, numerous hot springs flow into a snowmelt-fed stream. The area is managed by the U.S. Forest Service as a geologic interpretive site and has been a popular recreational area for fishing, swimming, hiking, bird watching, and photography. The U.S. Geological Survey (USGS) has long monitored spring activity, water temperatures and chemistry, and stream flow as part of a program that seeks to better understand volcanic unrest and possible geologic hazards throughout the region.

Conditions in Hot Creek can change very quickly. These fish—caught in a burst of high-temperature water—were cooked instantly. (USGS photo by Chris Farrar.)

The attractions of Hot Creek, however, also harbor danger. The locations, discharge rates, and temperatures of springs often change. The larger and more vigorous springs flow from fractures in the volcanic rock (altered rhyolite) in Hot Creek gorge. When fractures become sealed by mineral deposition, spring discharge and temperature decline. When new fractures develop or sealed fractures reopen, spring discharge and temperatures can increase suddenly. Rock fracturing happens because the thermal area lies within a region of frequent earthquakes and active ground uplift (deformation). The changes in the locations and vigor of springs can be sudden and dangerous to unprepared visitors, especially if they stray beyond walkways and fences.

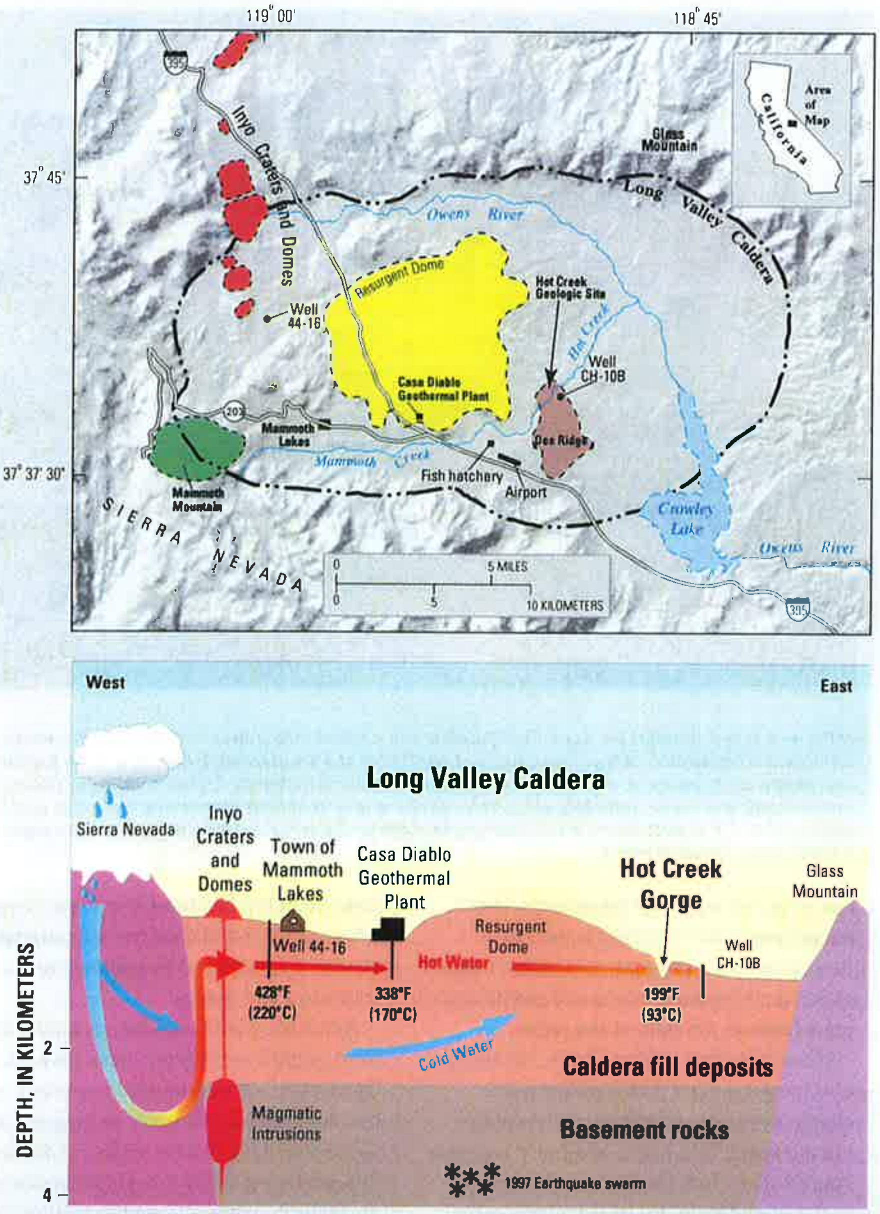
Since May 2006, springs in and near the most popular swimming areas have been "geysering" or intermittently spurting very hot, sediment-laden water as high as 6 feet (2 m) above the stream surface. At times this geysering activity is vigorous enough to produce "popping" sounds audible from hundreds of feet away. The geysering usually lasts a few seconds and occurs at irregular intervals, with several minutes between eruptions. The unpredictability of this hazardous spring activity led the U.S. Forest Service to close parts of the Hot Creek Geologic Site in June 2006, and the closure has remained in effect to date (June 2007).

The thermal springs in Long Valley Caldera have long been known to Native Americans. Many of the hot springs have special status with Native American tribes and have been used for spiritual and medicinal purposes. Early written records of the springs came from visits by pioneers and scientists— USGS scientist G.A. Waring visited thermal springs in Long Valley in 1908 and later wrote a paper describing hundreds of springs throughout California.

Volcanic History of the Hot Creek Area

The Hot Creek Geologic Site lies within the Long Valley Caldera, a large topographic depression formed 760,000 years ago during a massive volcanic eruption that produced extensive and thick deposits of ash and pumice. A reservoir of partially molten rock (magma) beneath the caldera has produced subsequent volcanic eruptions. This activity formed many hills within the caldera, such as the 300,000 year-old Hot Creek rhyolite flow, known locally as Doe Ridge. The toe of that slow-moving lava entered a lake, where interaction with water altered the rhyolite and formed clay and perlite, a gray to black, glassy material with a pearly luster now exposed along the path from the parking area down into the gorge. After the lake receded, a stream cut the steep-sided gorge through the toe of the solidified lava.

This stream, known here as Hot Creek, begins its winding course some 11 miles (17 km) to the west as Mammoth Creek, flowing through a series of small lakes west of the town of Mammoth Lakes. The stream water is derived primarily from melting snow as it leaves Twin Lakes, 8,500 feet (2,600 m) above sea level. It is quite cold, rarely above 50°F (10°C). About 1.5 miles (2.5 km) upstream from the thermal area, Mammoth Creek is joined by warmer water from thermal springs in the Hot Creek State Fish Hatchery. From this point on, the stream is named Hot Creek even though water temperature seldom exceeds 68°F (20°C) until it reaches the main thermal springs in the gorge.

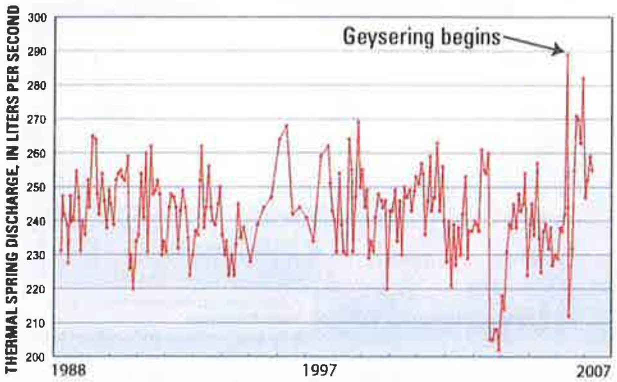


Simplified geologic map (top) and diagrammatic cross section (bottom) of Long Valley Caldera. The resurgent dome, Doe Ridge, Mammoth Mountain, and the Inyo Craters and Domes all reflect volcanic activity since 760,000 years ago, when a giant eruption formed the caldera. The thermal springs in Hot Creek are fed by Sierra Nevada snowmelt that seeps underground and migrates eastward, becoming heated to temperatures as high as 428°F (220°C) in the vicinity of partially molten rock (magma) beneath the western part of the caldera. The water cools as it migrates eastward beneath the ground (red arrows). The temperature at which water emerges in the springs at Hot Creek could be affected by changes in seismic activity, heat extraction, mixing with cooler water, and other factors.

Why is Hot Creek Hot?

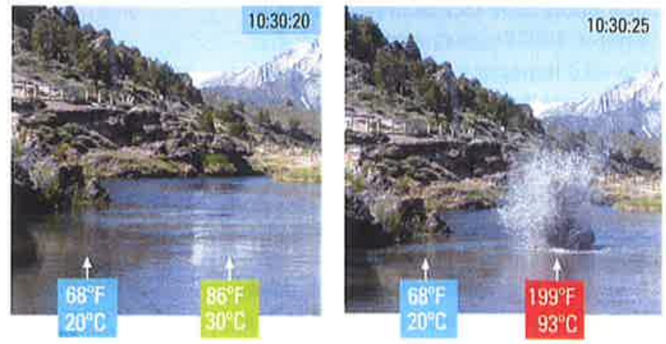
In hydrothermal ("hot water") systems the circulation of ground water is driven by a combination of topography and heat sources. The system in Long Valley Caldera is recharged primarily from snowmelt in the highlands around the western and southern rims of the caldera. The meltwater infiltrates to considerable depths, where some is heated to at least 430°F (220°C) by hot rock near cooling magma beneath the Inyo Craters and Domes, 10 miles (16 km) west of Hot Creek. This volcanic chain extends from the western part of Long Valley Caldera northward to Mono Lake and has produced numerous eruptions over the past 40,000 years, the latest only a few hundred years ago. The heated water, kept from boiling by high pressure, still has lower density than cold water, and it rises along steeply inclined fractures to depths of 0.3-1.25 miles (0.5-2 km). It then flows eastward through rock layers to discharge points at the surface along Hot Creek and around Crowley Lake. The water temperature de-

THERMAL WATER INPUT TO HOT CREEK



The U.S. Geological Survey monitors the thermal water discharge in Hot Creek gorge by measuring chloride concentration in the stream above and below the hot springs. The onset of geysering in 2006 was accompanied by a small spike in discharge. (1 liter = 0.264 gallon.)

DANGER COMES QUICKLY



The temperature in Hot Creek can change in seconds. These photos were taken 5 seconds before and then during a violent geysering event, in which boiling water (at 199°F or 93°C, the boiling point at this elevation) erupted above the surface. Any swimmer caught in this part of the creek would have been severely scalded. (Photos courtesy of Alix Ginter.)

creases eastward because of heat loss and mixing with cold water, and in the springs near Crowley Lake temperatures are at only about 125°F (50°C).

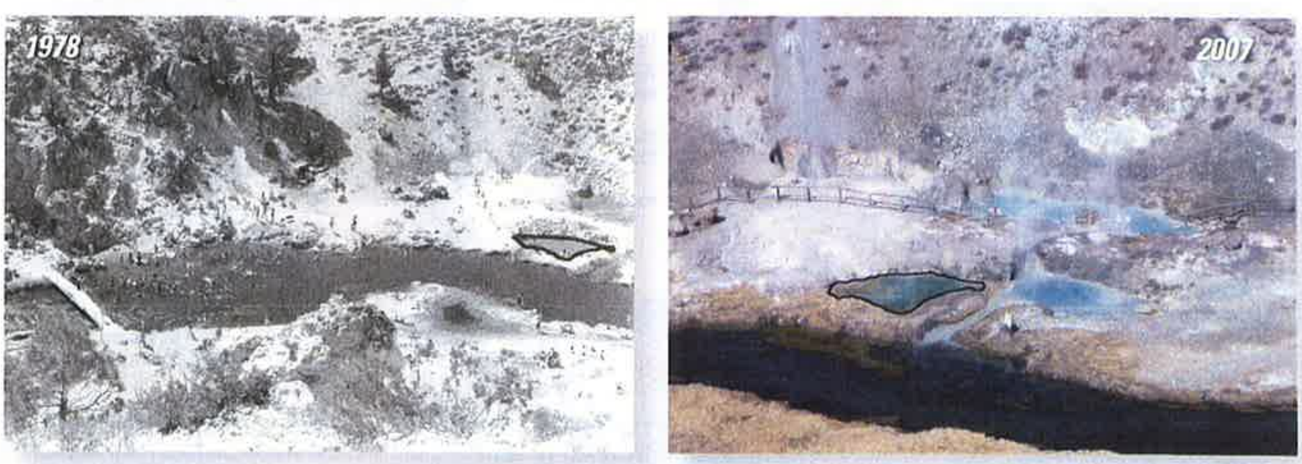
The springs in Hot Creek all emerge along a stream section between two faults and discharge a total of about 8.5 cubic feet per second (about 240 liters per second) of hot water. This water flow represents nearly 70 percent of the total heat discharged by all thermal springs in Long Valley Caldera. The thermal springs farther east all discharge less water and at lower temperatures.

