United States Department of the Interior
Bureau of Land Management

Environmental Assessment
DOI-BLM-CA-N050-2019-0011-EA

Twin Peaks Herd Management Area
Wild Horse and Burro Gather Plan

Preparing Office

Northern California District
Eagle Lake Field Office
2550 Riverside Drive
Susanville, CA 96130
530-257-0456

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1.0 Purpose and Need

1.1 Introduction

The Bureau of Land Management Eagle Lake Field Office (BLM) is proposing to gather and remove excess wild horses and burros from within and outside the Twin Peaks Herd Management Area (HMA) in order to achieve the established appropriate management level (AML) and implement a range of fertility controls to maintain the population to within AML over a period of up to 10 years. Aerial surveys would be conducted close to the onset of gathers to verify numbers and locations of the animals. The specific number of animals gathered would depend on when gathers occur and how many wild horses and burros are inhabiting the HMA. Any animals captured and selected for return to the range may be treated with fertility control. Females would be treated with an approved fertility control and males would be released to adjust the sex ratio and slow population growth. Fertility control measures would be administered in accordance with current BLM policy and guidance.

In compliance with the National Environmental Policy Act, this Environmental Assessment (EA) is a site-specific analysis of potential impacts that could result from implementation of the proposed action or alternatives. If the BLM determines significant impacts could occur, an Environmental Impact Statement (EIS) would be prepared for the project. If no significant impacts are expected, an EIS would not be prepared and a decision would be issued along with a Finding of No Significant Impact (FONSI) documenting the reasons why implementation of the selected alternative would not result in significant environmental impact.

1.2 Background

The Twin Peaks HMA contains 789,852 acres of public and private lands and consists of a vast, diverse, and remote landscape. The HMA lies on both sides of the California/Nevada border, with slightly more than half of the area within Lassen County, California and the remainder in Washoe County, Nevada. The HMA is approximately 55 miles long from north to south and 35 miles wide. It is located between California State Highway 395 to the west, Honey Lake to the south, the Smoke Creek Desert to the east, and the Coppersmith Mountains to the north (see Appendix A for map).

The BLM-administered lands within the Twin Peaks HMA (656,173 acres) encompass approximately 64 percent of the entire Eagle Lake Field Office lands. The HMA contains many unique and important biological, geological, scenic, and cultural resources. Besides providing forage and habitat for wild horses, mules, and burros, the HMA is an important habitat for several wildlife species, including the Greater Sage-Grouse, pronghorn, and the East Lassen Deer Herd. The predominant land uses within the HMA are livestock grazing, wilderness recreation, and general recreation, including hunting.

The AML range within the HMA is 448 to 758 wild horses and 72 to 116 burros. The AML upper limit is the maximum number of wild horses and burros that can graze while maintaining a thriving natural ecological balance and multiple use relationship on the BLM-administered public lands in the area. Establishing AML as a population range shows the need for the periodic removal of excess animals (to the low range) and subsequent population growth (to the high range) between removals. The AML was established in the Twin Peaks Herd Management Area Plan (June 1989), revised in the Twin Peaks Allotment Multiple Use Decision (January 2001), and reaffirmed in the Eagle Lake Resource Management Plan (April 2008). The AML was determined based on an in-depth analysis of habitat suitability, resource monitoring, and population inventory data with public involvement. The AML is set based on five home ranges within the HMA. The background history on home ranges and subsequent decisions can be found in the 2010 Twin Peaks Herd Management Area Wild Horse and Burro Gather Plan (DOI-BLM-CA-N050-2010-05-EA, Section 1.5) and is incorporated into this assessment by reference.

The 2010 Twin Peaks Herd Management Area Wild Horse and Burro Gather Plan EA (DOI-BLM-CA-N050-2010-05-EA) is available on the National NEPA Register at: https://eplanning.blm.gov/epl-front-office/eplanning/nepa/nepa_register.do. To locate the EA, select "text search," "California," "Eagle Lake," and fiscal year "2010."

In 2010, 1,637 wild horses and 162 burros were gathered, 1,575 wild horses and 160 burros removed, and 58 wild horses and one (1) burro were released back to the Twin Peaks HMA. Of these, 18 mares were treated with fertility control vaccine (Porcine Zona Pellucida, PZP-22) and freezemarked for future identification. Post-gather in 2010, an estimated 793 wild horses and 160 burros remained on the HMA.

The current estimated population within and outside the Twin Peaks HMA for 2019 is 3,506 wild horses and 632 burros. This estimate is based on an aerial survey using the simultaneous double-observer method. The population inventory conducted in May 2017 calculated an HMA population at 2,565 wild horses and 462 burros. The current population estimate includes the addition of the 2017 and 2018 foal crops. Wild horse and burro numbers have increased an average of approximately 17 percent *per year* since the HMA was last gathered in 2010 (Lubow 2013, 2015; USGS unpublished data 2017). The estimated 2019 population is more than 782 percent over the lower AML for wild horses and more than 877 percent over the lower AML for burros (see Figures 1-1 and 1-2).

Figure 1-1: Wild horse population estimates

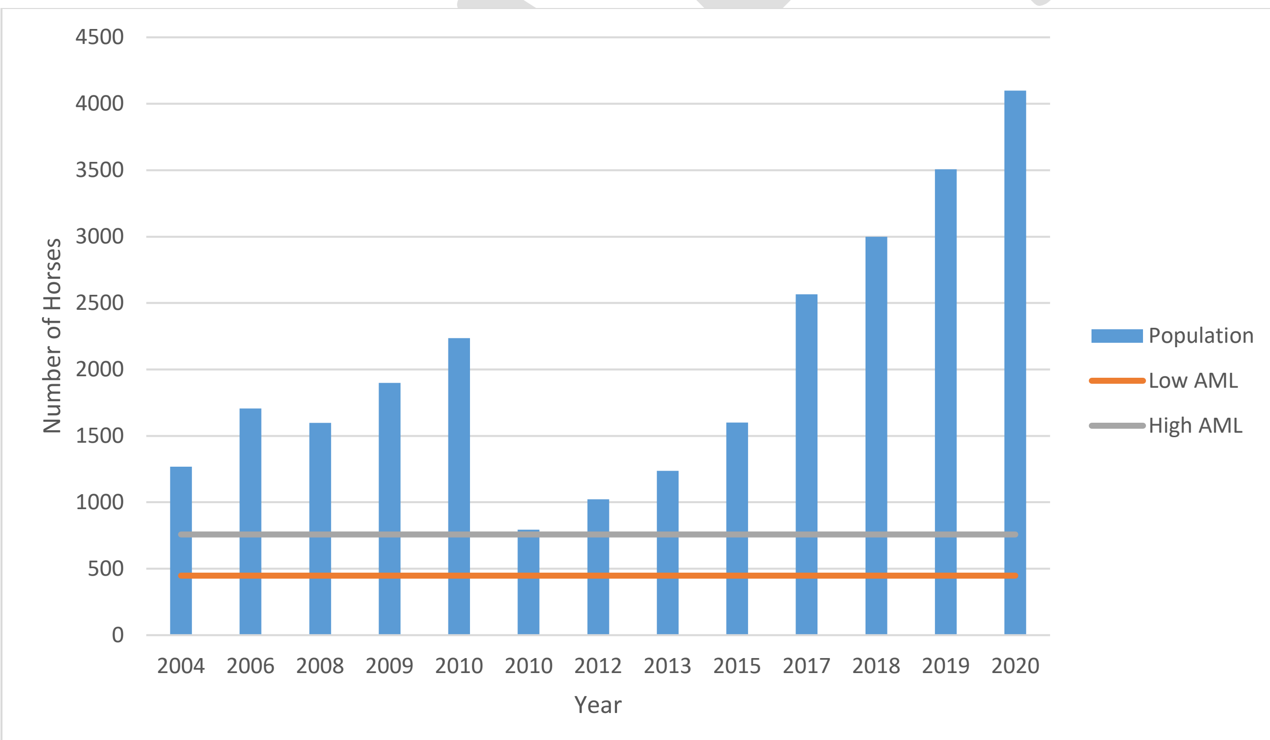
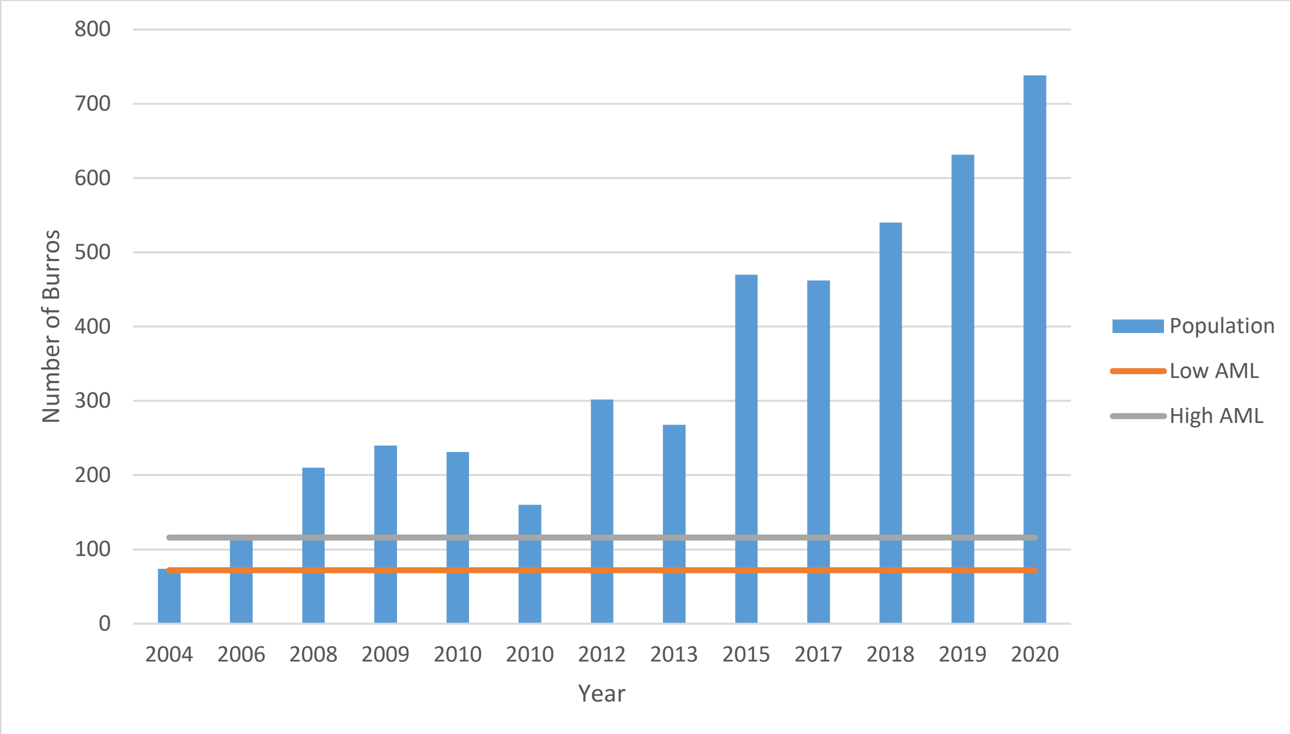


Figure 1-2: Wild burro population estimates



Based on all information available at this time, the BLM has determined that excess wild horses and burros exist within the HMA and need to be removed. This assessment is based on the following factors including, but not limited to:

1. In May 2017, the BLM conducted an aerial survey of the Twin Peaks HMA of 2,565 wild horses and 462 burros. There was an estimated 1,087 horses and 346 burros in excess of the AML upper limit (and 2,117 horses and 388 burros in excess of the AML lower limit). This estimate does not include the 2018 and later foal crops.

2. Wild horses and burros are using more than five times their allocated forage based on AUMs allocated by the upper limit AML (see Table 1-1).

3. Riparian functional assessments completed between 2010 and 2018 document severe utilization of forage within riparian and wetland habitats and extensive trampling and trailing damage by wild horses and burros.

4. Cultural resource surveys completed between 2008 and 2018 indicate that the wild horse and burro overpopulation is contributing to heavy trampling damage of cultural resource sites and artifacts from the animals.

5. Land health evaluations and determinations completed between 2004 and 2018 indicate that the wild horse and burro overpopulation is contributing to the following standard(s) not being met: Riparian/Wetland.

Table 1-1: Appropriate Management Levels for the Twin Peaks HMA

Home Range	2019 Population Estimates[4/]		BLM Document(s)/Date	Appropriate Management Level (Numbers)		Forage Allocation (AUMs) [1/]	
	Horses	Burros		Horses	Burros	Horses [2/]	Burros [3/]
Twin Peaks North	1465	354	Multiple Use Decision/ EA# CA-350-2000-16 (2001)	155 - 288	22 - 42	1860 - 3456	132 - 252
Skedaddle	521	176	Multiple Use Decision/ EA# CA-350-2000-16 (2001)	58 - 108	10 - 15	696 - 1296	60 - 90
Dry Valley Rim	224	96	Multiple Use Decision/ EA# CA-350-2000-16 (2001)	39 - 72	15 - 22	468 - 864	90 - 132
Observation North	625	1	EA# CA-350-98-20 (1998); Land Health Evaluation for the Observation Allotment (2008)	150 - 216	5 - 8	1800 - 2592	30 - 48
Observation South	230	4	EA# CA-350-98-20 (1998); Land Health Evaluation for the Observation Allotment (2008)	46 - 74	20 - 29	552 - 888	120 - 174
Total	3102	632		448-758	72-116	5376 - 9096	432 - 696

[1/] Animal Unit Month (AUM) is defined as the amount of forage necessary for the sustenance of one cow or its equivalent for a period of 1 month.
[2/] Horse AUMS are calculated using one mature horse (with foal) as 1 animal unit equivalent, for a 12 month grazing period.
[3/] Burro AUMS are calculated using one mature burro (with foal) as 0.5 animal unit equivalent, for a 12 month grazing period.
[4/] Total different from above because home range estimates not include animals outside HMA boundaries.