Possible Causes of the Recent Changes

Geysering activity similar to that which started in May 2006 also occurred along Hot Creek in 1980. That activity was during a period of greatly increased seismic (earthquake) activity and ground deformation. In 2006, however, local seismic activity and ground deformation were at the lowest levels in years, and the reason for this recent geysering is unclear. The change seems to be related to increased temperature in the shallow thermal ground water that supplies the springs. This increase was measured in the USGS monitoring well CH-10B, 330 feet (100 m) deep and located 0.6 mile (1 km) south of the gorge. Water level in this well is at the same altitude as the Hot Creek springs, and the temperature at that level reached the boiling point at about the time when geysering began in Hot Creek. What caused the temperature increase in the aquifer is not known, but it may be a delayed response to an earthquake swarm in 1997 that could have opened new flow pathways for hot water.

An alternative explanation for the onset of geysering is increased pressure in the aquifer leading to increased flow rate at

THE HOT CREEK GEOLOGIC SITE IS ALWAYS CHANGING



Before the present episode of unpredictable and dangerous geysering at Hot Creek, similar activity occurred here in the the 1930s and again in the early 1980s. A pool (outlined) where people used to soak in the 1970s (left photo) was near boiling temperature in the 1980s. It was then fenced off by the U.S. Forest Service in the interest of visitor safety. As you can see in the recent photo (right), Hot Creek Geologic Site continues to change, and the fence now goes through a pool instead of around it. (Left: USFS file photo; right: USGS photo by Dina Y. Venezky.)

Comment Letter I9

University of California
California Fish Website

California Fish Species

Fish	Tui Chub
Scientific Name	Gila bicolor
Native	Native Species

Identification

Tui chub, approximately 10 cm (4") long. Date: 7/10/2007.


Tui chub (Owens tui chub). Location: University of California White Mountain Research Station. Photo by Joe Ferreira, California Department of Fish and Game.

Tui chub, approximately 10 cm (4") long, frontal view. Date: 7/10/2007.

- Heavy bodied, up to 40 cm SL or more
- Large scales, head is large relative to body, short rounded fins
- Small terminal mouth, slightly oblique
- Gap between gill rakers greater than width of raker bases
- Olive, brown, to brassy back, white to silver underside
- Young fish silvery, progressively less with age
- Fin rays: dorsal 7-9, anal 7-9
- Lateral line scales: 41-64 (decurved)

Life History

Tui chub are capable of adapting to a variety of environments and dietary habits. They are found in springs, ponds, lakes, large sluggish streams, and in the shelter of small swiftwater streams. Typically tui chub habitat is characterized by slow water and abundant aquatic vegetation. Most tui chub waters have summer temperatures in excess of 20°C. The optimal range is 15-30°C, though these fish have shown the capability to survive from 2°C to 36°C. In addition, tui chub are tolerant of dissolved oxygen levels less than 4 mg/L and can handle highly alkaline waters such as Eagle Lake. Tui chub diet may vary with location and time as these fish are opportunistic omnivores. Fish in one location may focus on detritus and supplement with invertebrates or plants, whereas in a different water body they might focus on benthic macroinvertebrates and supplement with fish and fish eggs. Most often tui chub feed on detritus, organic matter, and plants. The characteristics of a water body affect both feeding and growth in these fish. Tui chub found in ponds or springs rarely exceed 20 cm SL, though in large lakes chubs commonly reach 30-40 cm SL. Tui chub reach sexual maturity after 2-4 years and spawn in spring and summer, with most breeding occurring between April and July. In some isolated ponds spawning may begin as early as February and continue into August. Fecundities are typically high, and eggs sometimes ripen at different times, leading to multiple spawning sessions per season. Typically tui chub spawn in shallow water areas with adequate gravel substrate and aquatic vegetation. One female may be surrounded by several males waiting to fertilize eggs. The fertilized eggs stick to the substrate or aquatic plants until hatching 3-6 days later. The resulting larvae feed in a pelagic state until reaching a length of around 2 cm, at which time they move towards shallow water. Tui chub may live up to 33 years in large lakes, though they tend to have shorter lifespans in small isolated waters.

Watershed Crowley Lake Watershed, East Walker Watershed, Goose Lake Watershed, Honey-Eagle Lakes Watershed, Lake Tahoe Watershed, Lost Watershed, Lower Klamath Watershed, Lower Pit Watershed, Madeline Plains Watershed, Mojave Watershed, North Fork Feather Watershed, Owens Lake Watershed, Scott Watershed, Shasta Watershed, Southern Mojave Watershed, Tomales-Drake Bays Watershed, Truckee Watershed, Upper Carson Watershed, Upper Klamath Watershed, Upper Pit Watershed, Warner Lakes Watershed, West Walker Watershed

Please note, watersheds are at the USGS 8-digit Hydrologic Unit Code (HUC) scale, so they often include a lot of sub-watersheds. If a species occurs in any sub-watershed within the HUC, the species appears within the HUC. Link to an EPA page that shows HUCs.

Agriculture and Natural Resources, University of California

Webmaster Email: mailto:lcthompson@ucdavis.edu?subject=CalFish Website Query

geologica

REPORT

EVALUATION OF THE OWENS TUI CHUB HABITAT

LONG VALLEY CALDERA MONO COUNTY, CALIFORNIA

For
County of Mono
Department of Economic
Development and Special Projects

By

geologica

December 17, 2003

-EXECUTIVE SUMMARY

This evaluation of the Owens tui chub habitat was performed to assess the current understanding of the habitat requirements of the Owens tui chub. The Owens tui chub is a federally listed endangered species due to species invasion and habitat degradation. The remaining genetically pure Owens tui chub populations only exist in habitats that are isolated from non-native fish. The isolation is necessary to protect the Owens tui chub from the Lahontan tui chub. a subspecies with which it readily interbreeds and hybridizes, as well as predatory exotic fish such as brown trout and largemouth bass.

Critical habitat has been designated as 'high quality cool water with adequate cover in the form of rocks, undercut banks, or aquatic vegetation, and a sufficient insect food base." Aspects of critical habitat include the following:

Vegetation and Water Flow – Owens tui chub are observed in low velocity waters, typically associated with well-developed beds of aquatic vegetation. Vegetation is used for predator avoidance, reproduction, water velocity displacement. and feeding

Temperature and Water Quality – Owens tui chub are found both in habitats of consistent temperatures, such as the Hot Creek Headsprings and the Little Hot Creek waterfowl impoundment, and habitats with fluctuating seasonal temperatures such as Lower Owens Gorge, White Mountain Research Station, and Mule Spring. At the Hot Creek Headsprings, water temperatures in the past 15 years have ranged from roughly 14.5 to 18.0 °C. At the White Mountain Research Station, annual temperatures fluctuate from 2 °C in winter up to 25 °C in the summer. Most species of chub spawn at temperatures between 13 and 17 °C.

Food Sources – Like other chubs, the Owens tui chub is an omnivore which feeds mainly by gleaning and grazing among the vegetation. Important food sources appear to be the chironomid larvae, micro caddisfly larvae, and detritus, mostly algae and plankton

Reproduction – Tui chubs typically spawn from late winter to early summer over aquatic vegetation or gravel bottom. Vegetation is considered important for the survival of the young larvae.

Predators – As mentioned above, non-native fish are predators of the Owens tui chub. The Lahontan tui chub readily interbreeds with the Owens tui chub resulting in hybridized, non-genetically pure offspring. Other predatory exotics such as brown trout and largemouth bass consume the smaller tui chub. The genetically pure Owens tui chub only exists where there are physical barriers to migration of the non-native fishes.

EVALUATION OF THE OWENS TUI CHUB HABITAT
LONG VALLEY CALDERA
MONO COUNTY, CALIFORNIA

1.0 Purpose and Scope of Services

This report has been prepared by Geologica, Inc., for Mono County in accordance with our scope of work (Attachment A2, Agreement between County of Mono and Geologica dated August 15, 2003).

An evaluation of the Owens tui chub habitat is important to the ongoing monitoring of the Long Valley Hydrological System to understand the range of water quality, flow and temperatures in surface features of the Long Valley Hydrological System that the Owens Tui Chub inhabits. This evaluation was accomplished by, and limited to, a review of research and information on the Owens Tui Chub available in the public domain and telephone interviews of appropriate individuals at regulatory agencies responsible for monitoring of this endangered species

1.1 Available Data

Few studies have been conducted specifically on the habitat requirements of the Owens tui chub. An overview of the life history of the tui chub species, in general, is provided by Moyle's classic textbook, Inland Fishes of California (2002). Absent specific habitat information regarding the Owens tui chub subspecies, one might infer that the Owens tui chub habitat lies within the generalized information provided about the species. Many of the environmental assessment documents cite McEwan's detailed study of Owens tui chub inhabiting the Hot Creek Headsprings (1989). Similarly, Jenkins (1990) describes the Owens tui chub at the Owens River Gorge.

Ongoing monitoring of the remaining Owens tui chub populations and habitats has been performed by the California Department of Fish and Game (Steve Parmenter, personal communication, 2003). The most recent report available is the 1999 Monitoring of Sensitive Aquatic Animals in The Owens Basin (Malengo, 1999). The 2002 monitoring report has not yet been completed but should be available soon. Other recent studies on the Owens tui chub have focused on genetics and systematics. References are provided in Section 6.0.

2.0 Introduction

The Owens Tui Chub (*Siphateles bicolor snyderi*) is a sub-species of tui chub. The tui chub is a minnow (*Cyprinidae*), typically small silvery fish. In California, tui chubs are native mostly to interior drainages, except the Central Valley, and absent from all coastal drainages, except where introduced. Tui chubs occur in many habitats. isolated springs. large desert lakes, sloughs, meadow streams, sluggish rivers, and backwaters of swift creeks (Moyle, 2002). Ten subspecies of tui chub are recognized in California, although further taxonomic work may change the current status. The tui chub subspecies include: Klamath; Cowhead Lake; Goose Lake; Pit River; Lahontan; Eagle Lake; High Rock Springs; Owens; and Mohave.

Early fish collections from the Owens Basin at the beginning of the 20th century suggest that the Owens tui chub were common and occupied a variety of aquatic habitats of the Owens River basin in Inyo and Mono counties (Miller, 1973). Since then, their survival has been imperiled by species invasion and habitat degradation. By 1974, the number of Owens tui chubs had declined so precipitously that the state of California added it to their endangered species list. In 1985, the fish became listed as "endangered" under the federal endangered species act (USFWS, 1998).

Tui chub currently occupy many valley-floor habitats in the Owens River and its tributaries, however, few of these populations are genetically pure Owens tui chub. Non-hybridized Owens tui chub appear to exist only where suitable habitat is isolated from non-native fishes. The isolation protects the Owens tui chub not only from predatory exotic fish such as brown trout and largemouth bass, but more importantly, from the Lahontan tui chub with which it readily interbreeds and hybridizes. The Lahontan tui chubs were presumably introduced as fish bait and spread throughout the Owens River basin.

The remaining genetically pure Owens tui chub populations exist in the following isolated habitats: 1) the AB and CD springs at Hot Creek Fish Hatchery; 2) the uppermost reach of the Owens River Gorge downstream of Crowley Lake, 3) an introduced population at a waterfowl impoundment on Little Hot Creek; 4) a newly rewatered section of the Lower Owens River Gorge (identified in 1995, current existence unknown); 5) University of California's White Mountain Research Station near Bishop (transfers from the Lower Owens Gorge and their progeny); 6) irrigation ditches and spring at Cabin Bar Ranch on Owens Lake (current existence unknown); 7) an impoundment at Mule Spring established in 1990 with rescued fish from Cabin Bar; and 8) Sotcher Lake, Madera County (Middle Fork San Joaquin River drainage). Based on a recent genetic study, the Cabin Bar/Mule Spring tui chubs could merit distinction as a separate subspecies (Chen and May, 2003). The non-hybridized Owens tui chub population at Sotcher Lake occurs outside of its native range. Other hybridized tui chubs are located in the Mono Lake and Mammoth Lakes basin. The origin of these extralimital chub populations is unknown, but may result from the use of tui chubs as live bait for sportfishing or the incidental stocking of trout (Chen and May, 1993).