The total forage allocation for wild horses and burros in the Twin Peaks HMA ranges between 5,808 AUMs at the low AML to 9,792 AUMs at the high AML.

1.3 Purpose and Need for Action

The purpose of the proposed action and alternatives is to implement actions that would achieve and maintain wild horse and burro populations to be within the established AMLs for the Twin Peaks HMA over a period of 10 years. These actions would allow the BLM to achieve management goals and objectives of attaining low AML, slow the current population growth rate, and restore and maintain a thriving natural ecological balance within the Twin Peaks HMA.

This action is needed to protect rangeland resources from undue or unnecessary degradation and restore a thriving natural ecological balance and multiple-use relationship on BLM-administered public lands in the area consistent with the provisions of Section 3(b)(2) of the Wild Free-Roaming Horses and Burros Act of 1971, as amended (Wild Horse and Burro Act).[1]

[1] The Interior Board of Land Appeals (IBLA) defined the goal for managing wild horse (or burro) populations in a thriving natural ecological balance as follows: "As the court stated in Dahl vs. Clark, supra at 594, the 'benchmark test' for determining the suitable number of wild horses on the public range is 'thriving natural ecological balance.' In the words of the conference committee which adopted this standard: 'The goal of WH&B management should be to maintain a thriving ecological balance (TNEB) between WH&B populations, wildlife, livestock and vegetation, and to protect the range from the deterioration associated with overpopulation of wild horses and burros.'"

1.4 Land Use Plan Conformance

The proposed action and action alternatives are in conformance with the Eagle Lake Resource Management Plan and Record of Decision (April 2008), Section 2.24.4, and the Nevada and Northeastern California Greater Sage-Grouse Record of Decision and Approved Resource Management Plan Amendment, as amended (March 2019), Section 2.1.5. These documents are available on the National NEPA Register at: https://eplanning.blm.gov/epl-front-office/eplanning/nepa/nepa_register.do.

1.5 Relationship to Laws, Regulations, and Other Plans

The action alternatives are in conformance with the Wild Free-Roaming Horses and Burros Act of 1971 (as amended), applicable regulations at 43 CFR § 4700, and BLM policies (see Appendix B).

1.6 Conformance with Rangeland Health Standards and Guidelines

Between 2000 and 2018, the BLM completed land health assessments within the Twin Peaks HMA. The BLM has determined that causal factors contributing to sites not meeting standards in the allotments include wildfire, activities on adjacent private lands, and historic (pre-1970s) livestock grazing. A causal factor is defined as the predominant current factor that is contributing to the degradation of resource conditions, or past management activities that have impacted the land. More information regarding the Upland Soil and Biodiversity Standards for land health assessments conducted in all nine grazing allotments of the Twin Peaks HMA between 2000 and 2009 can be found in the 2010 Twin Peaks Herd Management Area Wild Horse and Burro Gather Plan (DOI-BLM-CA-N050-2010-05-EA, Section 3.9). Allotments continue to be evaluated for achievement of the rangeland health standards. The Standards for Rangeland Health are located in the *Rangeland Health Standards and Guidelines for California and Northwestern Nevada Final EIS* (USDI 1998).

The BLM completed 32 individual riparian functional assessments within the Twin Peaks HMA between 2009 and 2018 and determined that high amounts of grazing and trampling, resulting from the excess numbers of wild horses and burros in the HMA, are contributing factors for sites not achieving the Riparian/Wetland Standard for Rangeland Health. See Section 3.3.4 for a complete description of upland and riparian/wetland health assessments and results.

1.7 Decision to be Made

The authorized officer would select an alternative that determines whether to implement the proposed actions to achieve and maintain wild horse and burro populations within the established AML range. The decision would not set or adjust AML nor would it adjust livestock use, as these were set through previous land use planning decisions.

1.8 Scoping and Identification of Issues

Relative to the BLM's management of wild horses and burros in the Twin Peaks HMA, the BLM interdisciplinary team identified issues through internal scoping. For this assessment, the BLM also considered issues from previous external scoping and coordination with the public from the 2010 Twin Peaks Herd Management Area Wild Horse and Burro Gather Plan EA (DOI-BLM-CA-N050-2010-05-EA, see Section 1.9). For the 2010 wild horse and burro gather for the Twin Peaks HMA, the BLM sent a scoping letter to approximately 250 public interests and received over 2,300 scoping letters or emails from individuals or groups. The issues analyzed in this assessment are the following:

1. Impacts to individual wild horses and burros and the herd. Indicators for this issue include the following:
   - Projected population size and annual growth rate [WinEquus population modeling (the modeling does not apply to burros)]
   - Effectiveness of proposed fertility control application (WinEquus)

- Effects to genetic diversity
- Impacts to animal health and condition

2. Impacts to vegetation/soils, riparian/wetland, and cultural resources. Indicators for this issue include the following:
   - Forage utilization and alteration
   - Impacts to vegetation/soils and riparian/wetland resources assessed by PFC

3. Impacts to wildlife, migratory birds, and threatened, endangered, and special status species and their habitat. Indicators for this issue include the following:
   - Displacement, trampling, or disturbance
   - Competition for forage and water

2.0 Description of the Alternatives

2.1 Introduction

This section describes the proposed action and alternatives, including any that were considered but eliminated from detailed analysis. For this EA, four alternatives are analyzed in detail (see Table 2-1).

2.2 Description of Alternatives Considered in Detail

Table 2-1: Summary of Alternatives Considered in Detail

Alternative 1 (Proposed Action)	**Alternative 2** Gather & Female Fertility Control	**Alternative 3** Gather Only	**Alternative 4** (No Action)
The BLM would conduct a series of gathers of wild horses and burros over a 10-year period to achieve and maintain low AML. Management actions would include the following: • Gather of excess wild horses and burros; • Removal of excess wild horses and burros based on current guidance and policy; • Population growth suppression using approved fertility control treatments (ZonaStat-H, Porcine Zona Pellucida (PZP, PZP-22, GonaCon[2]);	Alternative 2 is the same as alternative 1, but would not include a non-reproducing male (gelding or vasectomized) portion of the population. The core breeding population at low AML would be approximately 269 stallions, 179 mares, 43 jacks and 29 jennies. Mules older than four and unweaned foals would be returned to the HMA.	Gather and remove excess animals over a 10 year period to low AML without fertility control, sex ratio adjustments, or non-reproducing males. The core breeding population would be approximately 224 stallions, 224 mares, 36 jacks, and 36 jennies. Mules older than four and unweaned foals would be returned to the HMA.	No Action — Defer gather and removal.

[2] Reference in this text to any specific commercial product, process, or service, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement, recommendation, or favoring by the Department of the Interior.

• Sex ratio adjustments (60% stallions or non-reproducing males, 40% females); • Management of up to 25% of the male horse population as non-breeding (not to exceed 60% total male horses in the HMA). • Addition of 90 non-reproducing male horses and 61 females with fertility control bringing the total horse population to mid-AML (approximately 600 horses); • Core breeding population would be approximately 270 intact stallions, 240 mares, 43 jacks, and 29 jennies. Non-reproducing male horses would not be any more than 90. (total male horses in the HMA would be approximately 360 males) • Mules older than four and unweaned foals would be returned to the HMA.			

The action alternatives were developed in response to the identified resource issues and the purpose and need, as described in Section 1.3. The no action alternative would not achieve the identified purpose and need. However, it is analyzed in this EA to provide a basis for comparison with the other action alternatives and to assess the effects of not conducting a gather. The no action alternative is in violation of the Wild Horse and Burro Act which requires the BLM to immediately remove excess wild horses and burros when a determination is made that excess animals are present and that action is necessary to remove excess animals.

2.2.1 Management Actions Common to Alternatives 1, 2, and 3

- The gathers would begin when the gather is scheduled by the BLM National Program Office. Summer or early fall gathers are preferred to avoid seasonal Greater Sage-Grouse restrictions, peak foaling season, and hunting season. Several factors such as animal condition, herd health, weather conditions, or other considerations could result in adjustments in the schedule.

- The duration of the gathers would depend on the number of animal removals approved for removal following coordination with the National WHB Program. Aerial surveys would be used to estimate population size. Distribution flights should occur prior to gathering to determine herd locations.
- Gather operations would be conducted in accordance with the Comprehensive Animal Welfare Program (see Appendix C). The primary gather (capture) methods would be the helicopter drive method with occasional helicopter assisted roping (from horseback). Bait and water trapping may also be used to capture animals for removal or for fertility control treatment.
- Trap sites and temporary holding facilities would be located in previously used sites or other disturbed areas whenever possible (Appendix D). Undisturbed areas identified as potential trap sites or holding facilities would be inventoried for cultural, botanical, and wildlife resources prior to initiation of gathers. If any natural or cultural resources are encountered, these locations would not be used unless they could be modified to avoid impacts to cultural resources, as determined by the field office archaeologist.
- A U.S. Department of Agriculture – Animal and Plant Inspection Service or other veterinarian may be on-site during the gather, as needed, to examine animals and make recommendations to the BLM for care and treatment of wild horses and burros.
- Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy (Instruction Memorandum [IM] 2015-70; https://www.blm.gov/policy/im-2015-070).
- Data including sex and age distribution, condition class information (using the Henneke rating system), color, size, and other information may also be recorded, along with the disposition of that animal (removed or released).
- Excess animals would be transported to BLM off-range corrals where they would be prepared (e.g., freezemarked, vaccinated, de-wormed, and gelded) for adoption, sale (with limitations), or long-term holding.
- Mules older than four years of age or un-weaned foals that are gathered would be returned to the HMA.

2.2.2 Management Actions Common to Alternatives 1 and 2

- Fertility control for mares and jennies would be applied in conformance with current wild horse and burro policy and guidelines.
- All mares and jennies release back to the HMA would be treated with Porcine Zona Pellucida (PZP), GonaCon, or a similar approved vaccine. Fertility control treatment would be conducted in accordance with the approved standard operating and post-treatment monitoring procedures (SOPs, Appendix F). Mares and jennies would be selected to maintain a diverse age structure, herd characteristics, and conformation.
- Post-gather, every effort would be made to return released horses and burros to the same general area from which they were gathered. No horses or burros would be returned to areas outside the HMA.

2.2.3 Alternative 1 (Proposed Action): Phased-in Gather and Removal of Excess Wild Horses and Burros to Low-AML, Sex Ratio Adjustment, and Population Growth Suppression

The proposed action would gather and remove as many excess wild horses, mules, and burros as feasible (based on gather efficiencies and holding capacity) from within and outside the Twin Peaks HMA over a period of 10 years from the initial gather until low AML is reached. It is expected that gather efficiencies, funding, and holding space would not allow for attainment of the low AML during the initial gather. Therefore, multiple gathers over a period of 10 years would occur to achieve management objectives. All wild horses and burros residing in areas outside of the HMA would be gathered and removed. Summer and fall gathers are preferred to allow for foaling and provide better access to trap sites. Fertility control implementation would follow current program policy and guidelines.

Under this alternative, the BLM would attempt to gather a sufficient number of wild horses and burros, to allow for the application of fertility control (PZP, PZP-22, GonaCon, or other approved formulation) to all mares and jennies that are released. Over the 10 year period, all mares and jennies trapped and selected for release would be treated with fertility control treatments GonaCon and/or Porcine Zona Pellucida -22 (PZP-22), ZonaStat-H (native PZP), or most current approved formulations to prevent pregnancy in the following year(s). Some females would be treated once at the temporary holding facility and released back into the HMA while other females would be removed to the off-range corrals and treated, then given a booster prior to release back to the HMA. Decisions about fertility control treatments would be made based on availability of treatments, space at off-range corrals, and the presence of a foal. Fertility control treatments and re-treatments could be administered as part of gather and release operations, in off-range corrals, or by remote delivery.

The HMA would be gathered to low AML (448 horses, 72 burros). Once low AML is reached, up to 90 non-reproducing male horses and 61 fertility control treated female horses would be released back to the HMA bringing the total horse population to mid AML (approximately 600 horses). The core breeding population of the HMA would be comprised of 60 percent males (approximately 270 intact horses and 43 burros) and 40 percent females (approximately 240 horses and 29 burros). All females returned to the HMA would be treated with fertility control. Up to 25 percent of the stallions returned to the HMA would be gelded (neutered) or vasectomized (not to exceed 90 horses) leaving approximately 270 intact stallions for the core breeding population. No male burros would be gelded or neutered to be returned to the HMA. All animals treated with any type of fertility control would be freezemarked and identified according to current policy. Additionally, stallions (and non-reproducing males) would be selected for release with the objective of establishing a 60 percent male sex ratio. Intact studs and mares released back to the HMA would be selected to maintain a diverse age structure, historical herd characteristics, and correct conformation. The procedures to be followed for implementing fertility control and male sterilization are detailed in Appendices E and F.

Male Sterilization

Discussions about herds that are ‘non-reproducing’ in whole or in part are in the context of this ‘metapopulation’ structure, where self-sustaining herds are not necessarily at the scale of single HMAs. So long as the definition of what constitutes a self-sustaining population includes the larger set of HMAs that have past or ongoing demographic and genetic connections – as is recommended by the National Academies of Sciences 2013 report – it is clear that single HMAs can be managed as non-reproducing in whole or in part while still allowing for a self-sustaining population of wild horses or burros at the broader spatial scale. Wild horses and burros are not an endangered species (USFWS 2015), nor are they rare. Nearly 72,000 adult wild horses and about 16,000 adult wild burros roam BLM lands as of March 1, 2019, and those numbers do not include at least 10,000 wild horses and burros on U.S. Forest Service lands, and at least 50,000 feral horses on tribal lands in the Western United States.

Neutering (gelding)

In order to reduce the total number of excess wild horses that would otherwise be permanently removed from the HMA, up to 25 percent of the male horse population would be managed as geldings, but the total number of male horses would not exceed 60 percent of the population.

The BLM routinely gelds all excess male horses that are captured and removed from the range prior to their adoption, sale, or shipment to off-range facilities. The gelding procedure for excess wild horses removed from the range would be conducted at temporary (field) or short-term holding facilities by licensed veterinarians and follows industry standards. Under Alternative 1, some geldings would be returned to resume their free-roaming behaviors on the public range instead of being permanently removed from the HMA.

By including some geldings in the population, and having a slightly skewed sex ratio with more males than females overall in the core breeding population, the anticipated result would be a reduction in population growth rates while allowing for management of a larger total wild horse population on the range.

When gelding procedures are done in the field, geldings would be released near a water source, when possible, approximately 24 to 48 hours following surgery. When the procedures are performed at a BLM-managed off-range corral, selected stallions would be shipped to the facility, gelded, held in a separate pen to minimize risk for disease, and returned to the HMA within 30 days.

Contraception
The BLM has identified fertility control as a method that could be used to protect rangeland ecosystem health and to reduce the frequency of wild horse and burro gathers and removals. Expanding the use of population growth suppression to slow population growth rates and reduce the number of animals removed from the range and sent to off-range pastures is a BLM priority. The Wild Horse and Burro Act of 1971 specifically provides for contraception (Section 3.b.1). No finding of excess animals is required for the BLM to pursue contraception in wild horses or burros.

Contraception has been shown to be a cost-effective and humane treatment to slow increases in wild horse populations or, when used with other techniques, to reduce horse population size (Bartholow 2004, de Seve and Boyles-Griffin 2013, Fonner and Bohara 2017).

Fertility Control Vaccines
Fertility control vaccines (also known as immunocontraceptives) meet the BLM requirements for safety to mares and the environment (EPA 2009a, 2012). Because they work by causing an immune response in treated animals, there is no risk of hormones or toxins being taken into the food chain when a treated mare dies. The BLM and other land managers have mainly used three fertility control vaccine formulations for fertility control of wild horses and burros on the range: ZonaStat-H, PZP-22, and GonaCon-Equine. As other formulations become available they may be applied in the future.

In any vaccine, the antigen is the stimulant to which the body responds by making antigen-specific antibodies. Those antibodies then signal to the body that a foreign molecule is present, initiating an immune response that removes the molecule or cell. Adjuvants are additional substances that are included in vaccines to elevate the level of immune response. Adjuvants help to incite recruitment of lymphocytes and other immune cells which foster a long-lasting immune response that is specific to the antigen.

Liquid emulsion vaccines can be injected by hand or remotely administered in the field using a pneumatic dart (Roelle and Ransom 2009, Rutberg et al. 2017, McCann et al. 2017) in cases where mares are relatively approachable. Use of remotely delivered (dart-delivered) vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached within 50 meters (BLM 2010). Booster doses can be safely administered by hand or by dart. Even with repeated booster treatments of the vaccines, it is expected that most mares would eventually return to fertility, though some individual mares treated repeatedly may remain infertile. Once the herd size in a project area is at AML and population growth seems to be stabilized, the BLM can make adaptive determinations as to the required frequency of new and booster treatments.

The BLM has followed standard operating and post-treatment monitoring procedures for fertility control vaccine application (BLM Instruction Memorandum 2009-090: https://www.blm.gov/policy/im-2009-090). Herds selected for fertility control vaccine use should have annual growth rates over 5 percent and a herd size over 50 animals. The procedure requires that treated mares be identifiable via a visible freeze brand or individual color markings, so that their vaccination history can be known. The procedure calls for follow-up population surveys to determine the realized annual growth rate in herds treated with fertility control vaccines.

Porcine Zona Pellucida (PZP) Vaccine
The PZP may be applied to mares and jennies prior to their release back into the HMA. The PZP vaccines meet most of the criteria that the National Research Council (2013) used to identify promising fertility control methods, in terms of delivery method, availability, efficacy, and side effects. PZP is relatively inexpensive, meets BLM requirements for safety to mares and jennies and the environment, and is produced as the liquid PZP vaccine ZonaStat-H, an EPA-registered commercial product (EPA 2012, SCC 2015), or as PZP-22, which is a formulation of PZP in polymer pellets that may lead to a longer immune response (Turner et al. 2002, Rutberg et al. 2017).

Darting can be implemented opportunistically by applicators near water sources or along main trails out on the range. Blinds may be used to camouflage applicators to allow efficient treatment of as many mares as possible. Native PZP (or currently most effective formulation) would be administered by PZP certified and trained applicators in the one year liquid dose inoculations by field darting the mares. Prior to actually darting, an inventory of the wild horses and burros would be conducted. This would include a list of marked horses and burros and / or a photo catalog with descriptions of the animals to assist in identifying which animals have been treated and which need to be treated.

Gonadotropin Releasing Hormone (GnRH) Vaccine (GonaCon)
GonaCon may be applied to animals prior to their release back into the HMA. Taking into consideration available literature on the subject, the National Research Council concluded in their 2013 report that GonaCon-B (which is produced under the trade name GonaCon-Equine for use in feral horses and burros) was one of the most preferable available methods for contraception in wild horses and burros (NRC 2013), in terms of delivery method, availability, efficacy, and side effects. GonaCon-Equine is approved for use by authorized federal, state, tribal, public and private personnel, for application to wild and feral equids in the United States (EPA 2013, 2015). GonaCon will only be used in California if approved by the California EPA.

The BLM may apply GonaCon-Equine to captured mares, and would return to the HMA as needed to re-apply GonaCon-Equine, including by recapture and/or remote darting. GonaCon-Equine can safely be reapplied as necessary to control the population growth rate.

The BLM has been conducting wild horse and burro gathers since the mid-1970s. During this time, methods and procedures have been identified and refined to minimize stress and impacts to wild horses and burros during gather implementation. The CAWP in Appendix C would be implemented to ensure a safe and humane gather occurs and would minimize potential stress and injury to wild horses and burros.

Transport, Off-Range Corral (ORC) Holding, and Adoption (or Sale) Preparation
Animals would be transported from the capture/temporary holding corrals to the designated BLM off-range corrals ORC(s). From there, they would be made available for adoption or sale to qualified individuals or to off-range pastures (ORP).

Wild horses or burros selected for removal from the range are transported to the receiving ORC in a straight deck semi-trailers or goose-neck stock trailers. Vehicles are inspected by the BLM Contracting Officer's Representative (COR) and Project Inspectors (PIs) prior to use to ensure wild horses and burros can be safely transported and that the interior of the vehicle is in a sanitary condition. Wild horses and burros are segregated by age and sex and loaded into separate compartments. A small number of mares or jennies may be shipped with foals. Transportation of recently captured wild horses or burros is limited to a maximum of 8 hours.

Upon arrival at the ORC, recently captured wild horses and burros are off-loaded by compartment and placed in holding pens where they are fed good quality hay and water. Most wild horses and burros begin to eat and drink immediately and adjust rapidly to their new situation. At the ORC, a veterinarian examines each load of horses and provides recommendations to the BLM regarding care, treatment, and if necessary, euthanasia of the recently captured wild horses and burros. Any animals affected by a chronic or incurable disease, injury, lameness or serious physical defect (such as severe tooth loss or wear, club feet, and other severe congenital abnormalities) would be humanely euthanized using methods acceptable to the American Veterinary Medical Association (AVMA). Wild horses and burros in very thin condition or animals with injuries are sorted and placed in hospital pens, fed separately and/or treated for their injuries as indicated. Recently captured animals in very thin condition may have difficulty transitioning to feed. Some of these animals are in such poor condition that it is unlikely they would have survived if left on the range. Similarly, some females may lose their pregnancies. Every effort is taken to help females make a quiet, low stress transition to captivity and domestic feed to minimize the risk of miscarriage or death.

After recently captured wild horses and burros have transitioned to their new environment, they are prepared for adoption or sale. Preparation involves freezemarking the animals with a unique identification number, drawing a blood sample to test for equine infections anemia, vaccination against common diseases, castration, and de-worming.

At ORCs, a minimum of 700 square feet is provided per animal. Mortality at ORCs averages approximately five percent per year (GAO 2008), and includes animals euthanized due to a pre-existing condition; animals in extremely poor condition; animals that are injured and would not recover; animals which are unable to transition to feed; and animals which are seriously injured or accidentally die during sorting, handling, or preparation.

Adoption or Sale with Limitations and Off-Range Pastures (ORP)
Adoption applicants are required to have at least a 400 square foot corral with panels that are at least six feet tall for horses over 18 months of age. Applicants are required to provide adequate shelter, feed, and water. The BLM retains title to the horse for one year and the horse and the facilities are inspected to assure the adopter is complying with the BLM's requirements. After one year, the adopter may take title to the horse, at which point the horse becomes the property of the adopter. Adoptions are conducted in accordance with 43 CFR 5750.

Potential buyers must fill out an application and be pre-approved before they may buy a wild horse. A sale-eligible wild horse is any animal that is more than 10 years old; or has been offered unsuccessfully for adoption three times. The application also specifies that buyers cannot re-sell the animal to slaughter buyers or anyone who would sell the animal to a commercial processing plant. Sales of wild horses are conducted in accordance with BLM policy.

ORPs are designed to provide excess wild horses with humane, life-long care in a natural setting off the public rangelands. There wild horses are maintained in grassland pastures large enough to allow free-roaming behavior and with the forage, water, and shelter necessary to sustain them in good condition. About 33,000 wild horses that are in excess of the existing adoption or sale demand (because of age or other factors) are currently located on private land pastures in Iowa, Kansas, Oklahoma, Missouri, Montana, Nebraska, Wyoming, Utah, and South Dakota. Located mainly in mid or tall grass prairie regions of the United States, these ORP are typically highly productive grasslands as compared to more arid western rangelands. These pastures comprise about 370,000 acres. The majority of these animals are older in age.

Euthanasia and Sale without Limitation
Under the Wild Horse and Burro Act, healthy excess wild horses or burros can be humanely euthanized or sold without limitation if there is no adoption demand for the animals. However, while euthanasia and sale without limitation are allowed under the statute, for several decades Congress has prohibited the use of appropriated funds for this purpose. If Congress were to lift the current appropriations restrictions, then it is possible that excess horses removed from the HMA over the next 10 years could potentially be euthanized or sold without limitation consistent with the provisions of the Wild Horse and Burro Act.

Any old, sick or lame horses unable to maintain an acceptable body condition (greater than or equal to a Henneke BCS of 3) or with serious physical defects would be humanely euthanized either before gather activities begin or during the gather operations as well as within off-range holding facilities.

2.2.4 Alternative 2: Phased-in Gather and Removal of Excess Wild Horses and Burros to Low AML, Sex Ratio Adjustment, and Population Growth Suppression

Alternative 2 is similar to Alternative 1 but would not include a non-reproducing male component and would be gathered to low AML. Alternative 2 would include the removal of excess wild horses and burros to low AML, population growth control using fertility control treatments for females (PZP, PZP-22, GonaCon, or most current approved formula), and sex ratio adjustments. Under Alternative 2, the BLM would gather and remove excess wild horses and burros within the project area to return the population levels to low AML range. All excess wild horses and burros residing in areas outside of the HMA would be gathered and removed. Under this alternative, the BLM would attempt to gather a sufficient number of wild horses and burros, to allow for the application of fertility control (PZP, PZP-22, GonaCon, or other approved formulation) to all mares and jennies that are released. The procedures to be followed for implementation of fertility control are detailed in Appendix E. Once low AML has been achieved, animals would be released targeting a 60:40 male to female sex ratio on the range (including animals not gathered). The core breeding population at low AML would be approximately 269 stallions, 179 mares, 43 jacks and 29 jennies.

See Alternative 1 (Section 2.2.3) for descriptions on contraception, fertility control vaccines, porcine zona pellucida (PZP) vaccine, and gonadotropin releasing hormone (GnRH) vaccine (GonaCon) that also pertain to Alternative 2.

See Alternative 1 (Section 2.2.3) for descriptions regarding the transport, off-range corral (ORC) holding, and adoption (or sale) preparation, adoption or sale with limitations and off-range pastures (ORP), and euthanasia and sale without limitation that pertain to Alternative 2.

2.2.5 Alternative 3: Phased-in Gather and Removal Only

Alternative 3 would gather and remove excess wild horses and burros from within and outside the Twin Peaks HMA over a 10-year period to achieve and maintain low AML. The actual number removed in a given gather would depend on availability of national holding space and funding, and gather efficiencies. Fertility control would not be applied and no changes to the herd's existing sex ratio would be made. The core breeding population would be approximately 224 stallions, 224 mares, 36 jacks, and 36 jennies.

See Alternative 1 (Section 2.2.3) for descriptions regarding the transport, off-range corral (ORC) holding, and adoption (or sale) preparation, adoption or sale with limitations and off-range pastures (ORP), and euthanasia and sale without limitation that pertain to Alternative 2.

2.2.6 Alternative 4: No Action

Under Alternative 4, no gather and no population management to control the size of the wild horse and burro population within the Twin Peaks HMA would occur.