3.0 Habitat Requirements

While the Owens tui chub was historically present in a variety of habitats within the Owens River basin, the remaining populations are confined to limited areas that are isolated from non-native fishes. Information is provided below about the habitats of these areas. Based on its historical distribution, however, it is likely that the Owens tui chub could flourish at a wider range of conditions than currently exist in these sanctuaries, provided that non-native fishes were not present.

Critical habitat has been designated at two sites for the Owens tui chub: 1) 8 miles of the Owens River and 50 feet of riparian vegetation on either side of the river, encompassing a total of 97 acres in the Owens River Gorge; and two spring provinces and 50 feet of riparian vegetation on either side of spring brooks encompassing approximately 5 acres at Hot Creek Fish Hatchery. Constituent elements of Critical Habitat include high quality, cool water with adequate cover in the form of rocks, undercut banks, or aquatic vegetation, and a sufficient insect food base (50 CFR 17.95 (e)). In addition, the designation identified activities that could adversely modify the critical habitat of the tui chub to include " activities that decrease available water or cause significant change in the physical or chemical properties (e.g. temperature, pH, or dissolved gases of the water).

3.1 Vegetation and Water Flow

The "typical" tui chub habitat is quiet water with well-developed beds of aquatic plants and bottoms of sand or other fine materials (Moyle, 2002). McEwan observed a close affinity of the Owens tui chubs for aquatic vegetation in the Hot Creek Headsprings. He attributed it to four reasons: predator avoidance, reproduction, water velocity displacement, and feeding (McEwan, 1989). Under natural conditions, the aquatic vegetation in both springs covers 75% of the stream surface area, growing out from the sides of the channel. The substrate is a fairly uniform gravel/sand/silt mixture with a high degree of embeddedness. McEwan recommended limiting vegetation removal for hatchery operations to the center one-third of the channel, and only during the non-spawning period.

Morphology, swimming ability, and behavior all suggest that the tui chub as a species is not a stream adapted fish, yet it occurs in many moderate velocity streams, such as the Owens River, Hot Creek and Mammoth Creek. Beds of aquatic vegetation probably create suitable habitat in these streams. Water velocities in the beds of aquatic vegetation at the Fish Hatchery AB and CD springs was essentially zero. Velocities in the surrounding open water were recorded at 0.15m/s (0.5 ft/s). Chubs were observed darting across areas of relatively high velocity to move from one vegetation bed to another, but sustained swimming was not observed in those areas (McEwan, 1989). Water velocities in the waterfowl impoundment and holding ponds are presumed to be low as well.

The CD springs were virtually devoid of vegetation at the time of the 1999 annual monitoring and no tui chub were observed.

In Jenkins' study of the Owens River Gorge fish community, he observed that Owens tui chub were fairly abundant in pools and absent from riffles throughout the stream. The entire population of chubs probably numbered fewer than 5,000, most of which lived in the first kilometer of stream or in rare pool-like areas distributed sparsely along its length. Young-of-year chubs were found only at two sites, both of which were artificially constructed. One was a pond created by a concrete weir, and the other was an abandoned beaver pond. The water was deeper and slower in these areas, and encroached by aquatic vegetation on all sides (Jenkins, 1990).

3.2 Temperature and Water Quality

Information regarding temperature and water quality is presented below for the tui chub species in general, and specifically for the different Owens tui chub habitats.

3.2.1 Tui chubs in general

Waters containing abundant tui chubs usually have summer water temperatures in excess of 20 degrees C and are alkaline, but do well under many conditions from the cold, clear waters of Lake Tahoe to the cool, productive waters of Pyramid Lake, Nevada where total dissolved solids are greater than 4,700 ppm, approximately 75% sodium chloride. Mohave tui chubs, the southernmost representative of the species can survive temperatures from 2 to 36 °C, but optimal temperatures are between 15 to 30 °C. The range of alkalinities tolerated is considerably greater. Tui chubs are regularly found at pH values greater than 9 and can tolerate pH levels of around 11. Tui chubs are also tolerant of low dissolved oxygen levels. In Pyramid Lake they are regularly found at oxygen levels less than 50% saturation, and when the water is cold, they will survive at less than 25% saturation, or 4 mg/L (Moyle, 2002).

3.2.2 Owens Tui Chub

The remaining Owens tui chub habitats vary significantly with respect to water temperature and quality. Table 1 summarizes water temperature and quality information at these Owens tui chub habitats.

Hot Creek Springs (Fish Hatchery AB and CD Springs)

Several studies of the Fish Hatchery AB and CD spring temperatures suggest that temperatures have been fairly constant over the past 15 to 20 years.

McEwan measured temperature and some water quality parameters during his study from 1986 to 1988 at the Hot Creek springs. His results suggested that temperatures in the two springs were quite constant, ranging from 14.5 to 16.0 °C during this period. Dissolved oxygen concentrations varied from 5.4 to 7.0 mg/L and pH ranged from 6.6 to 7.0. Alkalinity varied from 68.0 to 88.4 mg/L (McEwan 1989).

During 1988 to 1997, the mean monthly temperature at the AB spring ranged from 16.3 to 18.0 °C, while the CD spring ranged from 14.5 to 16.8 °C (California Department of Fish and Game, 1998). The temperatures increased during the drought years (1987-1992) with low spring flows.

The 1999 California Department of Fish and Game monitoring (Malengo, 1999) measured the following water chemistry values: dissolved oxygen 5-6 mg/L; conductivity 230-255 Mmhos; pH 7.6; temperatures 14.6 °C (CD spring) and 16.7 (AB spring).

Results of the Long Valley Hydrological Monitoring Program summarized in the Hydrological Interpretive Report on the Geothermal System in Long Valley, Draft dated December 17, 2003 by Geologica, also indicate that temperatures in Fish Hatcher Springs AB and CD have varied over a narrow range between 1997 and 2002. While Fish Hatchery Spring AB ranged from >18 to 15.5 °C, temperatures in the CD springs were lower, ranging from 14 to almost 17 °C over this time period (Figure 1).

Little Hot Creek Waterfowl Impoundment

Water in Little Hot Creek cools significantly by the time it reaches the waterfowl impoundment. Steve Parmenter, California Department of Fish and Game) recalls that temperatures range from 21 to 25 °C (personal communication, November 26, 2003) in the waterfowl impoundment.

Upper Owens River Gorge

Water temperature in the Upper Owens Gorge is much cooler than in Hot Creek without the thermal contribution of the springs, and due to the high elevation and summer shade. Jenkins reports that chubs live in water temperatures below 8 °C from December through February (with extremes of 3.5 °C) and at temperatures from 12 to 19 °C for the rest of the year (Jenkins, 1990).

Basic water chemistry values for the Upper Gorge areas measured in 1980 were as follows: 106 total alkalinity (as CaCO3, mg/L); 250 mg/L total dissolved solids; 274 Mmhos/cm specific conductance; 53 mg/L dissolved hardness (as CaCO3); and 7.8 pH (Jenkins, 1990). The 1999 annual monitoring water chemistry data were: dissolved oxygen from 5.2 to 6.9 mg/L; conductivity from 300 to 340 Mmhos; pH between 8.1 and 8.6; and temperatures from 11 to 14.4 °C.

White Mountain Research Station

Three experimental ponds approximately, 18m x 18m in size, and one smaller decorative pond have been constructed by the University of California for research projects. Temperatures fluctuate greatly in the holding ponds., In winter, the ponds reportedly have a skin of ice on top and temperatures of 2-3 °C. Temperatures up to 25 °C were recorded in summer (Parmenter, personal communication, 2003). The 1999 monitoring, performed in September, recorded the following water chemistry values: dissolved oxygen 5.6–9.3 mg/L; conductivity 430-660 Mmhos; pH 7.8-8.9; and temperature14.2-19.6 °C.

Cabin Bar Ranch

The 1999 annual monitoring, was performed on June 28, 1999. Water chemistry readings were as follows: dissolved oxygen 2.8-3.2 mg/L; conductivity 202 to 207 Mmhos; pH 7.7 to 8.2; and temperatures of 20.1-20.2 °C. These small ponds would presumably be close to freezing in winter.

Mule Spring

Fish habitat at Mule Spring consists of a rectangular-shaped pond measuring 13m by 9.5m. The 1999 annual monitoring reported the following water chemistry values at the pond inlet: dissolved oxygen 5.8 mg/L; conductivity 870 Mmhos; ph 8.2; temperature 21.1 °C As in the above small ponds, water temperatures in winter would likely be close to freezing.

Sotcher Lake

One would expect distinct seasonal variations in water temperature at Sotcher Lake. We are attempting to locate this data.

3.3 Food Sources

Like other chub subspecies, Owens tui chub is an opportunistic omnivore which feeds mainly by gleaning and grazing amongst the vegetation. A diet analysis of the chub in the AB and CD springs (McEwan, 1989) indicated a diversity of food items (up to ten items in summer) and that chironomid larvae appeared to be the most important food item. They were present in 77.1% of the digestive tracts examined. Other important items were micro caddisfly larvae and detritus, mostly algae and plankton. The constant temperature of the springs promotes year-round growth and production of aquatic plants, algae, and invertebrate food base, allowing the Owens tui chub to remain active year-round.

3.4 Reproduction

Some aspects of tui chub life history can be surmised from studies of other species. In general, tui chubs congregate from late winter to early summer to spawn over aquatic vegetation or gravel substrate (Kimsey, 1954). Females may produce a large number of eggs. A female from Eagle Lake measuring 28 cm contained 11,200 ripe eggs, females from an Oregon population measuring 15-28 cm contained 4,140-25,000 eggs, and Mohave tui chubs measuring 10-22 cm contained 3,800-50,000 eggs. Spawning in most places occurs at temperatures between 13 and 17 °C, although Mohave tui chubs have been recorded spawning at 26 °C. Newly fertilized eggs are 1.5-1.9 mm in diameter and adhere to aquatic plants or bottom. Embryos hatch in three to six days and larvae start feeding soon after hatching (Moyle, 2002).

In McEwan's study Owens tui chub at the Hatchery headsprings, he found a long spawning season, from February until July. Because the water temperature remains constant year-round, it was unclear what environmental stimulus triggered spawning. While he did not observe the Owens tui chub eggs in the vegetation, he noted the adhesive quality of the eggs and observed larval and young chubs in the aquatic vegetation. Aquatic vegetation is presumed to be essential to its reproductive success (McEwan, 1989)

3.5 Predators

As noted above, the greatest predator to the reproduction of the genetically pure Owens tui chub subspecies, is the non-native Lahontan tui chub with which it readily interbreeds. As it is virtually impossible to eradicate the Lahontan tui chub from the Owens River basin, the Owens tui chub exists only in isolated refugia where there are physical barriers to migration of the non-native fishes.

As there are no native fish in the Owens River drainage that eat other fish (McEwan, 1989), the Owens tui chub has not co-evolved with a fish predator and may not have learned predator avoidance. Therefore, it has declined with the introduction of other predatory exotic fish, including brown trout and largemouth bass.

No predation, however, was observed by fingerling rainbow trout present in the AB and CD headsprings, indicating that tui chubs are not a preferred food for these trout at the time of the McEwan's study. Insects appeared to be the most important food item for the trout. McEwan postulates that the trout are selecting for food items which require less energy to capture. The overlap of prey items, particularly chironomids, between trout and tui chubs suggests some competition for food resources is occurring. He also suggested that the trout's diet might shift to include chubs as the trout grow larger (only small ones were observed)

(McEwan, 1989). In fact, numerous trout were observed in the 1999 monitoring of the CD spring, while tui chub were absent (Malengo, 1999). McEwan also observed potential predation by black crowned night herons and great blue herons. The herons cause trout losses at the Hatchery as well.