2.3 Alternatives Considered but Dismissed from Detailed Analysis

1. **Exclusive Use of Bait and/or Water Trapping**

This alternative involves the use of bait (feed) and/or water to lure horses and burros into trap sites as the primary gather method. It would not be timely, cost-effective, or practical to use bait and/or water trapping as the primary gather method because the number of water sources on both private and public lands within and outside the HMA would make it almost impossible to restrict wild horse and burro access to the selected water trap sites. Bait and/or water trapping may be used in strategic locations to assist in removals and fertility control treatments. As a result, this alternative was dismissed from detailed analysis.

2. **Remove or Reduce Livestock within the HMA**

This alternative would remove or reduce authorized livestock grazing instead of gathering and removing wild horses and burros within the HMA. This alternative was not considered in detail because it is contrary to previous decisions which allocated forage for livestock use and would not be in conformance with the existing land use plan. Livestock grazing can only be reduced or eliminated through provisions identified within regulations (43 CFR 4100) and must be consistent with multiple use allocation set forth in the RMP. This alternative would be contrary to the BLM's multiple-use mission as outlined in the 1976 Federal Land Policy and Management Act because this alternative would exchange use by livestock for use by wild horses. The BLM is required to manage wild horses and burros in a manner designed to achieve a thriving natural ecological balance between wild horse and burro populations, wildlife, livestock, and other uses. Thus reducing livestock AUMs to increase AMLs would not achieve a thriving natural ecological balance. Horses are present year-round and their impacts to rangeland resources differ from livestock, as livestock can be controlled through an established grazing system (confinement to specific pastures and limited period or season of use to minimize impacts to vegetation and riparian). This alternative would also be inconsistent with the Wild Horse and Burro Act, which directs the immediate removal of excess wild horses and burros.

3. **Gather the HMA to the AML Upper Limit**

Under this alternative, a gather would be conducted to remove enough wild horses and burros to achieve the upper range of the AML. This alternative was dismissed from detailed study because AML would be exceeded by the next foaling season following gather resulting in the need to conduct another gather within one year. This would result in increased stress to individual wild horses and the herd and resource damage due to wild horse and burro overpopulation in the interim, as the upper level of the AML established for the Twin Peaks HMA represents the maximum population for which thriving natural ecological balance would be maintained. This alternative is not consistent with the Wild Horse and Burro Act, which upon determination excess wild horses and burros are present requires their immediate removal.

4. **Fertility Control Treatment Only (No Removal)**

Under this alternative, no excess wild horses and burros would be removed. Population modeling (which does not apply to burros) was completed to analyze the potential impacts associated with conducting gathers about every 2 to 3 years over the next 20 year period to treat captured mares with fertility control. Due to the vast size of this HMA, wide distribution of animals, and accessibility to the animals, remote darting opportunities are extremely limited because of the annual retreatment requirements to maintain vaccination efficiency. While the average population growth would be reduced between approximately 13.4 percent and 22.3 percent (as modeled in WinEquus) per year, AML would still not be achieved through fertility control alone and damage to the range associated with wild horse and burro overpopulation would continue. Moreover, this alternative would not meet the Purpose and Need for the Action and would be contrary to the Wild Horse and Burro Act.

5. Designate the HMA to be Managed Principally for Wild Horse or Burro Herds

This alternative would address the issue of excess wild horses and burros in the HMA through the removal or reduction of authorized livestock grazing, instead of by gathering and/or removing wild horses and burros from the HMA. This alternative would be contrary to the Eagle Lake RMP by allowing the wild horse and burro population to remain above AML. Therefore, this alternative does not meet the purpose and need to achieve and maintain the established AMLs.

This alternative is also inconsistent with the Wild Horse and Burro Act, which directs the Secretary to immediately remove excess wild horses and burros. Furthermore, livestock grazing can only be reduced or eliminated if BLM follows regulations at 43 CFR § 4100. Such changes to livestock grazing cannot be made through a wild horse and burro gather decision. The current apportionment of multiple use grazing between livestock and wild horses and burros was established through a five year public review process between 2004 and 2008, which developed and approved the Eagle Lake RMP. A land-use plan amendment would be required to modify the current multiple use relationship. The available monitoring data does not indicate a need to change the level of livestock grazing. Nor does the available monitoring data indicate that changes to the wild horse AML are warranted at this time, since there is no evidence of changes in habitat conditions (such as greater availability of water) that would allow for increases in the wild horse and burro AML.

The current population of wild horses and burros above AML is resulting in adverse impacts to water sources, riparian/wetland sites, and vegetation. Even in areas where there has been little to no livestock grazing, monitoring data show that wild horse and burro impacts are affecting the BLM's ability to manage for rangeland health.

The current level of authorized livestock grazing has been established through inventory and monitoring data over the past 50 years. Forage allocations for livestock have been made in accordance with forage and habitat needs for wildlife and wild horses and burros. The BLM has not received any new information that would indicate a need to change the level of livestock grazing at this time. Furthermore, the BLM establishes grazing systems to manage livestock grazing through specific terms and conditions that confine grazing to specific pastures, limit periods of use, and set utilization standards. These terms and conditions serve to minimize livestock grazing impacts to vegetation during the growing season and to riparian zones during the summer months.

Wild horses and burros, however, are present year-round, and their impacts to rangeland resources cannot be controlled through establishment of a grazing system, such as for livestock. Thus impacts from wild horses and burros can only be addressed by limiting their numbers to a level that does not adversely impact rangeland resources and other multiple uses.

While the BLM is authorized to remove livestock from HMAs "if necessary to provide habitat for wild horses or burros, to implement herd management actions, or to protect wild horses or burros from disease, harassment or injury" (43 CFR § 4710.5), this authority is usually applied in cases of specific emergency conditions and not for the general management of wild horses or burros under the Wild Horse and Burro Act, as wild horse and burro management is based on the land-use planning process, multiple use decisions, and establishment of AML. For these reasons, this alternative was eliminated from further consideration.

6. Raising the Appropriate Management Level for Wild Horses and Burros

The BLM has established current AML ranges based on many years of data collection, resource monitoring, and multi-agency planning efforts. The current AMLs are based on established biological and cultural resource monitoring protocols and land health assessments and were approved in the Eagle Lake RMP. Delay of a gather until the AML can be reevaluated is not consistent with the Wild Horse and Burro Act, Public Rangelands Improvement Act, FLPMA, or the existing Eagle Lake RMP. Monitoring data collected within the HMA does not indicate that an increase in AML is warranted at this time. On the contrary, such monitoring data confirms the need to remove excess wild horses and burros to reverse downward resource trends and promote improvement of rangeland and riparian health. Severe resource degradation would occur in the meantime and large numbers of excess animals would ultimately need to be removed from the HMA in order to achieve AML or to prevent the death of individual animals under emergency conditions. This alternative was eliminated from further consideration because it is contrary to the Wild Horse and Burro Act which requires the BLM to manage the rangelands to prevent resources from deterioration associated with an overpopulation of wild horses and burros. In addition, raising the AML where there are known resource degradation issues associated with an overpopulation of wild horses and burros does not meet the purpose and need to restore and maintain a thriving ecological balance. If future data suggests that adjustments in the AML are needed (either upward or downward), once the AML has been achieved then changes would be based on an analysis of monitoring data, including a review of wild horse and burro habitat suitability, such as the condition of water sources in the HMA. For the reasons stated above, this alternative was eliminated from further consideration.

3.0 Affected Environment

This section of the EA briefly discusses the relevant components of the human environment which would be either affected or potentially affected by the action alternatives or no action (see Table 3-1).

3.1 General Description of the Affected Environment

The Twin Peaks HMA encompasses 789,852 acres of public, private, and state lands within Lassen County, California and Washoe County, Nevada (see Appendix A for map). Topography varies from gently rolling hills to deeply dissected canyons. Elevation varies from 4,020 feet to 7,964 feet. Precipitation averages 7 inches at lower elevations to 27 inches at the highest elevations. Temperatures also vary from 19 to 44 degrees Fahrenheit in the winter and between 55 to 94 degrees Fahrenheit in the summer.

The wild horses of the Twin Peaks HMA are descendants of local ranch horses, and cavalry remounts (Amesbury 1967). During World War II the Marr Ranch of the Madeline Plains was involved in gathering wild horses from the Twin Peaks HMA for U.S. Army remounts. The first aerial inventory of the Twin Peaks HMA was undertaken by the BLM in 1973, which noted 835 horses and 104 burros. Based on 2006 and 2010 capture data, horses in the Twin Peaks HMA predominantly exhibit bay, sorrel, and brown coat colors; however many horses have varied colors, including palomino, gray, dun, grulla, buckskin, appaloosa, pinto, and chestnut. Horses within the Twin Peaks HMA are commonly 15 hands tall, of slight to moderate build, and average 800 to 1100 pounds in weight. Burros are typically 11 hands tall and average 400 pounds in weight.

Vegetation is typical of sagebrush steppe with co-dominance of shrubs and native perennial grasses. The Rush Fire of 2012, which burned approximately 40 percent of the HMA, led to conversion of large tracts of sagebrush steppe to invasive annual grasses despite restoration efforts. Other smaller wildfires have also occurred in the HMA, resulting in additional conversions of sagebrush steppe to invasive, annual grass monocultures. Invasive grass monocultures are generally stable ecological states, in which recovery to native perennial grasses is not expected. In addition to a decline in biodiversity, wildfires have also exposed vulnerable soils to trampling resulting in increased wind and water erosion.
Water is available through a variety of undeveloped streams, springs, and seeps, as well as developed water sources such as stock tanks, pits, troughs, and reservoirs on public and private lands. These are scattered throughout the HMA, though more abundant on the northern end and less abundant on the southern end. Many of the undeveloped springs and seeps are ephemeral and produce water for only a few months in normal precipitation years. Many of them produce no water during below average precipitation years.

A more detailed description of the Twin Peaks HMA, history, and elements of the affected environment can be found in the 2010 Twin Peaks Herd Management Area Wild Horse and Burro Gather EA (Chapter 3, pages 32 to 82) and is incorporated into this assessment by reference.

3.2 Description of Affected Resources/Issues

Table 3-1 lists the elements of the human environment subject to requirements in statute, regulation, or executive order which were considered for detailed analysis. The BLM has discussed all the resources mentioned below, and has either incorporated and analyzed them within this EA, or provided an explanation of why they were not analyzed in detail. Resources that may be affected by the proposed action and alternatives were identified to be analyzed in detail. Resources that are not present or not affected by the proposed action and alternatives were considered but eliminated from detailed analysis.

Table 3-1: Supplemental Authorities (Critical Elements of the Human Environment)

Supplemental Authorities	Present	May Affect	Rationale
Area of Critical Environmental Concern (ACEC)	**YES**	**NO**	The Twin Peaks HMA contains four ACECs: the Pine Dunes, Lower Smoke Creek, Buffalo Creek Canyons, and North Dry Valley ACECs. The proposed action would positively affect ACECs by reducing damage to cultural resources, upland vegetation, and riparian areas and improve the biological integrity of the ACEC's from reducing year-round grazing pressure by wild horses and burros.
Air Quality	**YES**	**NO**	The planning area is outside a non-attainment area. The proposed action would result in small and temporary areas of disturbance.
Cultural Resources	**YES**	**YES**	To prevent any impacts to cultural resources, trap sites and temporary holding facilities would be located in previously surveyed areas. Cultural resource inventories and clearances would be required prior to using trap sites or holding facilities outside existing areas of disturbance.

			Cultural resources would mostly be impacted under the no action alternative. Discussed below in Sections 3.2.1 and 4.4.1.
Environmental Justice	**NO**	**NO**	The proposed action would have no disproportionately high or adverse human health or environmental effects on minority or low-income populations.
Greater Sage-Grouse	**YES**	**YES**	Discussed below in Section 3.3.6 and 4.4.6.
Farmlands, Prime or Unique	**NO**	**NO**	No Prime or Unique Farmlands (as defined by 7 CFR 657.5) are present in the HMA.
Fish Habitat	**YES**	**NO**	Fish habitat would benefit from the removal of excess wild horses and burros by reducing year-round trampling and sediment loading.
Floodplains	**NO**	**NO**	Not present.
Forest / Woodlands	**YES**	**NO**	Juniper woodlands occurring in the HMA would not be affected.
Fuels/ Fire	**YES**	**NO**	Fuel projects within the HMA would not be affected.
Health and Safety	**YES**	**NO**	The health and safety of the public during gather operations would follow Observation Day Protocol and Ground Rules that have been used in recent gathers to ensure that the public remains at a safe distance and does not impede gather operations. Appropriate BLM staff would be present to ensure compliance with visitation protocols. These measures minimize the risks to the health and safety of the public, BLM staff and contractors, and to the wild horses and burros during the gather operations. The BLM also follows current policy and guidelines pertaining to Observation Day [BLM IM No. 2013-058].
Lands/ Access	**NO**	**NO**	No new rights-of-way or other land authorizations are required to implement the proposed action or alternatives.
Livestock Grazing	**YES**	**YES**	Discussed below in Section 3.2.2 and 4.4.2.
Migratory Birds	**YES**	**YES**	Discussed below in Section 3.3.6 and 4.4.6.
Native American Religious Concerns	**YES**	**NO**	None known.
Noxious Weeds	**YES**	**NO**	To prevent the risk for spread of noxious weeds, any noxious weeds or non-native invasive weeds would be avoided when establishing and accessing trap sites and holding facilities. Protocol to reduce the spread of noxious weeds by vehicles is discussed in the Eagle Lake 2019 Updated Integrated Invasive Plant Management EA (DOI-

			BLM-CA-N050-2019-08-EA). The protocol would be followed under this EA. All trap sites, holding facilities, and camp sites would be surveyed prior to selection. A reduction of wild horse and burro populations would reduce the occurrence of noxious weed sites across the landscape.
Recreation	**YES**	**NO**	Recreation infrastructure would not be impacted. Recreation use has occurred mainly in the form of wilderness recreation, hiking, camping, and hunting. Activities that have occurred with very low frequency are wildlife observation, nature study, and archaeological sightseeing.
Riparian-Wetland Zones	**YES**	**YES**	Discussed below in Section 3.3.4 and 4.4.4.
Socioeconomics	**YES**	**NO**	The proposed action or alternatives would not affect the socioeconomic status of the counties or nearby towns.
Soil Resources	**YES**	**YES**	Impacts to soils would affect less than 1% of the HMA and would be temporary under Alternatives 1, 2 and 3. Alternative 4 would have an impact to soils in areas where horses and burro congregate, which would generally be around riparian areas. Discussed below in Section 3.3.5 and 4.4.5.
Threatened and Endangered (T&E) Plant Species	**NO**	**NO**	There are no known populations of designated T&E species occurring within the Eagle Lake Field Office boundary.
T&E Wildlife Species	**NO**	**YES**	Discussed below in Section 3.3.6 and 4.4.6.
Vegetation	**YES**	**YES**	Discussed below in Section 3.3.3 and 4.4.3.
Visual Resources	**YES**	**NO**	Gather operations are temporary and would not impact visual resources within the HMA.
Water Quality	**YES**	**NO**	Trap sites and temporary holding facilities would be located away from any water sources to avoid impacts to water quality. Any impacts to water sources used while horses are in route to trap sites would be temporary and would not significantly affect water quality.
Waste (Hazardous or Solid)	**NO**	**NO**	Not present.
Wild Horse and Burros	**YES**	**YES**	Discussed below in Sections 3.3.7 and 4.4.7
Wild and Scenic Rivers	**NO**	**NO**	Not present.
Wilderness and Wilderness Study Area	**YES**	**NO**	Alternatives 1, 2, and 3 would result in long-term benefits to wilderness characteristics and short-term impacts from low-level aerial disturbance. BLM guidelines and policy regarding management in WSAs would be followed. Alternative 4 would

			result in negative impacts over time, as impacts to these resources would increase with escalating populations.
Wildlife	**YES**	**YES**	Discussed below in Section 3.3.6 and 4.4.6.

Critical elements of the human environment identified as present and potentially affected by the action alternatives (alternatives 1, 2, and 3) and/or the no action alternative include: cultural resources, livestock grazing, upland vegetation, riparian and wetland resources, soil resources, wildlife (migratory birds, threatened and endangered wildlife species, Greater Sage-Grouse), and wild horses and burros. The affected environment relative to these resources is described below.

3.2.1 Cultural Resources

Ethnographically, the Twin Peaks HMA was part of the territory of three indigenous groups. The majority of the HMA is within the territory of the *Kamotkut* and *Wadatkut* Bands of the Northern Paiute. The eastern edge of the gather area borders the Pyramid Lake Paiute Reservation and the northeastern portion of the gather area is within the territorial boundaries of the *Hammawi* Band of the Pit River Tribe. The very southern portion of the HMA is within the peripheral use area of the Washoe Tribe.

Historically, this area has been used for sheep and cattle grazing by Euro-Americans. Cultural resource inventories within the gather area indicate that the area was used by prehistoric people for resource procurement activities and habitation locations. In addition, seasonal, temporary campsites were established for the purposes of procuring stone-tool material, game, and plant resources. Historic resources are associated with early homesteading, ranching, and emigrant and military trails.

There are nine established Cultural Resource Management Areas (CRMAs) within the Twin Peaks Gather area, shown in Appendix G. Each CRMA was designated in 2008 as a result of the high density of cultural resource sites in each area. The CRMA is an unofficial designation that is intended to provide heightened awareness to sensitive resources by increasing law enforcement patrols within these areas and providing research opportunities to scientific institutions.

Various Class II and III cultural resource inventories have been conducted within the Twin Peaks HMA since the 1970s. These inventories have resulted in the recordation of 1,292 previously unidentified archaeological sites. The majority of these are prehistoric Native American sites and the rest are associated with historic Euro-American use, or a combination of both. Prehistoric artifact scatters mark the locations of former habitation sites, camps, resource processing, management or procurement locations, transportation features, and refuse disposal areas. Other prehistoric resources include rock stack features and petroglyphs.

The most sensitive areas for cultural resources are those which have natural water sources, such as springs and streams. Lithic scatters (reduction areas), village sites, and quarry sites are especially vulnerable because trampling can break up, move around, and destroy artifacts. Sites damaged by livestock or wild horse and burro grazing begin to erode and can lose their integrity until they are eventually completely destroyed. Soil compaction due to hoof action also contributes to a loss of integrity within archaeological sites.

Increasing populations of wild horses and burros and competition for limited access to water has resulted in serious impacts to cultural resources at riparian areas. In an effort to access water, horses and burros have caused significant ground disturbance from trampling and pawing the ground around the spring source. As a result, both prehistoric and historic artifacts at the springs have been displaced and/or destroyed. In addition to the loss of artifacts, the sites suffered a serious loss of integrity and data potential that cannot be recovered.

3.2.2 Livestock

The affected environment for livestock grazing provides information on how ecosystems within the Twin Peaks HMA are being affected by multiple uses of the land, including livestock grazing permits. Adjustments to livestock grazing permits is outside of the scope of this assessment. Information about livestock grazing permits within the Twin Peaks HMA is provided below in Table 3-2.

All livestock permits within the Twin Peaks HMA have undergone multiple changes to permit terms and conditions over the past 30 years. Livestock active AUMs were reduced in several allotments in the 1960s. In recent years, the BLM has monitored livestock grazing utilization, conducted riparian functional assessments and other used monitoring methods to determine if the active numbers are meeting allotment resource objectives. The BLM issues grazing permit renewals on a 10-year basis and makes adjustments as necessary to active numbers, AUMs, and season of use to meet land health standards.

The BLM has reduced active livestock use on the Twin Peaks HMA by 61 percent over the last 50 years (see Appendix I). Further information regarding reduced use is incorporated into this assessment by reference from the 2010 Twin Peaks Herd Management Area Wild Horse and Burro Gather EA (Section 3.4, pages 44 to 49). The decision to reduce the amount of livestock grazing in the allotment was to promote healthy sustainable rangeland ecosystems. The allotments within the HMA are mapped in Appendix H. There are a total of nine livestock operators who are currently authorized to graze livestock in these allotments annually. The cattle and sheep operators are authorized to use a total of 26,644 AUMs of forage each year. An AUM is the amount of forage needed to sustain one cow, five sheep, or five goats for a month. The allotments consist of various pastures grazed in a rest- and deferred-rotation.

Each allotment has specific terms and conditions defining turnout locations and seasons of use depending on the prior year's available water, climatic conditions, and actual use numbers. Annual meetings (Annual Operating Plans) are held prior to livestock turnout to plan deferment and livestock rotations. During drought years, livestock use may be limited or decrease due to lack of water availability. The BLM Range Management Specialists work closely with operators on livestock distribution and movement during such years to limit excessive use on riparian areas. The season of use may vary by one to two weeks annually based upon forage availability, drought conditions, and other management criteria.

The BLM allocated forage for livestock use, and the management of cattle and sheep in the Twin Peaks HMA involves careful adherence to permit stipulations, particularly regarding livestock numbers and season-of-use restrictions. Decisions pertaining to the nine grazing allotments are contained in the following documents:

1. BLM Environmental Assessment, DOI-BLM-CA-N050-2014-32-EA, Shinn Allotment Complex – Spanish Springs Individual, Twin Buttes, Spanish Springs AMP, and Shinn Peak Allotments (#708, 0709, 0710, 0711) August 2014
2. BLM Environmental Assessment, CA-350-2008-04, *Observation Allotment 10 Year Grazing Authorization, 2009*
3. BLM Environmental Assessment, CA-350-2008-05**,** *Winter Range Allotment 10 Year Grazing Authorization* (2008)
4. BLM Environmental Assessment, CA-350-2004-09*, Grazing Permit Renewals for the Spanish Springs Allotment Complex (Shinn Peak, Spanish Springs AMP, Spanish Springs Individual, Twin Buttes Allotments)* (2004)

5. BLM Environmental Assessment, CA-350-2002-19, *10 Year Grazing Authorization on the Deep Cut Allotment* (2002)
6. BLM Decision Record, *Notice of Final Multiple Use Decision for the Twin Peaks Allotment* (January 2001)
7. BLM Environmental Assessment, CA-350-2000-15, *Implementation of Management Actions for the Twin Peaks Allotment* (2000)
8. BLM Decision Record, *Notice of Final Multiple Use Decision for the Observation Allotment* (August 1998)
9. BLM Environmental Impact Statement, *Proposed Livestock Grazing Management for the Cal-Neva Planning Unit, Final Environmental Impact Statement* (1982)

Livestock grazing use is controlled by fencing, herding, and strategic placement of water and salt. Rest-rotation and/or deferred rotational grazing strategies are also employed. Under the rest rotation grazing strategy, a pasture is grazed for one season then rested for one or two growing seasons to allow sufficient recovery time for plant growth and vigor prior to being grazed again. Deferred grazing is the postponement of grazing on a pasture until a specified time. For example, when plants mature and seeds set, they are not as vulnerable to damage from grazing as they would be during spring growth, therefore grazing may be deferred until seed set. Other grazing strategies include early-on and early-off grazing, turnout location rotation, delayed turnout, or a modified annual season-of-use. Annual adjustments to livestock grazing are made by the BLM according to forage availability and in response to below- or above-average precipitation.

Tables 3-2 and 3-3 below include the number of animals and AUMs that are permitted in each grazing allotment for cattle and sheep, the permitted season of use, and the type of grazing system used. See Appendix I for a more complete description of grazing management actions that are permitted within each of the nine grazing allotments within the Twin Peaks HMA. See Appendix J for summary of livestock actual use information for the allotments in the HMA since the 2010 gather in the Twin Peaks HMA.

Table 3-2: Cattle Grazing Summary in the Twin Peaks HMA

Livestock Grazing Allotment Name	No. of Cattle Permits	No. of Cattle	Active Cattle AUMs	Season of Use (Dates)	Grazing System
Twin Peaks	2	1,094	10,580	04/1-1/31	2 pasture deferred rotation; use restrictions within 13 compartment areas based on soils, deer habitat, forage/water availability
Observation	3	923	6,010	4/15-10/31	3 pasture deferred rotation
Deep Cut	2	978	2,405	4/1-6/15	3 pasture deferred rotation/ riparian restrictions
Winter Range Nevada	3	310	1,504	11/1-3/31	Winter use only, reduced AUMs in N. Dry Valley ACEC
Spanish Springs AMP	2	300	1,513	5/16–7/15[1/] or 7/16-11/30	3 pasture deferred – spring and fall
Twin Buttes	2	52	210	5/01-8/31[1/] or 7/01-11/15	Deferred spring turnout – water availability dependent
Spanish Springs Ind.	1	73	259	5/01-8/31[1/] or 7/01-11/15	Spring – fall deferment
Total		**3,730**	**22,481**		

[1/] These dates reflect a change in grazing season every other year; both periods are not used in one single year.

Table 3-3: Domestic Sheep Grazing Summary in the Twin Peaks HMA

Livestock Grazing Allotment Name	No. of Sheep Permits	Sheep (No.)	Active Sheep AUMs	Season of Use (Dates)	Grazing System
Twin Peaks	1	4,000	2,850	4/1 - 10/25	Multiple short seasons, herder
Observation	1	4,000	958	6/1-7/15 9/1-9/30	Multiple short seasons, herder
Winter Range California	1	1,000	617	2/1-4/30	1 pasture, short season, herder
Shinn Peak	1	1,000	272	6/01-11/30	1 pasture, short season, herder, trailing
Total		**10,000**	**4,697**		

Livestock use has varied since the 2010 wild horse and burro gather. In 2012, one of the largest wildfires in California history (Rush Fire) burned over 300,000 acres of BLM, state, and private lands within the Twin Peaks HMA. The fire altered entire plant communities within the burned area. Subsequent grazing management was altered as well. Appendix J shows the decreased livestock use in the three years following the fire. Livestock use fluctuated between 2012 and 2016 as BLM worked with permittees to rest burned areas from livestock grazing. Additionally, many permittees do not use their full grazing preference most years because they are balancing their use with conditions on the ground (e.g., available water, pastures rested previous year, soil moisture conditions). This allows for rest from livestock grazing. However, wild horses and burros have free access to all areas year-round, thus livestock rest does not allow for complete rest for vegetative communities, especially in riparian areas which continue to be degraded by wild horses and burros.

3.3.3 Upland Vegetation

Maintaining a balance of grazing animals and controlling the timing and amount of forage that is consumed each year by wildlife, livestock, and wild horses is crucial to maintaining healthy upland plant communities within the Twin Peaks HMA. A more complete description of the upland vegetation can be found in the 2010 Twin Peaks Herd Management Area Wild Horse and Burro Gather Plan EA (Section 3.9, pages 67 to 69). Increased grazing on the upland vegetation from excess wild horses and burros does not allow upland sites to recover from past disturbances and are in danger of trending downward in ecological health.

Maintaining a balance of grazing animals and controlling the timing and amount of forage that is consumed each year by livestock and wild horses is crucial to maintaining healthy upland plant communities. Plant communities that have been impacted in the past by wildfires and historic livestock grazing are vulnerable to losing more of their native perennial grass component when grazed at higher than moderate utilization levels (less than 60 percent). Sites that are close to crossing an ecological successional threshold to annual species and sites that are adjacent to water sources are the most vulnerable. Increased amounts of grazing on the uplands from an excess number of wild horses and burros does not allow some upland sites to obtain the amount of rest needed to recover from past disturbances.