4.0 Appropriate Habitats within the Long Valley Caldera

The essential requirements for Owens tui chub habitat appear to be: 1) physical isolation from non-native fish; 2) vegetation; 3) low-velocity waters; 4) sufficient food sources (larvae and detritus); 5) water temperature and quality within its tolerance range. Of these, isolation is probably the most important.

The Owens Basin Wetland and Aquatic Species Recovery Plan (US Fish and Wildlife Service, 1998) describes actions necessary to restore populations and enhance habitat for the Owens tui chub and other threatened or endangered species so they no longer require protection of the Endangered Species Act. It is a broad ecosystem-based recovery plan. The Plan identifies a number of potential Conservation Areas, or landscape units characteristic of the Owens Basin valley-floor that include habitat for rare species, where impacts to existing land and water uses are minimal and chances for recovery of candidate species are greatest. The Conservation Areas include: Little Hot Creek and Hot Creek in Long Valley; Round Valley, Fish Slough, Warm Springs, Blackrock and Southern Owens in the Owens Valley; and Mule Spring in the Inyo Mountains. These habitats are on lands owned by Los Angeles Department of Water and Power, Bureau of Land Management, and US Forest Service. Besides the difficulty of obtaining cooperation from these entities, one problem of this multi-species plan with respect to the Owens tui chub is maintaining isolation on a stream system such as Little Hot Creek. If non-native fish are present within the Conservation Area, an Owens tui chub population will probably not be viable.

The success of the Owens tui chub at Sotcher Lake indicates that it is adaptable, even to habitats out of its native range. Within the Long Valley Caldera, suitable habitat for Owens tui chub may exist in isolated ponds or impoundments that could be stocked with the fish. The landowner, however, would have to agree to the restrictions on land use and potential responsibilities of maintaining an endangered population.

5.0 Conclusions

Owens tui chub habitat in the Long Valley Caldera is typically low velocity waters with abundant vegetation, and includes a wide range of water temperatures. Waters vary from the consistently warm temperatures of the Fish Hatchery Springs and Little Hot Creek impoundment (14-18 °C and 21-25 °C, respectively) to the seasonal variations observed in the Upper Owens Gorge and various holding ponds where temperatures can range from 2-25 °C within a year.

Perhaps the greatest challenge to the Owens tui chub is locating habitats that are free of non-native fish, for its biggest threat appears to be introduced exotics such as the Lahontan tui chub with which it readily interbreeds and predatory fish such as brown trout and largemouth bass.

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Habitat	*Temperature (° C)*	*Water Quality (mg/L)*	*Vegetation*	*Population*
AB Springs Hot Creek (McEwan, 1989); (CDFG, 1998)	14.5-16.0 16.3-18.0	DO 5.4-6.8, Alkalinity 68.0-81.6; PH 6.6-6.9	Abundant floating vegetation	Native 334 +/- 105 individuals in 1988. 180-245 in 1999
CD Springs Hot Creek (McEwan, 1989), (CDFG, 1998)	14.5 14.5-16.8	DO 5.8-7.0; Alkalinity 74.8-88.4, PH 6.7-7.0	Abundant in 1988, absent in 1999	Native. 523 +/- 145 individuals in 1988. Not observed in 1998-1999
Upper Owens River Gorge (Jenkins, 1990; Malengo, 8/1999)	3.5 – 19 11-14.4	Alkalinity 106, TDS 250 pH 7.8 DO 5.2-6.9 PH 8.1-8.6	Abundant in pools where chubs observed	Native Less than 5000 in 1989. 28 observed in 1999
Waterfowl Impoundment Little Hot Creek (Parmenter, 2003)	21-25	NA	NA	811 transplants from CD Springs and Upper Owens in 1988
UC White Mountain Research Station ponds (CDFG, 2003) (Malengo, 9/1999)	2-25 14.2-19.6	DO 5.6-9.3 pH 7.8-8.9	Thick algae	24 transplants from Lower Owens Gorge relocated in 1997. 40 chub moved to new pond in 1999.
Cabin Bar Ranch pond (Malengo, 6/1999)	20.1	DO 2.8-3.2 pH 7.7-8.2	Dense aquatic vegetation	273 trapped in 1999 monitoring;
Mule Spring (Malengo, 6/1999)	21.1	DO 5.8 pH 8.2	Cattails along edges	52 transplants from Cabin Bar in 1990. Few in 1999.
Sotcher Lake Madera County	NA	NA	NA	Incidental population

Table 1. Selected Characteristics of Owens tui chub habitat.

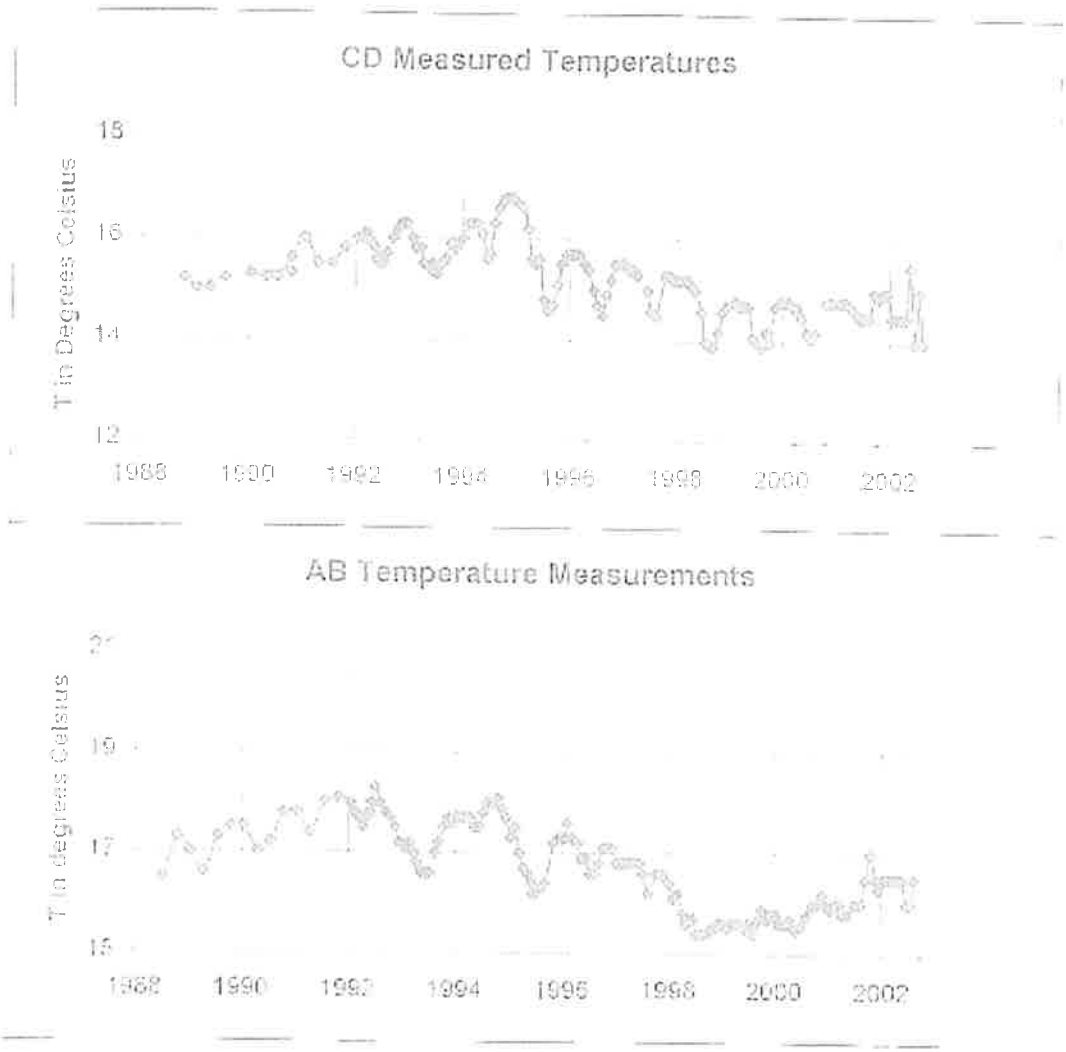

Figure 1. Temperatures in Fish Hatchery Springs AB and CD
Evaluation of Owens Tui Chub Habitat

Owens Tui Chub (*Siphateles bicolor snyderi* = *Gila bicolor snyderi*)

[Species photo to come]

Legal Status

State: Endangered, Fully Protected
Federal: Endangered (50 FR 31592–31597)
Critical Habitat: Designated on August 5, 1985 (50 FR 31592–31597)
Recovery Planning: Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties (USFWS 1998)
Notes: The 5-year review for this species (USFWS 2009) found that threats that were present when the Owens tui chub was listed are still present with new threats identified. The recovery priority number assigned was 3, which indicates the taxon is a subspecies that faces a high degree of threat and has a high potential for recovery (USFWS 2009).

Taxonomy

The Owens tui chub (*Siphateles bicolor snyderi*) is a member of the minnow family (*Cyprinidae*). It was described in 1973 as a subspecies of tui chub endemic to the Owens Basin (Miller 1973) as *Gila bicolor snyderi*. Simons and Mayden (1998) published a paper addressing the classification of the North America genera of *Cyprinidae* and, based on ribonucleic acid sequences, restored *Siphateles* from a subgenus to a full genus. The California Department of Fish and Game (CDFG) currently includes the species under the genus *Siphateles* (CDFG 2011), and the U.S. Fish and Wildlife Service (USFWS) proposes the taxonomic change from *G. b. snyderi* to *S. b. snyderi* (USFWS 2009). This taxonomic change will not affect its federal listing status.

It is morphologically similar to the Mohave tui chub (*S. b. mohavensis*) and Lahontan tui chub (*S. b. obesus*). It is distinguished from its closest relative, the Lahontan tui chub, by scales with a weakly developed or absent basal shield, lateral and apical radii that number 13 to 29, the structure of its pharyngeal arches, the number of anal fin rays, gill-raker counts of 10 to 14, and 52 to 58 lateral line scales (Miller 1973). Dorsal and lateral coloration varies from bronze to dusky green, grading to silver or white on the belly. The species may reach a total length of 12 inches. The Owens tui chub evolved in the Owens River watershed with only three other smaller species of fishes, Owens pupfish (*Cyprinodon radiosus*), Owens speckled dace (*Rhinichthys osculus* ssp.), and Owens sucker (*Catostomus fumeiventris*) (USFWS 2009).

Based on recent genetic research, Chen et al. (2007) proposed that the Cabin Bar Ranch population is a separate lineage—the Toikona tui chub lineage—from the Owens tui chub lineage. They do not propose making a formal taxonomic split from the Owens tui chub until more information becomes available.

Descriptions of the species' physical characteristics can be found in USFWS (1998) and USFWS (2009).

Distribution

General

The Owens tui chub is endemic to the Owens Basin (Owens Valley, Round Valley, and Long Valley) of Inyo and Mono counties, California (USFWS 1998).

Distribution and Occurrences within the Plan Area

Historical

Early fish collections in the Owens Basin documented Owens tui chub in Owens Lake, several sites along the Owens River from Long Valley to Lone Pine, tributary streams near the Owens River in Long Valley and Owens Valley, Fish Slough, and irrigation ditches and ponds near Bishop, Big Pine, and Lone Pine (Miller 1973; USFWS 2009). Although there is only one record for Owens tui chub in the Plan Area from before 1990 in the California Natural Diversity Database (CNDDB) (Figure SP-F4; Dudek 2011), the scattered distribution of these localities and the ease with which researchers captured fish suggest that Owens tui chub were common and occupied all valley floor wetlands near the Owens River in Inyo and Mono counties (USFWS 2004).

Recent

Currently, genetically pure Owens tui chub is limited to six isolated sites in the Owens Basin: Hot Creek Headwaters (AB Spring and CD Spring), Little Hot Creek Pond, Upper Owens Gorge, Mule Spring, White Mountain Research Station (operated by the University of California), and Sotcher Lake, the last of which is outside the historical range of the species in Madera County (USFWS 2009). However, there are only three recent occurrence records documented in the CNDDB database (Figure SP-F4; Dudek 2011). In 1987, Owens tui chub were found occupying irrigation ditches and a spring at Cabin Bar Ranch on the southwest shore of Owens Dry Lake, and became known as the Cabin Bar Ranch population (USFWS 2009). Predation from introduced largemouth bass (*Micropterus salmoides*) and bluegill sunfish (*Lepomis macrochirus*), and failure to maintain adequate water quality and quantity, extirpated the Cabin Bar Ranch population of Owens tui chub in 2003 (USFWS 2009). However, prior to extirpation, 24 individuals were placed in an artificial pond and moved to Mule Spring in 1990; all extant fish of this group descend from this transplant (Chen et al. 2007). The Plan Area includes the former Cabin Bar Ranch population and the Mule Spring population (see Figure SP-F4). USFWS (1998) has proposed three conservation areas within the Plan Area: Mule Spring, Black Rock, and Southern Owens (the Cabin Bar Ranch population was found on the southwest shore of Owens Dry Lake).

Natural History

Habitat Requirements

The Owens tui chub occurs in low-velocity waters with well-developed beds of aquatic plants, rocks, and undercut banks with bottoms of gravel (Leunda et al. 2005; Moyle 2002). Dense aquatic vegetative cover is likely important to Owens tui chubs for predator avoidance, reproduction, water velocity displacement, and feeding (McEwan 1989, as cited in Geologica 2003; McEwan 1991). Plant species observed in occupied habitat at the Hot Creek Headwaters population include watercress (*Nasturtium officinale*), water fern (*Azolla filiculoides*), duckweed (*Lemna* sp.), pondweed (*Potamogeton* sp.), aquatic buttercup (*Ranunculus aquatilis*), and elodea (*Elodea canadensis*) (McEwan 1991). McEwan (1991) provides details of the habitat structure at the Hot Creek Headwaters population, where plants cover approximately 50% to 75% of the stream surface area. The plants typically grow out from the sides in the main channel, forming dense beds along the stream margins that delineate a small chute of swift-flowing water in the center of the channel. In the backwater areas with zero water velocities, vegetation covers nearly 100% of the surface area. There is a limited die-off of vegetation beds during the winter, but most of the beds persist due to the thermal characteristics of the headsprings.

Water temperature within occupied habitat varies to a great degree (as summarized in Geologica [2003]). It can be fairly constant at spring sites (14–18°C [57–64°F]), hotter at hot springs (21–25 °C [70–77°F]), and cooler in a river (36–78°F [2–25°C]) (Geologica 2003). Within occupied habitat where measurements exist, pH ranges from 6.6 to 8.9 (McEwan 1989; Geologica 2003), dissolved oxygen varies from 5 to 9.3 milligrams/liter (Malengo 1999; Geologica 2003), and alkalinity varies from 68.0 to 88.4 parts per million (McEwan 1989).

The Owens tui chub is restricted to six total populations, five of which are within the historical range of the species. Of these five populations, three (Hot Creek Headwaters, Little Hot Creek Pond, and Upper Owens Gorge) are located in small, isolated, man-altered portions of these waterways. The other two populations (Mule Spring and White Mountain Research Station) exist in manmade ponds at upland sites with water supplied by artificial methods. A detailed account of the habitat at each of the extant populations can be found in the 5-year review (USFWS 2009).

Table 1. Habitat Associations for Owens Tui Chub

Land Cover Type	Land Cover Use	Habitat Designation	Habitat Parameters	Supporting Information
Low-velocity waters	Breeding/foraging	Primary	Low-velocity waters with well-developed beds of aquatic vegetation, rocks, and undercut banks	Direct observation studies

Sources: USFWS 2009; Leunda et al. 2005; McEwan 1991, Geologica 2003.

Foraging Requirements

The results of a gut content analysis indicate that Owens tui chub is an opportunistic omnivore that utilizes a wide variety of food items (McEwan 1991). Aquatic vegetation is especially important as it provides forage and habitat for aquatic invertebrates, the main food item of the Owens tui chub (McEwan 1989, as cited in Geologica 2003; McEwan 1991). Specific food items that appear to be of importance include chironomids, larvae of two species of hydroptillid caddisfly, other aquatic invertebrates, plant material, and detritus (McEwan 1991). There is evidence that the diet varies seasonally at the Hot Creek Headwaters (McEwan 1991); the dominant items in Owens tui chub diet there are chironomid larvae and algae in spring, chironomid larvae in summer, hydroptillid caddisflies in fall, and chironomid larvae in winter (McEwan 1991). Owens tui chubs feed mainly by gleaning and grazing among submerged vegetation (Geologica 2003).

Reproduction

Sexual maturity in Owens tui chub appears dependent on the microhabitat. For example, sexual maturity in springs with constant water temperature has been recorded at 2 years for females and 1 year for males, in comparison to more varied temperatures where males and females reach sexual maturity at 2 years (McEwan 1990, as cited in USFWS 2009). In general, tui chubs congregate from later winter to early summer to spawn over aquatic vegetation or gravel substrates (Kimsey 1954, as cited in Geologica 2003). More specifically, McEwan (1990, as cited in USFWS 2009), recorded spawning from late winter to early summer at spring habitats, and from spring to early summer in riverine and lacustrine or lake-like habitats. Spawning appears to be triggered by day length and warming water temperatures (McEwan 1989, 1990, as cited in USFWS 2009). With the adhesive quality of the eggs, spawning usually occurs over gravel substrate or aquatic vegetation (USFWS 2009). Multiple spawning bouts during the breeding season are likely (Moyle 2002), and females may produce large numbers of eggs at each bout (Geologica 2003). Embryos hatch in 3 to 6 days (Moyle 2002), and may be influenced by water temperature, with eggs hatching earlier in warmer water (Cooper 1978, as cited in USFWS 2009). Larvae remain near aquatic plants after hatching (Moyle 2002). Growth during the first summer is rapid and slows at maturity, usually in the second to fourth year (Moyle 2002).

Table 2. Key Seasonal Periods for Owens Tui Chub

	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Breeding			X	X	X	X	X					

Sources: USFWS 1998, 2009.

Spatial Activity

The dispersal, home range, and migratory patterns of Owens tui chub are not well understood. Many of the locations where they are currently found are completely isolated from other populations. Tui chubs congregate from late winter to early summer to spawn over aquatic vegetation or gravel substrates (USFWS 2009). Chen et al. (2007) have determined that the Owens tui chub lineage is more genetically distinct from the Cabin Bar Ranch population (the Toikona tui chub lineage) than the Lahontan tui chub, which may represent independent lines of evolution (i.e., no dispersal). Morphology, swimming ability, and behavior all suggest the species is not adapted to movement through rapid waters (Moyle 2002). Therefore, movement of this species likely requires the presence of vegetation beds so that high-velocity areas are encountered only briefly. Jenkins (1990, as cited in Geologica 2003) observed no Owens tui chub in the Owens River Gorge within riffle habitat. Dispersal of other species of tui chub has been inferred using gene flow, where unidirectional dispersal and bidirectional inter-basin gene flow have been recorded (Chen 2006). In addition, daily migrations have been observed for tui chub in large, deep lakes during summer, whereas they move between deep water during the day and shallow water during the night (Moyle 2002).

Ecological Relationships

Owens tui chub were once common and occupied all valley floor wetlands near the Owens River in Inyo and Mono counties. Since that time, predaceous non-native fishes, extensive development of water resources, and interbreeding with Lahontan tui chub has resulted in population decline and habitat loss.

Currently, the major threat to the species is introgression with Lahontan tui chub (Chen et al. 2007). The Owens tui chub is reliant on slow-moving freshwater habitats that provide food and cover, but that are free of non-native aquatic predators and other tui chub subspecies and hybrids. It requires aquatic vegetation for cover, foraging, and spawning, as well as gravel substrates for spawning. If one or more of these elements are absent, it can be quickly extirpated from a location.

Population Status and Trends

Global: Critically imperiled (NatureServe 2011)
State: Same as above
Within Plan Area: Same as above

Since its listing in 1985, three new populations of Owens tui chub have been established, bringing the current number to six. Four of these populations are in small, manmade or man-altered waters, and one is outside the historical range of the species at an artificial lake (Sotcher Lake). USFWS (2009) recommends that a Recovery Priority Number of 3 be assigned to Owens tui chub, which indicates that the taxon is a subspecies that faces a high degree of threat and has a high potential for recovery. The threats that were present when the Owens tui chub was listed are still present with new threats identified (USFWS 2009).

Threats and Environmental Stressors

USWFS (2009) provides a detailed explanation of the threats to Owens tui chub, which are summarized here. Currently, the major threat to the species is introgression (i.e., hybridization) with Lahontan tui chub (Chen et al. 2007), which has resulted in extirpation throughout most of its range (USFWS 2009). In 1973, the Lahontan tui chub was introduced as baitfish into many of the streams in the Owens Basin. Historically, the Owens tui chub and Lahontan tui chub were isolated from each other, but now hybridization has been documented for populations in Mono County—at Hot Creek (downstream from the hatchery), Mammoth Creek, Twin Lakes–Mammoth, June Lake, and Owens River Upper Gorge Tailbay. In Inyo County, hybridization has been documented at A1 Drain, C2 Ditch, and McNally Canal (Madoz et al. 2005, as cited in USFWS 2009; Chen 2006, as cited in USFWS 2009). If the barriers that are acting to isolate the Owens tui chub populations from Lahontan tui chub become permeable, this could result in the loss of genetically pure populations of Owens tui chubs at Hot Creek Headwaters, Little Hot Creek Pond, and the Upper Owens Gorge. In addition, the opportunities to establish new populations of Owens tui chub in the Owens Basin are limited by the presence of hybrids in the Owens River and its tributaries. Currently, the only viable locations for establishing the Owens tui chub are isolated springs or the headwaters of streams with downstream barriers to upstream movement of Lahontan tui chubs or hybrids.

USFWS (50 FR 31592–31597) identified extensive habitat destruction and modification as threats to the Owens tui chub, and this is current as of today. Currently, Owens Basin water is in high demand that is expected to increase, which would reduce the overall availability of surface waters. The survival of two populations (White Mountain Research Station and Mule Spring) is dependent upon the continual maintenance of the artificial water supply and assurance of adequate water quality. The Upper Owens Gorge population is a pool created by a beaver dam that is eroding, which is slowly reducing the lacustrine habitat for Owens tui chubs.

Submerged aquatic vegetation is a key habitat requirement for the Owens tui chub, but not with large amounts of emergent vegetation because it may provide cover for nonnative predators of Owens tui chubs, such as bullfrogs and crayfish (*Procambarus* sp.). At the spring sites (Hot Creek Headwaters, Little Hot Creek Pond, and Mule Spring), emergent vegetation (e.g., cattail) have reduced and altered the aquatic habitat, and routine removal of emergent vegetation is required. The Mule Spring and White Mountain Research Station populations require routine management of water quantity and water quality. The environment that the Upper Owens Gorge population inhabits has been severely altered by the construction of a dam, with no mechanism to manage adequate releases of water downstream of the dam.

Since listing, evidence of disease has been observed in some populations of the Owens tui chub (USFWS 2009). In AB Spring at Hot Creek Headwaters, Bogan et al. (2002, as cited in USFWS 2009) found evidence of infection in six of the seven Owens tui chubs that were collected for genetic analysis. Since disease has been identified in Owens tui chubs, it is considered a threat. However, the magnitude of this threat is unknown (USFWS 2009).

The final listing rule (50 FR 31592–31597) identified predation by introduced non-native fish as a major threat to the Owens tui chub. Predation by non-native largemouth bass and brown trout is thought to have eliminated Owens tui chubs from much of their historical range in the Owens River (Chen and May 2003), and it is believed that non-native fish (largemouth bass and bluegill sunfish) played a role in extirpating the Cabin Bar Ranch population (Chen et al. 2007). Mosquito fish (*Gambusia affinis*) may also present a threat, as they are known to prey on small individuals of Mohave tui chub (Archdeacon 2007, as cited in USFWS 2009). At Mule Spring, bullfrogs are present and probably prey on Owens tui chubs, as they are known to prey on other subspecies of tui chubs (Parmenter 2009, as cited in USFWS 2009).

The inadequacy of existing regulatory mechanisms is considered a threat at this time by USFWS (2009), largely due to unregulated actions that could overdraft the aquifer in the Owens Valley Groundwater Basin area, which may result in reduced or no water flow to existing isolated springs and headwater springs of streams in the Owens Basin. The issue stems from the fact that the aquifer in the Owens Basin has not been adjudicated and its use is not regulated.