After the Rush Fire in 2012, the BLM requested to remove excess wild horses and burros to allow recovery of upland vegetation. The request was unable to be accommodated, so upland vegetation recovery was limited and continues to degrade due to overuse from excess wild horses and burros.

3.3.4 Riparian-Wetland Sites

Past uses include, but are not limited to, historical grazing by domestic livestock and wild horses and burros, multiple large wildfires, numerous multi-year droughts that resulted in the loss of riparian vegetation and erosion of riparian soils. To mitigate effects to riparian areas, over the last 50 years, livestock AUMs have been reduced and grazing management actions such as deferred rest rotation have been implemented.

Riparian and wetland sites within the Twin Peaks HMA are generally small (less than 1 acre) and are capable of providing water for a limited number of wildlife, livestock, and wild horses and burros. A more complete description of riparian areas and wetland sites within the HMA can be found in the 2010 Twin Peaks Herd Management Area Wild Horse and Burro Gather Plan EA (Section 3.6, pages 57-65). A few larger springs with associated wet meadows exist within the HMA, and these sites are typically heavily used by livestock and wild horses and burros. Green riparian vegetation available during the hot summer months is an attractant to grazing animals when adjacent upland vegetation becomes mature, dry, and loses nutritional value.

Figure 3-1: Large, connected patches of bare ground are evident at Selic Spring, a severely degraded riparian system. These large, connected patches of bare ground lead to soil loss, erosion, and invasion by non-native species.

During drought years, and in seasons with less than average precipitation, many riparian areas are unable to store water past spring or early summer. Therefore, many riparian/wetland areas are not capable of providing water for any species during drought years. As a result of water sources drying up during a drought season, larger, perennial riparian systems receive a disproportionate amount of use, as shown in photos of Selic (Figure 3-1) and Pete's (Figure 3-2) springs. This often leads to riparian systems becoming degraded from heavy use and soil loss occurs from a concentrated number of animals using limited perennial water sources.

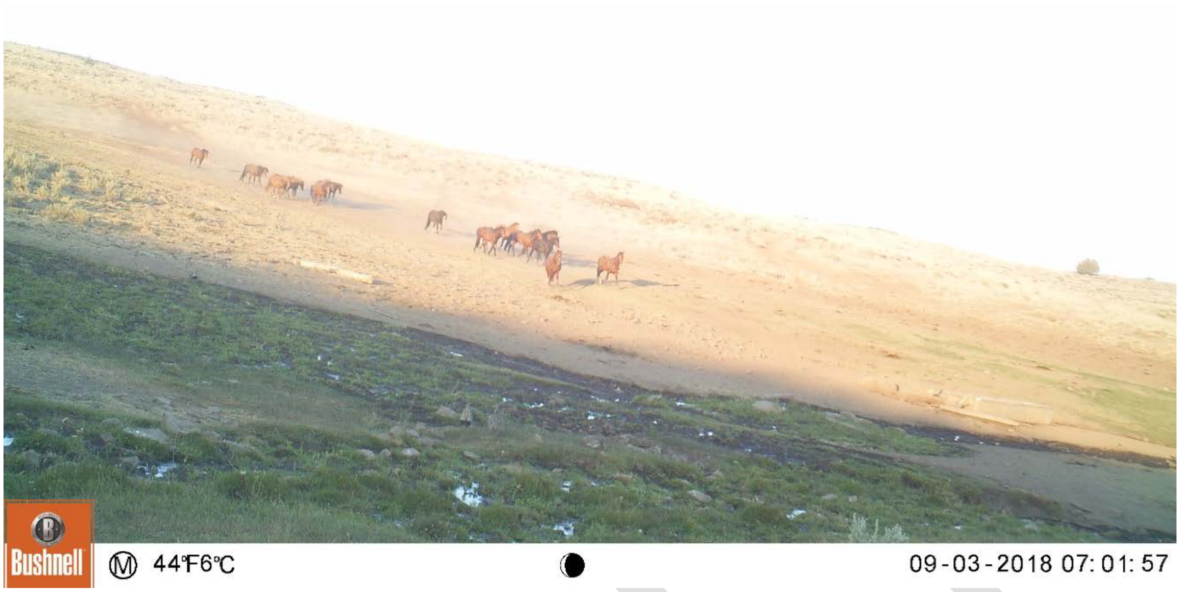


Figure 3-2: Pete's Spring is heavily and chronically used by wild horses and burros. This has led to large, continuous patches of bare ground and increased soil erosion by wind and water as evidenced in this photo.

Figure 3-3: Pete's Spring in the NE part of the HMA has such large extents of bare ground, that windblown dust is significant enough to trigger the motion detector on the trail camera monitoring the spring.

Grazing by wildlife, livestock, and wild horses and burros can impact riparian/wetland areas through trampling and/or grazing of riparian vegetation. When forage plants are overgrazed and trampled, desirable native species can be replaced by less desirable species that produce little or no forage value. Since wild horses and burros graze year-round (unlike livestock where areas can be rested or deferred from grazing), wild horses and burros can damage riparian areas and spring sites in late summer and fall when little green forage is available in the uplands. A decline in soil condition, plant cover, and plant species composition from trampling and overgrazing can result in bare soil and/or encourage the invasion and growth of noxious weeds or other invasive plants in riparian sites. Early spring grazing can also adversely affect vegetation resources as a result of trampling of wet soils, uprooting of seedlings, and damaging mature plants. These damaging effects are all occurring as a result of the overpopulation of wild horses and burros in the Twin Peaks HMA.

Sensitive riparian and wetland areas are often the first to show impacts of degradation in arid environments such as the Twin Peaks HMA. Of the 32 individual riparian functional assessments conducted since the last gather in 2010, nearly 60 percent (n =19) rate as "Functional at Risk." Of the 25 percent (n = 8) rated as "Proper Functioning Condition" five of the eight are fenced to exclude wild horses and burros and livestock. The remaining 15 percent (n = 8) were rated as "Non Functional" which means that biological, geomorphological, and hydrologic processes have been so severely disrupted that the spring is no longer providing ecosystem goods and services (Chambers et al. 2014).

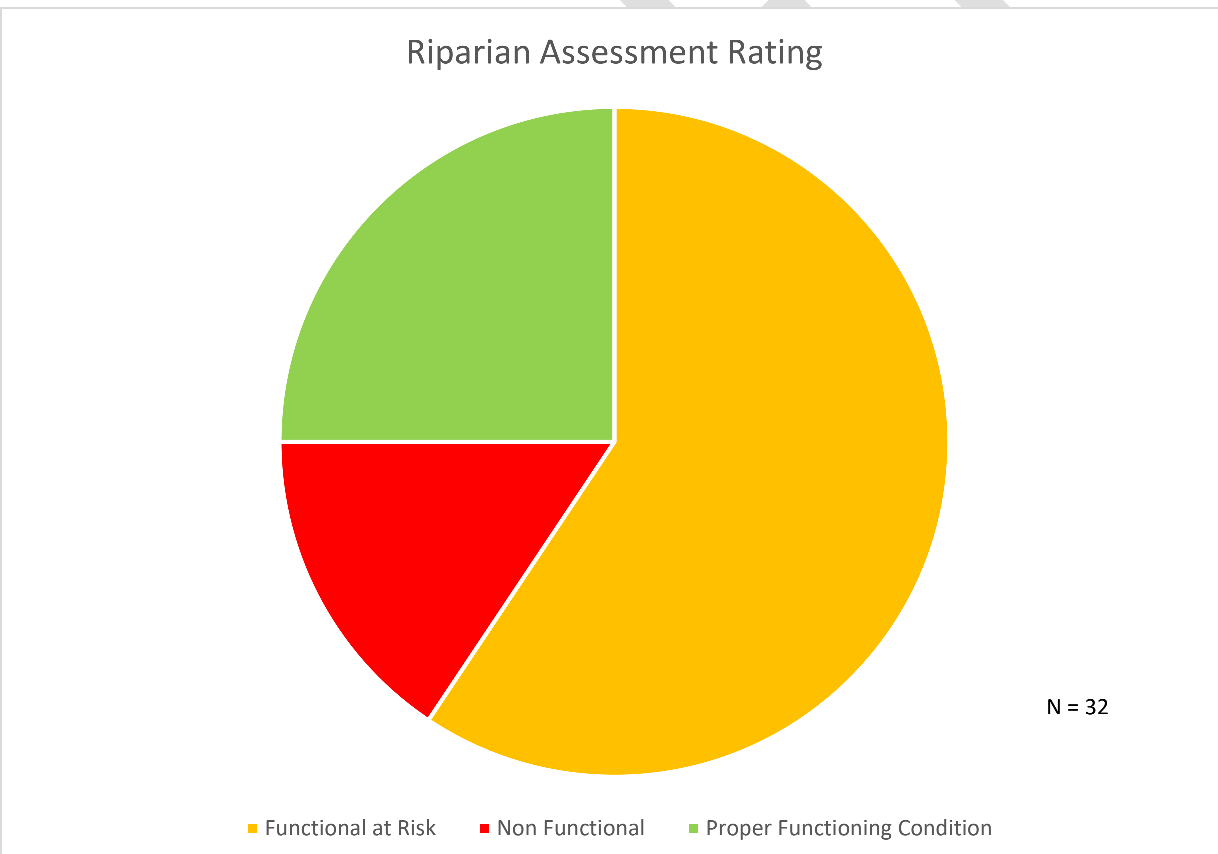


Figure 3-4: Riparian function assessments were completed for 32 springs in the Twin Peaks HMA. The majority were rated as "Functional At Risk."

Additionally, of the four springs that had repeated visits, 50 percent (n = 2) of those springs rated as "Functional at Risk" and 50 percent (n = 2) were rated as "Non Functional" in 2015 and 2016. This means from 2009 to 2015/2016, the rating of two springs transitioned from “Functional at Risk” to “Non Functional” (see Table 3-4) due to continued overuse by wild horses and burros.

Table 3-4: Repeat assessment ratings for Twin Peaks HMA selected springs.

Spring	2009 Assessment	2015/16 Assessment
Byers Spring	FAR	FAR =
Porcupine Spring	FAR	NF ↓
East Crooked Canyon Spring	FAR	NF ↓
West Crooked Canyon Spring	FAR	FAR =

FAR = Functional at Risk and NF= Non Functional

Seven riparian areas within the HMA were selected in 2018 to represent a range of use (very light to very heavy) and were monitored using game cameras paired with alteration and utilization data. Alteration (measurement of hoof trampling of riparian area banks) measurements followed the methods described in Burton et al. 2011. In October 2018, alteration ranged from 2.4 (fenced riparian area) to 4.8 with an average of 4.0 over all seven riparian areas (a measurement of 5 = 100 percent of the frame altered with hoof prints). Utilization measurements were collected on graminoids and were an average height of one plant within a frame, or if no vegetation was present in the frame, distance to nearest vegetation. In October 2018, the average vegetation height ranged from 1.2 inches to 1.8 inches with an average of 1.6 (Riparian Standard is 4 inches) and distance to nearest vegetation ranged from 7.0 inches to 216.4 inches with an average of 61 inches (Riparian standard is 0 inches). A more in-depth report of riparian area monitoring in the HMA can be found in Appendix K.

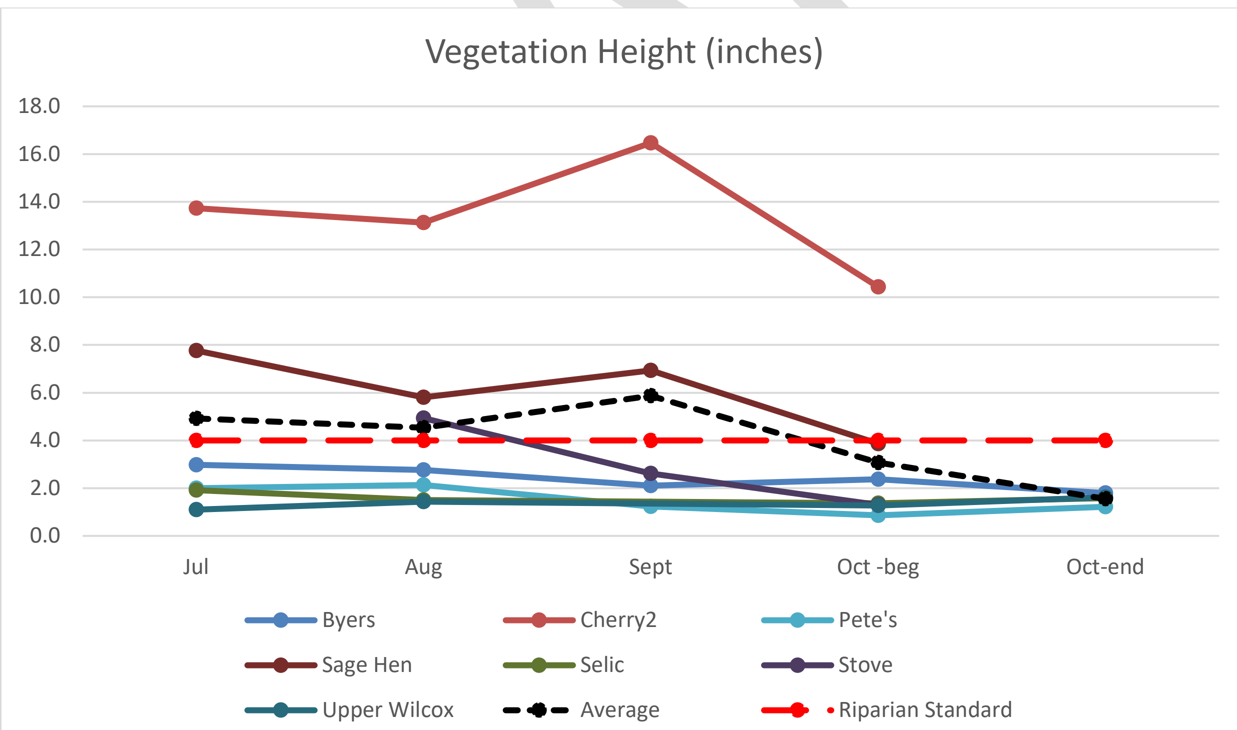


Figure 3-5. Vegetation height (measured at multiple points in the riparian area) indicate a downward trend over the growing season.

3.3.5 Soil Resources

Landforms that make up the HMA vary from mountains to valley bottoms. Soils types within the HMA are quite variable from loams to clays. The vertisol soils (montmorillonitic) in the HMA are of particular concern, as they are easily destroyed if trampled when wet. When these soils are undisturbed they are deep enough to support substantial plant production. Seasonally-controlled grazing can limit disturbance to these fragile soils when wet, but continuous, season-long grazing does not provide any protection against damage to soils. Once these soils are damaged they can become unproductive and are vulnerable to invasion from annual invasive grasses (e.g. medusahead). Loss of herbaceous cover and change in plant community composition negatively impacts soils. Soils within riparian areas and wetlands are extremely vulnerable to trampling by livestock and wild horses and burros. A detailed description of the soils within the HMA can be found in the Soil Survey of Susanville Area, parts of Lassen County and Plumas Counties, California (NRCS 2004) and Soil Survey of Washoe County, Nevada, Central Part (NRCS 1997).

The soil surface community includes cyanobacteria, green algae, lichens, mosses, microfungi and other bacteria. Soils with these organisms are often referred to as cryptogamic soils and form biological crusts. The cyanobacteria and microfungal filaments aid in holding loose soil particles together, forming a biological crust which stabilizes and protects soil surfaces (Belknap et al. 2001). Bryophytes (mosses and liverworts) are most prevalent in the HMA. Biological crusts benefit soils by increasing moisture retention, nitrogen fixation, and inhibiting annual plant growth. Most biological crust organisms grow during cool, moist conditions when soils are most vulnerable to trampling. Soils in the Twin Peaks HMA are at risk for degradation by trampling due to the overpopulation of wild horses and burros.

3.3.6 Wildlife

Greater Sage-Grouse

The Greater Sage-Grouse (GRSG) is a BLM Sensitive Species as a result of a 2015 decision by the U.S. Fish and Wildlife Service to not list the species under the Endangered Species Act. GRSG are a landscape-scale species that are seasonally mobile and annually have a large home range (Stiver et al. 2006). According to the California Department of Fish and Wildlife, any interference with GRSG reproduction is a limiting factor in the survival of sage-grouse in Lassen County. Specific factors that limit population expansion of sage-grouse include: loss of vegetation cover and degradation of riparian areas, and degradation of wet meadows. Chick recruitment is diminished in areas lacking an abundance of succulent vegetation or available clean water.

The HMA falls almost entirely within the boundary of the Buffalo-Skedaddle GRSG Population Management Unit. The HMA contains lands classified as priority habitat management areas (PHMA), general habitat management areas (GHMA), other habitat management areas (OHMA), and unclassified (typically non-habitat) (see Appendix L for map). PHMAs are defined as BLM-administered lands identified as the highest value to maintaining sustainable GRSG populations. GHMAs are BLM-administered lands where special management will apply to sustain GRSG populations in adjacent areas. OHMAs are BLM-administered lands identified as unmapped habitat within the planning area and contain seasonal or connectivity habitat areas (ARMPA, as amended 2019).

GRSG and their habitat are present within the HMA. There are currently 13 active leks (strutting grounds vital to mating) within the HMA. Early brood-rearing usually requires meadow and herbaceous riparian habitat within a close proximity to sagebrush cover. Late summer brood-rearing habitat includes areas with an abundance of sagebrush uplands. As with nesting habitat, late summer brood-rearing habitat is very limited in some parts of the HMA due to a lack of native perennial herbaceous understory. Based on telemetry detections and visual observations GRSG use portions of the HMA year round. These sensitive birds are at risk because of the continued degradation of their critical habitats by overuse from excess wild horses and burros.

Migratory Birds

Numerous species of migratory birds use habitat within the HMA for food, cover, and nesting. Most of these species require diverse plant structure and herbaceous understory. Some species (e.g., western scrub jay, juniper titmouse, Oregon junco) primarily use trees, some other species (e.g., western meadowlark, Brewer's sparrow, sage thrasher, sage sparrow) use sagebrush and other shrub species, and some nest on the ground. Woodland plants, such as western juniper, provide nesting and foraging habitat for many species. Riparian areas with woody species are important habitats for some migratory bird species as they provide important foraging and nesting habitats and are at risk for degradation due to yearlong continued use by wild horses and burros. Riparian areas also serve as important transition habitats for a variety of species between seasons and are often heavily used during summer months. Habitat components for many of these species are available in small habitat patches throughout the HMA. No formal surveys have been conducted for migratory birds within the HMA.

Threatened and Endangered Species

The HMA has no known occurrences of federally-listed threatened and endangered species. The HMA contains habitat for two federally endangered wildlife species, the gray wolf, and the Carson wandering skipper butterfly.

Sensitive and other wildlife species

Habitat for several BLM Sensitive Species occurs within the Twin Peaks HMA. BLM Policy (USDI 2001) directs that BLM sensitive species shall be managed as if they are candidate species under the Endangered Species Act of 1973, as amended. Species and/or their habitat that occur within the HMA include: bald eagle, golden eagle, burrowing owl, greater sandhill crane, bank swallow, northern sagebrush lizard, fringed myotis, long-eared myotis, Yuma myotis, western-small footed myotis, pallid bat, and Townsend's western big-eared bat.

Mule deer and pronghorn are common in the Twin Peaks HMA and their populations are managed under California Department of Fish and Wildlife management plans. Other mammals (e.g. coyote, badger, rabbit), birds (migratory and non-migratory), and reptiles (snake and lizard) occur within the HMA, and are dependent on the vegetation and riparian/water sources present. This habitat provides forage, shelter, and water needs for all of these species. The habitats of all wildlife species are at risk of degradation from continued overuse by wild horses and burros.

3.3.7 Wild Horses and Burros

The Twin Peaks HMA was formally designated through the *Susanville District Wild Horse and Burro Management Plan* in June 1976. The AML for the HMA is 448 to 758 wild horses and 72 to 116 burros. The last removal of excess wild horses and burros from the Twin Peaks HMA was completed in September 2010. At that time, 1,637 wild horses and 162 burros were gathered, 1,575 wild horses and 160 burros removed, and 58 wild horses and one (1) burro released back to the range. All mares released were administered a fertility control vaccine (PZP, or Porcine Zona Pellucida, PZP-22) prior to their release. Since that time, 147 burros have been removed from private property adjacent to the HMA. Appendix M provides details on number of animals removed by year.

The current estimated population of wild horses, mules, and burros in the Twin Peaks HMA is based on a simultaneous double observer aerial population survey completed in May 2017. Previous surveys were completed in 2015, 2013, 2012, 2010 (post-gather). Analysis of the most recent survey data (2013 to

2017) indicates an average annual growth rate of approximately 17 percent since the last gather, including application of fertility control.

The Twin Peaks herd is in overall good health. Few animals rate lower than a 3 Henneke body condition score. As the population increases, however, competition for resources, especially water in drought years, would likely lead to more animals in poorer body conditions.

Origins of this herd, documentation of past ecological conditions (up to 2010), and evolution of AML and the HMA can be found in the 2010 Twin Peaks Herd Management Area Wild Horse and Burro Gather Plan EA (DOI-BLM-CA-N050-2010-05-EA). Genetic diversity data was collected at the last gather in 2010 and results are provided in Appendix N. If deemed necessary, hair samples would be collected on at least 25 to 100 animals per home range/trap location to assess the genetic diversity of the herd. Samples would also be collected during future gathers as needed to determine whether management is maintaining acceptable genetic diversity (avoiding inbreeding depression). "Genetic variability of this herd is high both for the total herd and the individual subpopulations sampled. Genetic similarity results suggest a herd with mixed ancestry primarily of North American origin" (Cothran 2011).

Results of Win Equus Population Modeling
The Action Alternatives (2 and 3) were modeled using Version 3.2 of the Win Equus population model (Jenkins 2000). The purpose of the modeling was to analyze and compare the effects of the action alternatives on population size, average population growth rate, and average removal number. The Win Equus population model lacks a feature that would allow permanent sterilization, so modeling Alternative 1 was not possible. Alternatives 2 and 3 both reduce the population. Alternative 4 results in a large population increase that could result in up to between 7,488 and 14,604 wild horses within 10 years (average numbers from WinEquus modeling, see Appendix O). Win Equus population model also lacks adequate input data for burro population modeling.

4.0 Environmental Consequences

4.1 Introduction

This section of the EA analyzes the potential environmental impacts which would be expected with implementation of Alternatives 1, 2, 3, or 4. These include the direct impacts (those that result from the management actions), indirect impacts (those that exist once the management action has occurred), and cumulative impacts for the resources that were identified as issues to analyze—cultural resources, livestock, upland vegetation, riparian/wetland zones, soils, wildlife, and wild horses and burros.

The NEPA regulations define cumulative impacts as impacts on the environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions (40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The cumulative impacts study area for the purposes of evaluating cumulative impacts is the Twin Peaks HMA and adjacent areas where horses have strayed outside the HMA boundary.

For the purposes of analyzing cumulative impacts on all affected resources, Sections 4.2 and 4.3 describe the past, present, and reasonably foreseeable relevant actions within the Twin Peaks HMA.

4.2 Past and Present Actions

Livestock
Livestock have used allotments within the Twin Peaks HMA for grazing for at least 70 years. Prior to 1979, willful trespass livestock grazing occurred in the HMA and contributed to degradation of upland and riparian plant communities. Over the past 40 years, the BLM has reduced the amount of livestock grazing in the HMA by approximately 60 percent (including the numbers reduced from the stop of willful trespass) (see Appendix I). Livestock grazing management has been modified to reduce or eliminate impacts to vegetation and cultural sites though coordination with the grazing permittees. Through previous decisions, the BLM has allocated the available forage to livestock. Other decisions have resulted in adjustments to livestock numbers and seasons of use and for implementation of grazing systems and the associated range improvements to promote rangeland health.

Recreation
Recreation use has occurred mainly in the form of wilderness recreation, hiking, camping, and hunting. Activities that have occurred with very low frequency are wildlife observation, nature study, and archaeological sightseeing. Some areas of the HMA have been impacted by off-highway vehicle use that occurred off established trails. The Eagle lake RMP limits all off-highway vehicle use to designated trails.

Vegetation and Riparian
While the current livestock grazing system and efforts to manage the wild horse and burro population within the AML has reduced the potential of past historic impacts, the current overpopulation of wild horses and burros is continuing to contribute to areas of heavy vegetation use, trailing and trampling damage and is preventing the BLM from managing for rangeland health and a thriving natural ecological balance and multiple use relationship on BLM-administered lands in the area. This overpopulation has degraded vegetation and riparian areas and the growing overpopulation continues to degrade vegetation resources and sensitive riparian areas. The BLM has repaired or newly constructed (fenced) approximately 20 riparian areas have been in the Twin Peaks HMA since 2010.

Wildfire and Noxious Weeds
Over 35 wildfires are known to have occurred within the Twin Peaks HMA. These wildfires have influenced native vegetation and potentially affected cultural resources. There have been numerous seedings within the HMA in response to wildland fires. Past seedings include the use of both native and non-native plant species. Noxious may also spread and increase post-wildfire. The BLM has conducted integrated weed management for the past 30 years to monitor and treat infestations of noxious weeds and invasive species within the HMA.

Wildlife
Hunting for various wildlife species within and outside of the HMA occurs consistent with state wildlife laws and is managed by the CDFW. Forage allocations for livestock, wild horses and burros, and wildlife have been established in the past by the BLM. Additionally, annual livestock numbers, seasons of use, and other factors in livestock grazing management have been implemented to improve rangeland and ecosystem health benefitting wildlife. The ARMPA (2019, as amended) contains program area goals, objectives, and management decisions to strive to protect and preserve the Greater Sage-Grouse and its habitat on BLM-administered lands that include the HMA and its vicinity. Vegetation, livestock grazing, and wild horses and burros are examples of these program areas. The BLM and CDFW, along with other partners, have also installed guzzlers (water catchments) that benefit wildlife and may also be used at times by wild horses, burros, and livestock. Overpopulation of wild horses and burros is increasing the

habitat degradation of both vegetation and water resources within and outside of the HMA, and decreasing habitat quantity and quality for numerous wildlife species.

Wild Horses and Burros

Historically, wild horses and burros have used the Twin Peaks HMA. In years that the populations of wild horses and burros have exceeded the established AML range, disturbance to vegetation and to cultural resource sites has occurred in some areas. Since 1976, the BLM has conducted approximately 25 gathers of wild horses and burros throughout the HMA in order to remove excess animals to manage the population size within the established AML ranges. The excess animals removed have been transported to short-term corral facilities where they were prepared for adoption, sale (with limitations), long-term pasture, or other statutorily authorized disposition.