Any reduction in flow from springs in the Owens Basin would result in further reductions of habitat quality and quantity for the Owens tui chub at springs and tributaries of the Owens River.

Currently, Owens tui chub populations are small, between 100 and 10,000 individuals; therefore, random events that may cause high mortality or decreased reproduction could readily eliminate an entire population, which would have a significant effect on the viability of Owens tui chub populations. Furthermore, because the number of populations is small (six) and each is vulnerable to this threat, the risk of extinction is exacerbated (USFWS 2009). The Owens tui chub has experienced population loss from environmental stochastic events and will likely do so in the future. For example, the Cabin Bar Ranch population was lost because of an apparent failure to maintain adequate water quality and quantity and the introduction of non-native predators. Another example is the disappearance of Owens tui chub from the Owens Valley Native Fishes Sanctuary (Fish Slough). Reasons for the loss of this population are not known, but the small, isolated nature of this population likely contributed to their extirpation (USFWS 2009).

In small populations, such as the Owens tui chub, there are a number of factors that may reduce the amount of genetic diversity retained within populations and may increase the chance that deleterious recessive genes are expressed. Loss of diversity could limit the species' ability to adapt to future environmental changes and contributes to inbreeding depression (i.e., loss of reproductive fitness and vigor) (USFWS 2009). Deleterious recessive genes could reduce the viability and reproductive success of individuals. Isolation of the six remaining populations, preventing any natural genetic exchange, will lead to a decrease in genetic diversity.

Conservation and Management Activities

The recovery plan (USFWS 1998) provides a detailed account of management goals that need to be successfully implemented in order for the species to be delisted:

- Establish multiple, self-sustaining populations of Owens tui chubs throughout much of the historical range of the species in six identified conservation areas;
- Ensure these populations are self-sustaining;
- Ensure that each population contains juvenile and three additional age classes, and that the biomass of Owens tui chubs exceed the biomass of deleterious, non-native aquatic predatory species, which would demonstrate successful recruitment and minimal predation on smaller Owens tui chubs by non-native aquatic species;
- Reduce competition with non-native aquatic species;
- Increase the ability to conserve and protect aquatic habitats;
- Implement measures to prevent hybridization with introduced Lahontan tui chubs;
- To the extent possible, reduce the probability of the loss of Owens tui chub populations from stochastic events; and
- Complete an approved management plan and implementing agreement that address water quantity and groundwater management with the land managers.

These recovery plan criteria do not address threats from disease; catastrophic events that may affect the Owens Basin; demographic, genetic, or environmental stochasticity; or climate change. The recovery plan identifies no recovery criteria for the Toikona lineage, as the occurrence of this lineage was unknown when the recovery plan was approved. The 5-year review (USFWS 2009) finds that none of these management goals has either not been achieved or can't be evaluated.

Data Characterization

The distribution of and threats to Owens tui chub are sufficiently well known to allow coverage of this species in the Desert Renewable Energy Conservation Plan. Missing pieces of information on this species include the lack of understanding of the Toikona lineage as far as origin, genetics, and ecophysiology (Chen et al. 2007). Additionally, the lack of management plans at each of the six existing populations has resulted in less than ideal protections for the species and a poor understanding of the population dynamics. A reintroduction plan with a specific genetic distribution of the current populations is also needed. Considering the degree of known introgression between Lahontan and Owens tui chub (Chen et al. 2007), data on the distribution of genetically pure Owens tui chub and existing barriers is key.

Management and Monitoring Considerations

The Plan Area includes the former Cabin Bar Ranch population and the Mule Spring population, as well as three proposed conservation areas: Mule Spring, Black Rock, and Southern Owens Dry Lake. The genetically important and distinct Toikona lineage that occurs in the Plan Area descended from a total of 24 founders from Cabin Bar Ranch and its extant population is confined to two diminutive artificial ponds at Mule Spring (Chen et al. 2007). Chen et al. (2007) have determined that the Owens tui chub lineage is more genetically distinct from the Toikona lineage than the Lahontan tui chub, which illustrates the genetic importance of the Toikona lineage. They have also determined that the Toikona lineage is suffering from low genetic variation that may be a consequence of founder effects. Specific management within the Plan Area may include development of a management plan specific to the Mule Spring population. The management plan should propose methods to secure the conservation and the management of water quantity, water quality, habitat, and aquatic predators at the existing occupied ponds at Mule Spring. It should also illustrate in detail how to create new populations for the Toikona lineage, as well as increase effective population size. This detail should include a specific standardized genetic protocol. Candidate conservation areas to be evaluated within the Plan Area for new Toikona lineage populations may include Black Rock, Southern Owens Dry Lake, and other areas at Mule Spring. Evaluation criteria may include the presence of suitable habitat and the absence of predators and the Lahontan tui chub and their hybrids. Because so little is known about the Toikona lineage, additional studies and research should be proposed, such as origin, genetics, and ecophysiology.

Predicted Species Distribution in Plan Area

Species model summary and results will be provided following model development.

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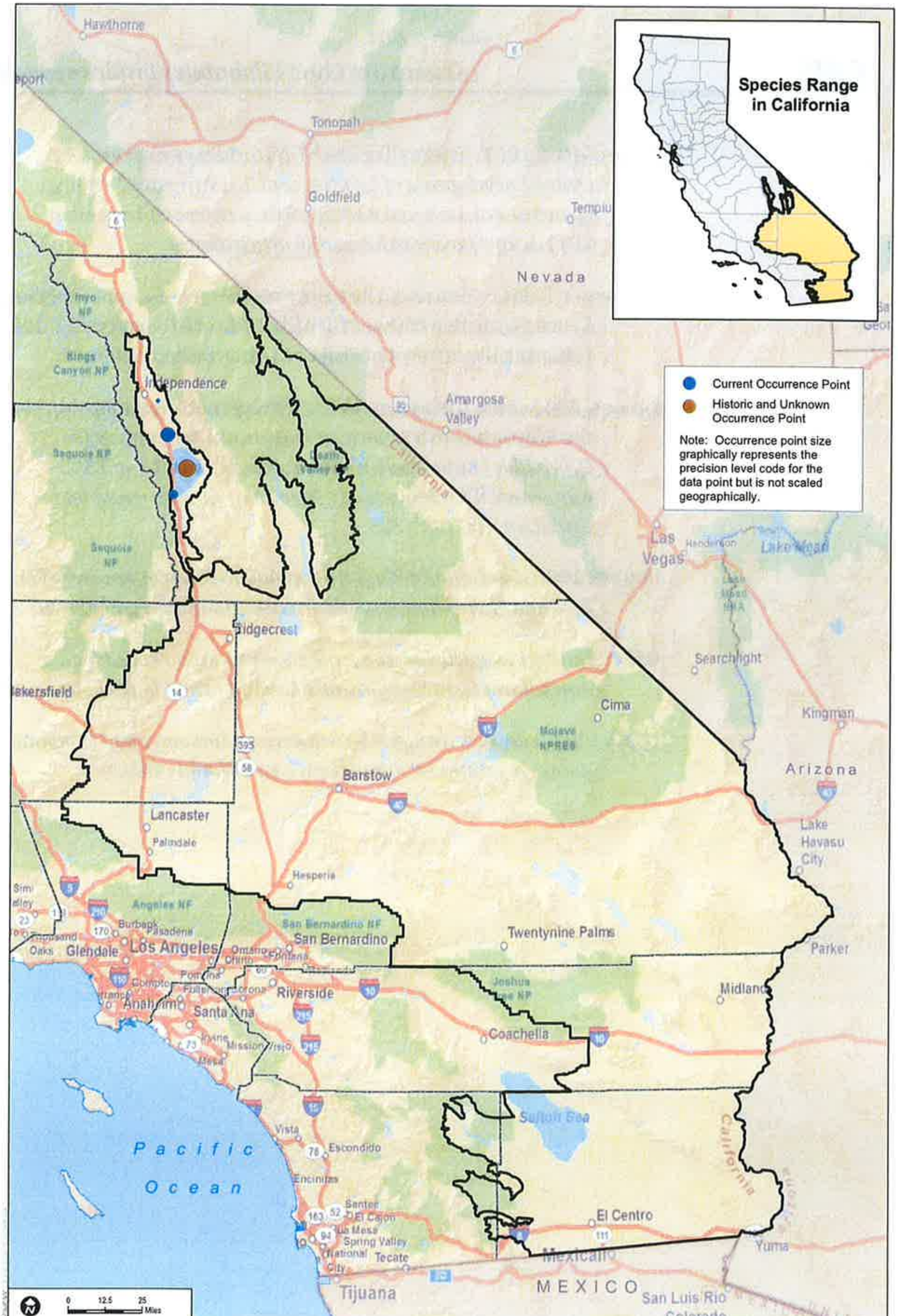

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FIGURE SP-F4
Owens Tui Chub Occurrences in the Plan Area (N=4)

Desert Renewable Energy Conservation Plan (DRECP) Baseline Biology Report

Proceedings World Geothermal Congress 2000
Kyushu - Tohoku, Japan, May 28 - June 10, 2000

GEOTHERMAL DEVELOPMENT AND CHANGES IN SURFICIAL FEATURES: EXAMPLES FROM THE WESTERN UNITED STATES

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Key Words: geothermal development, hot springs, impacts, monitoring

ABSTRACT

Changes in surficial thermal features and land-surface elevations can accompany development of geothermal reservoirs. Such changes have been documented to varying extents at geothermal fields in the Western United States, including Long Valley caldera, Coso Hot Springs, and Amadee Hot Springs in California, and Steamboat Springs, Beowawe, Dixie Valley, and Brady Hot Springs in Nevada. The best-documented cases are for the Casa Diablo area in Long Valley caldera, California and for Steamboat Springs, Nevada where hydrologic monitoring programs have delineated some combination of declines in thermal-water discharge, increases in fumarolic steam discharge, and subsidence. At other areas noted above, similar types of changes have occurred but existing monitoring programs do not permit the same level of analysis of cause-and-effect relationships between such surficial changes and contributing factors.

1. INTRODUCTION

In most respects, geothermal energy offers considerable advantages over other forms of electrical and direct-use energy development in terms of minimizing adverse environmental effects. However, exploitable geothermal reservoirs are commonly associated with surficial thermal features such as hot springs and fumaroles, and some level of change in such features can be expected to accompany subsurface pressure changes associated with the production and injection of reservoir fluids. Geothermal reservoir pressure and temperature declines can also result in subsidence of the land surface. Perhaps the best-documented examples are from the Wairakei and Broadlands geothermal fields in New Zealand (Allis, 1981; Glover et al., 1996).

Most areas of existing or potential geothermal development in the Western United States include natural thermal features such as hot springs, geysers, spring-fed thermal pools, and steam-heated features such as fumaroles and hot pools. The extent that these features may be impacted by geothermal development depends on many factors, including both the properties of the subsurface and the details of the development (production and injection) scheme. The hydrologic and mechanical properties of the subsurface are usually not sufficiently known before development begins to predict the distribution and magnitude of surficial changes. Ideally, a hydrologic monitoring program should be in operation before and during development in order to delineate changes from both natural and man-made influences. For a variety of institutional, economic, and engineering reasons, this ideal is rarely met. Even when monitoring data are available, it is often difficult to quantify the relative effects of different factors that can influence surficial conditions, e.g. variations in precipitation and groundwater recharge, pumpage of groundwater aquifers, and crustal unrest (earthquakes and deformation).

The following list (see Figure 1 for locations) includes areas for which some degree of documentation exists for changes in surficial thermal features and land-surface elevations, followed by references to background information.

- Amadee Hot Springs, California: Land subsidence (Unpublished consultant's reports available from Lassen County Planning Department and California Division of Oil, Gas, and Geothermal Resources)
- Beowawe, Nevada: Cessation of geyser discharge (Layman, 1984; Faulder et al., 1997)
- Brady Hot Springs, Nevada: Cessation of hot-spring discharge and onset of boiling and steam upflow from shallow aquifers (Garside and Schilling, 1979)
- Coso Hot Springs, California: Increased activity of steam-heated features (Combs and Rotstein, 1975; Moore and Austin, 1983)
- Dixie Valley, Nevada: Increased activity of steam-heated features and subsidence (Benoit, 1997; Bergfeld et al., 1998)
- Long Valley caldera, California: Increased steam discharge in the well field, decreased thermal-water discharge at sites downstream from the well field, and subsidence (Sorey and Farrar, 1998)
- Steamboat Springs, Nevada: Cessation of geyser discharge (Sorey and Colvard, 1992)

In this paper, we describe the hydrologic monitoring program and the evidence for changes in surficial features associated with ongoing geothermal development in the Casa Diablo area of Long Valley caldera. We also compare and contrast the Long Valley development experience with that at Steamboat Springs, Nevada, and comment on situations at the other development areas listed above.

2. LONG VALLEY CALDERA, CALIFORNIA

2.1 Geothermal Development

The geothermal system in Long Valley involves upflow from a source reservoir in the west moat of the caldera and lateral outflow of thermal water in a generally west to east direction (Sorey et al., 1991). Reservoir temperatures range from 214°C beneath the west moat, to 170°C at Casa Diablo, and 110°C near Hot Creek gorge in the east moat of the caldera (Figure 2). Hot springs discharge primarily within Hot Creek gorge. Geothermal development currently consists of three binary power plants on a combination of private and public lands located at Casa Diablo. The plants produce a total of about 40 MW from wells that tap the shallow, 170°C, reservoir at depths of ~150 m. Plant MP-1 has been in continuous operation since 1985; plants MP-2 and PLES-1 began operations in 1991. In this single-phase, closed system,

cooled geothermal water at ~80°C is reinjected in the well field at depths of about 600 m. Total flow rate through the plants is about 900 kg/s.

Inadvertent leaks of isobutane working fluid into the injection wells at Casa Diablo have provided a useful chemical tracer within the geothermal system. Isobutane has been detected in fumaroles at and near Casa Diablo and in the Hot Bubbling Pool 5 km to the east. Fluorescein tracer tests and isobutane data indicate that less than 10% of the fluid injected at Casa Diablo moves into the production zone. Instead, most of it flows away from the well field within the injection reservoir. The appearance of isobutane at distant thermal features, however, indicates a higher degree of connection between these two zones outside the well field.

2.2 Hydrologic Monitoring Program

The Long Valley area, which includes the resort town of Mammoth Lakes, has numerous features of geologic, hydrologic, and recreational significance. Concerns over possible impacts of geothermal and water-resources developments on surficial thermal features led to establishment of the Long Valley Hydrologic Advisory Committee (LVHAC) in 1987. LVHAC membership includes the U.S. Bureau of Land Management, U.S. Forest Service, U.S. Geological Survey (USGS), Mono County, California State Department of Fish and Game, Mammoth Community Water District, geothermal developers, and various environmental organizations. As described by Farrar and Lyster (1990), the purpose of the LVHAC was to implement a hydrologic monitoring program focused on early detection of changes in surficial features that could be influenced by water-resource developments within the caldera. The LVHAC provides information to permitting agencies on such changes and recommends mitigation alternatives for specific development projects. The committee is advisory and as such its recommendations do not create legal obligations. The USGS, as a non-voting member of the LVHAC, is responsible for collecting and compiling hydrologic monitoring data, and has on occasion been requested to prepare interpretive reports based on these data.

In addition to the hydrologic monitoring program conducted by the USGS, each resource developer is required to monitor conditions in and around their well fields. Thermal and nonthermal subcommittees of the LVHAC meet with specific developers to discuss both public and proprietary monitoring and development data and interpretive analyses of such information. Findings and/or recommendations are conveyed to the LVHAC. Experience has shown that this full and open disclosure and discussion of public and proprietary monitoring data has allowed a more complete understanding of changes accompanying development and promoted an attitude of trust that has helped to avoid litigation. One example of this process is the planning and completion of a numerical model of the response of the geothermal field to development. The modeling was funded by the developer and carried out by one of its consultants, but input and review were sought from members of the thermal subcommittee.

The LVHAC monitoring program includes thermal springs east of Casa Diablo (Figure 2), streamflow measurement sites along Mammoth and Hot Creek, and both thermal and nonthermal wells (e.g. CH10B, and M-14, respectively). Areas of environmental concern include thermal springs at the Hot Creek Fish Hatchery and in Hot Creek gorge. The Hatchery springs discharge at a composite temperature near 16°C, considered optimum for trout-rearing operations. These springs contain a small (~5%) component of thermal water. Springs in Hot Creek gorge discharge at temperatures up to boiling (93°C), and provide a popular environment for bathing in heated creek water.

2.3 Changes in Surficial Features

Geothermal development at Casa Diablo has resulted in declines in reservoir pressure and temperature over the 1985-1998 period. As exemplified by data from observation well 65-32 on the edge of the well field (Figure 3), a cumulative pressure change of 0.1 Mpa between 1985 and 1990 was followed by an additional drop of 0.25 Mpa during 1991 in response to increased production and deepening of injection wells. Between 1991 and 1999, reservoir pressures have declined by about 0.1 Mpa, for a total decline of 0.45 Mpa (4.5 bars). The reduction in reservoir temperature amounts to 10-15°C, compared with localized reductions of ~80°C in the deeper injection zone. Boiling conditions in the heated groundwater system above the production reservoir have resulted in significant steam occurrences at and near the land surface, including fumaroles occupying former hot-spring vents, steam collecting beneath building foundations, and steam flowing upward through the roots of trees.

Data from the USGS monitoring program outside the Casa Diablo area (Sorey and Farrar, 1998a, b) show cessation of spring flow at Colton Spring (2 km east of Casa Diablo) and declines in water level in Hot Bubbling Pool (HBP, 5 km east of Casa Diablo). The water-level record for thermal well CW-3 adjacent to HBP correlates with the pressure record from well 65-32, indicating that the 0.25 Mpa pressure decline in the well field in 1991 (equivalent to a water-level drop of 25 m) caused a drop of 1.2 m in water level at this distance.

At the Hot Creek Fish Hatchery, chemical-flux measurements show that the thermal-water component in the springs has declined by some 30-40% since 1990. However, temperatures in the Hatchery springs have changed mainly in response to variations in the nonthermal component caused by seasonal and annual variations in groundwater recharge. The apparent lack of observable response in spring temperature accompanying the decline in thermal-water component suggests a moderating influence of conductive heating from rocks within and adjacent to the shallow flow zone containing a mixture of thermal and nonthermal fluids.

Total thermal-water discharge at Hot Creek gorge is calculated from chemical flux measurements at gaging sites on Hot Creek upstream and downstream from the thermal springs. Within a measurement error of ~15%, no decrease in thermal-water flow has been detected over the 1988-1998 period and the presence of isobutane has not been detected in the gorge springs. It appears from this that the current level of geothermal development has not caused detectible hydrologic changes beyond distances of about 5 km from the well field.

Leveling data collected along Highway 395 show subsidences in the vicinity of Casa Diablo beginning in 1986,

superimposed on a general pattern of uplift that began in 1980 in response to crustal unrest (Sorey and Farrar, 1998; Sorey et al., 1995). Since 1988, benchmarks at Casa Diablo have subsided approximately 25 cm relative to benchmarks on the resurgent dome, which have risen approximately 20 cm. This perhaps represents a unique situation in that subsidence induced by geothermal fluid withdrawal has allowed the actual land surface elevation to remain relatively constant, while intermittent intrusive activity has cause significant uplift of the surrounding region.

3. STEAMBOAT SPRINGS, NEVADA

3.1 Geothermal Development

The geothermal system beneath the Steamboat Hills, located about midway between Reno and Carson City, Nevada, is currently being developed by two well fields and associated power plants (Figure 4). To the south, the higher-temperature Caithness Power Incorporated (CPI) development involves single-stage steam flash and residual liquid injection. To the north, the lower-temperature Far West Capital (FWC) project involves production and injection of pressurized single-phase liquid and binary power plant conversion. Electrical production totals about 15 MW at the CPI plant and 85-90% of produced fluids are reinjected north of the production well field. The generating capacity of the FWC plants totals about 40 MW and 100% of produced fluids are reinjected in wells adjacent to the production well field.

Between the two development areas is a silica terrace through which hot springs and geysers discharged until 1987, when sustained testing of geothermal wells began and water levels in the spring vents began falling (Sorey and Colvard, 1992; Collar and Huntley, 1990; Collar, 1990). Analyses of available hydrologic and geochemical data have led various authors to conclude that a single, interconnected, geothermal system exists in the Steamboat Springs area (Sorey and Colvard, 1992; Mariner and Janik, 1995, and White, 1968). Hot water flows upward beneath the Steamboat Hills and then laterally toward the north and northeast. In addition to the main terrace described above, the ultimate point of discharge of thermal water under pre-development conditions was Steamboat Creek.

3.2 Hydrologic Monitoring Program

Regulation and monitoring activities at Steamboat have tended to be more complex and difficult to pursue than at Long Valley. Although there are multiple regulatory jurisdictions involved at each area, the absence of an entity such as the LVHAC at Steamboat has made it more difficult to conduct adequate monitoring and to provide for interpretive studies of changes associated with development. This situation still exists today, in spite of the fact that part of the silica terrace and adjacent areas to the west were designated an Area of Critical Environmental Concern by the Bureau of Land Management (Sorey and Colvard, 1992).

Each developer has been responsible for monitoring conditions in and around their well field. A set of wells drilled for testing and monitoring exists in the FWC well field; in the CPI well field wells drilled for stratigraphic information are monitored. A network of wells drilled into the nonthermal groundwater system surrounding the Steamboat Hills is included in the monitoring program carried out by FWC.

3.3 Changes in Surficial Features

Data on pressure changes in the developed well fields are either not publicly available or are difficult to interpret. Pressures declines in both fields appear to be minimal (~0.05 Mpa, or 0.5 bars). This indicates high reservoir transmissivity and pressure support from injection wells. Indeed, tracer tests at the FWC show that most of the injected water remains within the well field (Rose et al., 1999). This is in contrast to the situation at Long Valley described above.

By the time monitoring programs began in earnest in 1986, the geysers and springs were in decline and by 1987, liquid discharge on the main terrace had stopped. Monitoring of water levels in some spring vents continued through 1989, when water levels in the silica-lined spring conduits fell beyond the reach of measuring equipment. Two measurements were also made in 1989-1990 of thermal-water discharge in Steamboat Creek, using chloride flux techniques, for comparison with similar estimates made in the 1950-1960 period (Sorey and Colvard, 1992). These data suggest declines in total discharge of about 40%.

The analysis by Sorey and Colvard (1992) concluded that declines in hot-spring activity and thermal-water discharge at Steamboat Springs resulted from a combination of (1) successive years of below-normal precipitation and groundwater recharge, (2) groundwater pumpage in the South Truckee Meadows (north of the Steamboat Hills), and (3) geothermal fluid production. It was not possible at that time to adequately determine the relative impacts of each factor. However, precipitation has returned to normal or above-normal levels since 1994 and monitoring records show that groundwater levels have risen significantly since that time and are now at nearly the same levels as in the late 1980's. Although no recent measurements have been attempted of water levels in the spring vents on the main terrace, there is no evidence of any renewed spring flow.

4. OTHER AREAS OF GEOTHERMAL DEVELOPMENT

The scale and type of geothermal development at other noted areas in the Western United States vary widely, ranging from a small binary-electric power plant supplied by two production wells and no injection wells at Amadee Hot Springs in northeastern California to the ~250 Mwe steam-flash power plants at Coso Hot Springs in eastern California (Figure 1). In all but one case, all or most of the development area and surficial thermal features are privately owned. The exception is the Coso Hot springs area south of Long Valley in eastern California, where most of the land under development is part of the federally operated China Lake Naval Weapons Center. Thermal features at Coso Hot Springs, located adjacent to the well field, are traditionally utilized by local Native Americans. Environmental agreements between the Navy, the U.S. Bureau of Land Management, and Native American organizations call for mitigation in the event that geothermal development causes changes that negatively effect future use for religious and ceremonial purposes (Bureau of Land Management, 1980).

In cases where geothermal reservoirs and associated surficial thermal features are on privately owned land, regulations governing geothermal development are usually specified by state or county agencies, rather than federal agencies. Monitoring programs may not include observations of thermal features, so that information about changes in thermal features or land elevations is usually anecdotal or unpublished and often not sufficiently detailed to provide adequate documentation of cause-and-effect relations. Even when thermal features are on public lands, hydrologic monitoring may be deemed unnecessary where expected changes in thermal features or land-surface elevations are judged a-priori to be either mitigatable or insignificant.

A common aspect of changes induced by development of hot-water reservoirs is the reduction of liquid discharge in springs and geysers and the increase in steam discharge in fumaroles and other steam-heated features. Available information indicates that such changes have occurred at Long Valley, Steamboat, Beowawe, Amadee Hot Springs, and Brady Hot Springs, while at Coso Hot Springs and Dixie Valley naturally occurring steam discharge has increased during development. At Amadee Hot Springs, Brady Hot Springs, Dixie Valley, and Long Valley, reductions in reservoir pressure have also induced significant levels of land subsidence and ground cracking. As pointed out previously, documentation of such changes and determinations of the influence of various factors on the thermal features is adequate only for Long Valley. At Beowawe and Steamboat Springs, reductions and cessation of geyser activity accompanied the pre-development testing of production wells in the 1970's, at a time when monitoring efforts were inadequate. Some of the previously cited references contain information on thermal features at the "other" areas of geothermal development discussed in this section; additional pertinent references are listed below:

- Beowawe: Zoback (1979); White (1998); Layman (1984); Olmsted and Rush (1987)
- Brady Hot Springs: Ettinger and Brugman (1992); Harrill (1970), Osterling (1969); Olmsted et al. (1975)
- Coso Hot Springs: Monahan and Condon (1991a,b); Erskine and Lofgren (1989); Fournier et al. (1980); Fournier and Thompson (1982)
- Dixie Valley: Williams et al. (1997); Waibel (1987)

5. CONCLUSIONS

Changes in surficial thermal features and land elevations accompanying geothermal development should be viewed as the rule, rather than the exception. This follows from the nature of geothermal reservoirs within flow systems that commonly include discharge of fluids at the land surface. In the absence of fluid injection in locations proximal to such discharge areas, reductions in reservoir pressure will cause some degree of reduction in fluid upflow feeding the thermal features. Natural geyser activity should be expected to be most sensitive to such changes because of the unique combination of processes and characteristics typically required for geyser discharge. Where hot fluids occur at relatively shallow depths, either within a developed reservoir or in the overlying groundwater system, pressure reduction can also induce boiling conditions that result in increases in steam discharge at the land surface.

Factors other than pressure reductions in geothermal reservoirs can influence the temperature and flow rate of surficial thermal features. Information gained from hydrologic monitoring in and around the developed well fields, both during and prior to the development period, can allow quantification of the timing and magnitude of cause-and-effect relations between various factors that affect surficial thermal discharge and guide attempts to mitigate any adverse impacts caused by development.

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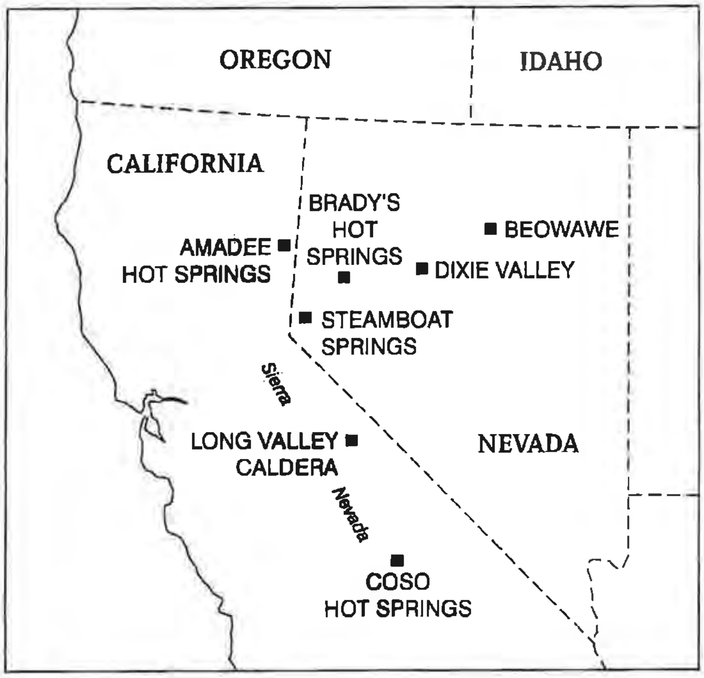

Figure 1. Locations of some geothermal fields where development has been associated with changes in thermal features and/or land subsidence.

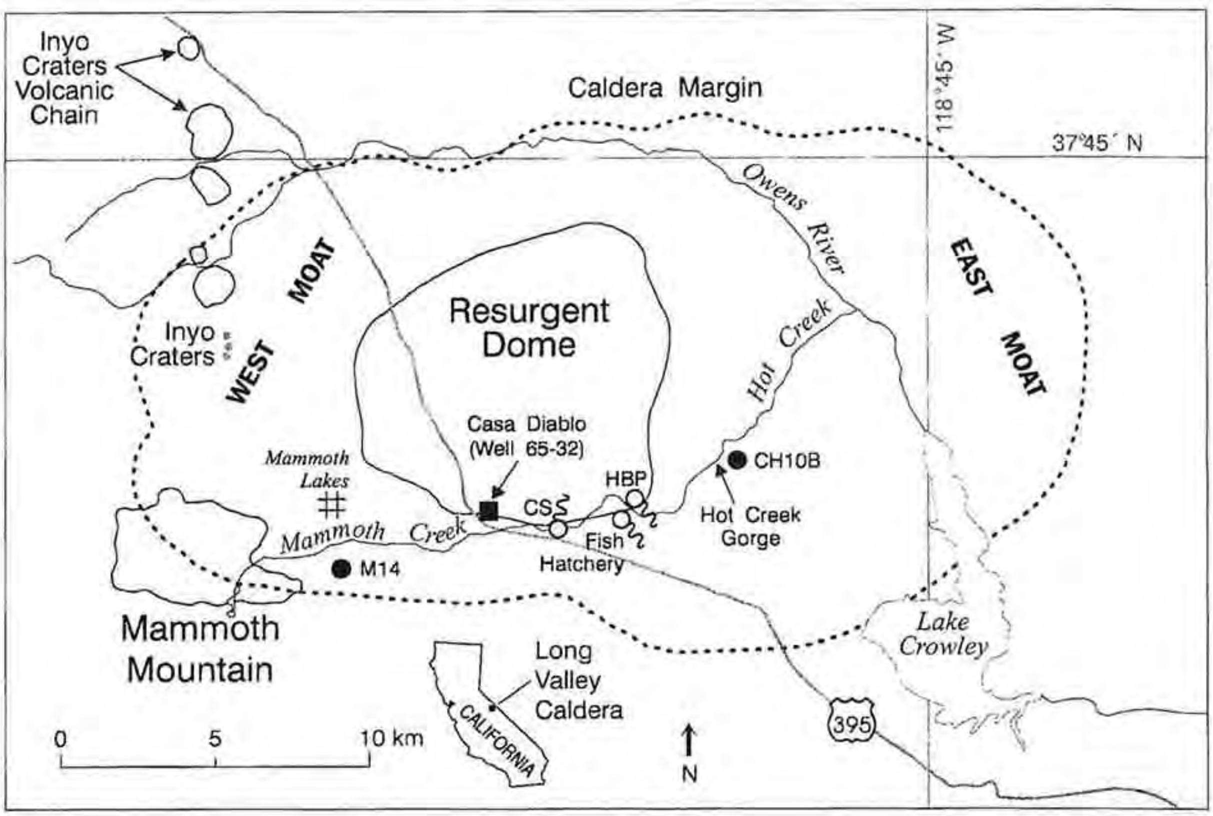

Figure 2. Map of Long Valley caldera showing various geologic and cultural features, and key sites in the hydrologic monitoring program directed by the Long Valley Hydrologic Advisory Committee.

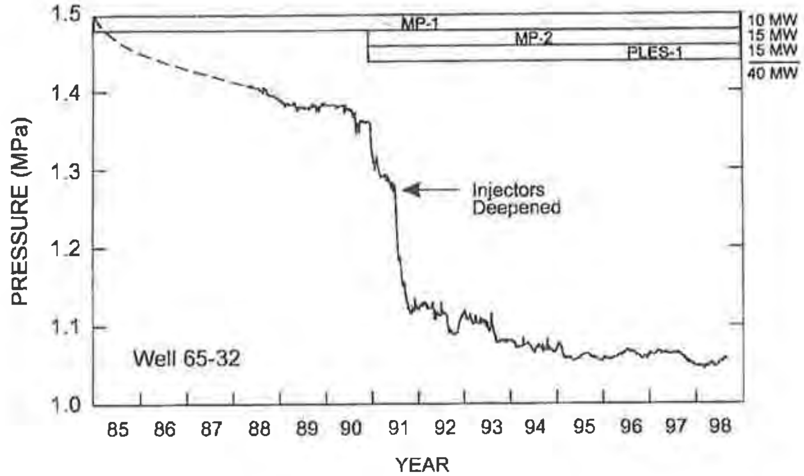

Figure 3. Pressure history in observation well 65-32, located on the edge of the geothermal well field at Casa Diablo, and periods of operation of three geothermal power plants.

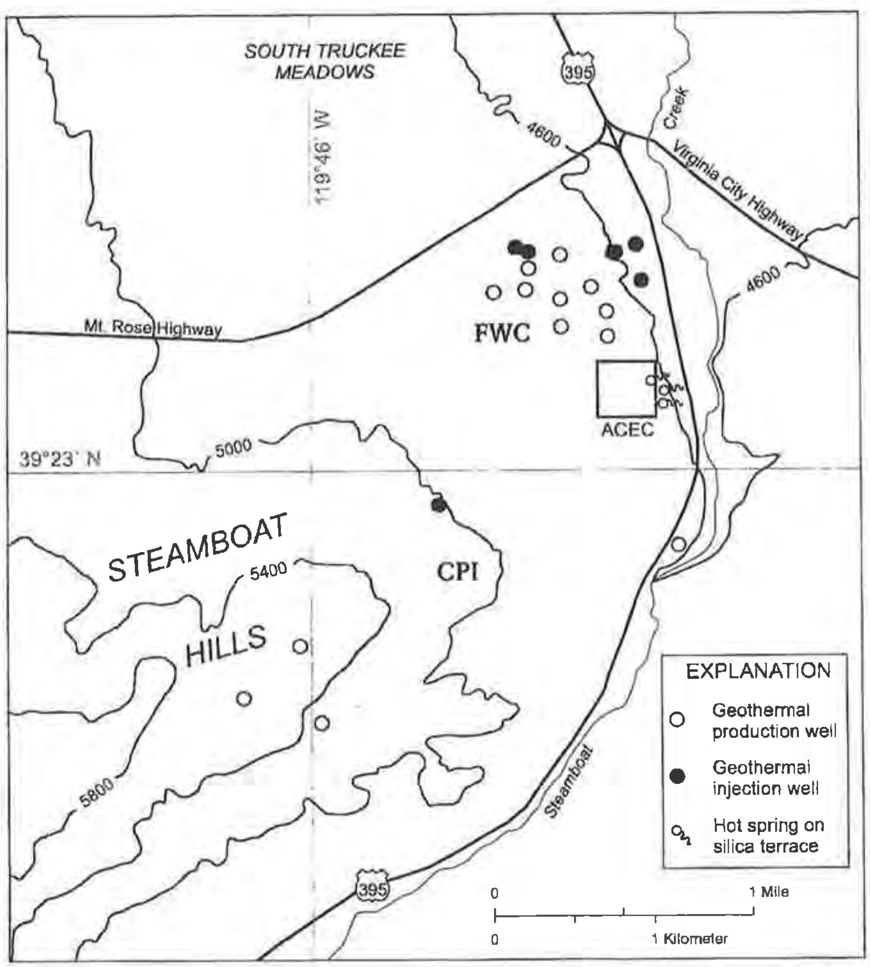

Figure 4. Map of the Steamboat Hills and surrounding region showing approximate wellfield areas for the Caithness Power, Incorporated (CPI) and Far West Capital (FWC) geothermal developments, locations of most of the production and injection wells, some of the vents on the main silica terrace that formerly included active hot springs and geysers, and the outline of the Area of Critical Environmental Concern (ACEC) designated by the Bureau of Land Management.