The last gather for the Twin Peaks HMA was conducted in 2010. In 2010, 1,637 wild horses and 162 burros were gathered, 1,575 wild horses and 160 burros removed, and 58 wild horses and one (1) burro were released back to the Twin Peaks HMA. Of these, 18 mares were treated with fertility control vaccine (Porcine Zona Pellucida, PZP-22) and freezemarked for future identification. Post-gather in 2010, an estimated 793 wild horses and 160 burros remained on the HMA.

The current estimated population within and outside the Twin Peaks HMA for 2019 is 3,506 wild horses and 632 burros. The actions which have influenced today's wild horse and burro population are primarily wild horse and burro gathers, which have resulted in the capture of wild horses and burros, removal of excess wild horses and burros, and release of wild horses and burros back into the HMA (see Appendix M for the historical gather and release record for the Twin Peaks HMA).

4.3 Reasonably Foreseeable Future Actions

Wild Horses and Burros

Continued livestock and wild horse and burro grazing would likely occur. Over the next 10 to 20 year period, reasonably foreseeable future actions include gathers with a frequency of up two years to remove excess wild horses and/or implement fertility controls in order to manage population size within the established AML range could occur. The excess animals removed would be transported to ORCs where they would be prepared for adoption, sale (with limitations), or long-term holding. A remotely-delivered fertility control program or one administered in conjunction with future gathers could also reduce population growth. Any future wild horse and burro management would be analyzed in appropriate environmental analysis/documentation following site-specific planning with public involvement.

Vegetation, Wildfire, and Noxious Weeds

It is predicted that additional wildfires will occur in the future, and the lands affected may have emergency stabilization or rehabilitation efforts implemented on them. Future actions would likely be related to the effects from wildfires. Ongoing restoration and rehabilitation efforts include planting native shrubs and beneficial herbaceous species to increase cover, biodiversity and function. This type of action also increases soil health and productivity. Planting vegetation would be the primary action to reduce wind and water soil erosion. Other actions could include juniper thinning and removing Phase I stands that are encroaching on sagebrush dominated rangelands. No new roads are expected to be built. Livestock grazing is expected to continue at similar stocking rates and utilization of the available vegetation (forage) would also be expected to continue at similar levels. The BLM will continue to monitor and treat infestations of noxious weeds and invasive species in the Twin Peaks HMA using Integrated Weed Management.

Wildlife
Wildlife habitat needs and hunting of game species would continue to occur in the HMA. The ARMPA and its program area goals, objectives, and management decisions will continue to be implemented for the benefit of sage-grouse and other wildlife species. The BLM, CDFW, and other partners will maintain and replace the guzzlers (water catchments) that benefit wildlife and continue to implement projects to improve rangeland health and wildlife habitat. Reasonable foreseeable future actions also include sage-grouse lek (breeding ground) counts, which will continue within the HMA to assist in contributing to population data and to monitor habitat conditions.

Livestock
Livestock grazing is expected to continue at similar stocking rates as those currently authorized. The BLM will continue to authorize permits that require livestock to be grazed under specific terms and conditions that are designed to achieve, or make significant progress towards achieving Rangeland Health Standards.

Riparian
Ongoing restoration and rehabilitation efforts include restoring riparian and wet meadows through spring head development, off-site watering, and spring protection exclosures to increase cover, biodiversity, and function. Maintaining a balance of grazing animals and controlling the timing, intensity, and duration of grazing and amount of forage consumed each year by livestock and wild horses and burros is crucial to maintaining healthy riparian plant communities for the future. Approximately 15 riparian areas are planned to be repaired or newly constructed in the Twin Peaks HMA by the BLM.

4.4 Predicted Effects of Alternatives
The direct, indirect, and cumulative impacts to these resources which would be expected to result with implementation of the Action Alternatives or No Action Alternative are discussed in detail below.

4.4.1 Cultural Resources
Impacts Common to Action Alternatives (1, 2, and 3)
The gather and removal of excess wild horses and burros is an action common to alternatives 1, 2, and 3. Alternatives 1, 2, and 3 would result in minimal effects to cultural resources within the Twin Peaks HMA due to avoidance and clearance of proposed gather and holding sites. The gather and removal of excess wild horses and burros would reduce future soil compaction, artifact breakage, and bare ground. Grazing by wild horses and burros has probably affected a larger number of sites than is documented. By removing excess wild horses and burros, as described in Alternatives 1, 2, and 3, vegetation health and cover would improve, trampling, rolling and wallowing by horses would be reduced, and protection to cultural resources would be improved.

Impacts of Alternative 4 (No Action)
The no-action alternative (4) could be expected to result in continued or increased detrimental effects on cultural resources, particularly those around water sources where horses and burros congregate. Increasing numbers of wild horses and burros could intensify damage to archaeological sites, especially in areas adjacent to water. This damage could be expected through loss of archaeological soil deposits near the surface, soil compaction, artifact breakage, and increased bare ground, exposing sites to looting. Overgrazing of upland areas where cultural resources are located could result in complete destruction of sites as the vegetation cover is reduced and removed.

Cumulative Effects
Any ground disturbing activities can damage site function and integrity, thus the excessive overgrazing of uplands and riparian/wetland sites that would occur with Alternative 4, combined with past actions of wildfire and historic heavy livestock grazing, would likely cause some plant communities to become

degraded to the point of crossing an ecological threshold. The resulting limited amount of plant litter and cover would afford little to no protection to cultural sites, resulting in potential breakage and displacement of cultural resources. Riparian sites or wetlands which are still recovering from the damage caused by past heavy grazing use would likely become so damaged as to lose the entire structure, function, and integrity of the water source. Smaller sites would likely become nonfunctional and dry up, with a high amount of damage to cultural resources through breakage, displacement, and loss of site integrity. The gather and removal of excess wild horses and burros, as described in Alternatives 1, 2, and 3, would improve vegetation health, reduce tramping, and provide greater protection/less threat to cultural resources.

4.4.2 Livestock

Impacts Common to Action Alternatives (1, 2, and 3)

Wild horses and burros directly compete with livestock for available forage and water. Alternatives 1, 2, and 3 would have less impact on social and economic values associated with livestock grazing operations than the no action alternative (4). Grazing systems for individual allotments are designed to function in a thriving natural ecological balance with wild horse and burro populations within the established AML range. Within the established AML range, livestock operations and grazing systems would function properly and forage plants would be less heavily used by excessive season-long wild horse and burro grazing. Furthermore, livestock operators could improve pasture rotation and defer spring rest in areas where year-round wild horse and burro use has negatively impacted deep rooted perennial grasses and riparian areas.

Impacts of Alternative 1 and 2

With Alternatives 1 and 2, a thriving natural ecological balance would be achieved and maintained longer than with Alternative 3. A thriving natural ecological balance would not be achieved with Alternative 4. Alternatives 1 and 2 would allow for longer recovery and less overall use of forage species and would result in healthier livestock and forage.

Impacts of Alternative 3

With Alternative 3, wild horse and burro populations would exceed high AML again in four to five years after achieving low AML, and the benefits to livestock would be shorter-term than benefits resulting from Alternative 1 or Alternative 2. Additionally, livestock operators would be more likely to receive reductions in permits due to poor range condition from continual, yearlong grazing by wild horses and burros under Alternative 3.

Impacts of Alternative 4 (No Action)

Utilization by authorized livestock has been directly impacted due to the overpopulation of wild horses and burros, both within and outside the HMA. Livestock operators have been asked by the BLM to take voluntary non-use or reduce use in some areas due to the impacts of the wild horse and burro population on range vegetation/forage conditions. Wild horses and burros are currently using five times more than their forage allocation resulting in heavy to severe utilization of vegetation. The indirect impacts of Alternative 4 include increased damage to the rangelands, continued competition between livestock, wild horses and burros and wildlife for the available forage and water, reduced quantity and quality of forage and water, and undue hardship on the livestock operators who would continue to be unable to make use of the forage they are authorized to use. Additionally, further damage to range improvements such as water troughs and riparian protection fencing would also occur as a result of large numbers of horses and burros concentrating in one location competing for water. This amount of use and destruction increases maintenance and labor costs to repair and inspect each development.

Allotment and pasture division fences become damaged by excess wild horses and burros attempting to move out of areas where their numbers and resource competition has become so severe they have to move somewhere else to find food and/or water. When this occurs, livestock may be able to get through these areas of fence lines that were damaged by excess wild horses and burros, therefore livestock may end up on an adjacent allotment in which they are not authorized to graze.

Cumulative Effects
Through the land-use planning process and grazing permit renewal decisions, livestock grazing permits have been set at level that balances forage resources between livestock and wild horses and burros. The terms and conditions of livestock grazing permits are designed to allow forage resources to rest from grazing at various times of each year and to ensure that plants have adequate time for regrowth after grazing. When horse and burro numbers become higher than the established AML, overall impacts to forage resources are higher, as more forage is consumed in the same time periods. This does not allow the livestock grazing systems to function as they have been designed, as no rest occurs on forage plants after livestock are removed from the allotment since they are continuously grazed by higher numbers of horses and burros than the range can sustain.

By removing excess wild horses and burros as described in Alternatives 1, 2, and 3, livestock operations and grazing systems would function properly, and forage plants would receive rest from grazing during scheduled rest periods. The health and condition of vegetation would be maintained, and plant communities that have been impacted by wildfires or past heavy livestock grazing would continue to improve in condition. Forage quality and production for livestock grazing would be expected to be maintained.

Implementation of Alternative 4 would result in substantial increases in wild horse and burro numbers, and competition for forage and water would become more prevalent between livestock and horses. Plant communities that are still recovering from the effects of wildfires or past heavy livestock grazing would be the most vulnerable to further degradation. As wild horse and burro numbers increase, plant communities would experience a serious decline in condition, forage quality, and production. Forage resources for livestock would be highly degraded, and changes to grazing permits would most likely need to be made because of declining rangeland health.

4.4.3 Upland Vegetation
Impacts of Action Alternatives (1, 2, and 3)
Under Alternatives 1, 2, and 3, numbers of wild horses and burros would be reduced, which would result in decreased impacts to vegetation throughout the HMA. While removal of excess wild horses and burros may not be able to restore plant communities that have crossed ecological thresholds to annual grass dominated communities, having a number of horses and burros in the HMA within AML would help prevent areas dominated by annual grass species from spreading. The removal of grazing pressure from excessive numbers of wild horses and burros would lessen the impacts to perennial grasses, thus allowing them to better recover from natural disturbances such as fire, and to compete with non-native annual grasses such as cheatgrass and medusahead.

There would be some short-term direct effects to the vegetation within the gather sites and temporary holding facilities. Each of the gather sites is expected to be used for only a short duration (1 to 10 days) and at a level of use where effects would be short-term. Holding sites would be used for 1 to 30 days. In all trap and holding sites, vegetation is expected to be trampled by the animals with some plants likely becoming uprooted. Annual vegetation would have already senesced for the season, so the effects would be greater to the perennial species, such as bunchgrasses and shrubs. This short-term effect is outweighed, however, by reducing the long-term impacts to vegetation from heavy grazing by high numbers of horses and burros (above AML) on the upland vegetation.

Impacts of Alternative 4

Implementation of alternative 4 would result in a continued increase in the number of wild horses and burros above AML, which would have compounding impacts upon upland vegetation. Impacts would be seen first in sites that are already close to crossing an ecological successional threshold, or on sites that are near water sources. The increased grazing pressure from horse and burros numbers in excess of the high AML range would result in a decrease in native perennial species, and an increase in non-native annual species (e.g., cheatgrass) or shrubs tolerant of disturbance (e.g., rabbitbrush) that have lower forage value and provide fewer ecosystem goods and services (Chambers et al. 2014). These changes would decrease the stability, biodiversity, vigor, and production of native plant communities within the HMA.

Cumulative Effects

The Twin Peaks HMA contains several areas where upland vegetation has been impacted by wildfires, historic livestock grazing, and other disturbances, which has damaged those plant communities. Sites that have low biodiversity have lost a high percentage of their native plant component, are comprised of a higher percentage of shrubs, or have been invaded by annual grasses. Maintaining a balance of grazing animals, and controlling the timing and amount of forage that is consumed each year by livestock and wild horses is crucial to maintaining healthy upland plant communities. By removing excess wild horses and burros as described in Alternatives 1, 2, and 3, cumulative impacts are expected to be positive for vegetation resources.

Alternative 4 would result in the increase in wild horse and burro numbers and increased disturbance to native vegetation and soils, which could lead to increased damage to upland vegetation. Plant communities that been impacted in the past by wildfires and historic livestock grazing would be vulnerable to losing native perennial grasses, due to the high amount of surface disturbance and trampling from excessive wild horses and burros.

As perennial plant cover decreases within the HMA, annual plant cover from invasive species would increase, as these species are adapted to filling in gaps (areas devoid of vegetation). This change in functional/structural groups would have an impact on the vegetation, forage resources, and soil resources in the HMA. Soils would become less resistant to trampling impacts and would become more susceptible to wind or water erosion. Many sites that have been previously disturbed would transition from native perennial plant communities to invasive annuals plant (e.g., cheatgrass) communities.

4.4.4 Riparian-Wetland Zones

Impacts of Alternatives 1, 2, and 3

Implementation of Alternatives 1, 2, and 3 would improve and protect springs, streams, and associated riparian and wetland communities by managing wild horses and burros within established AML ranges. This would reduce direct impacts to many riparian and wetland sites from high use, continuous grazing, and ground disturbance from wild horses and burros. Many of the riparian and wetland sites are currently rated as “Functioning At Risk” or “Non Functioning,” mostly due to yearlong grazing pressure from excessive wild horses and burros. Decreased grazing pressure from excessive wild horse and burro use would allow these areas to recover and return to a healthier, better functioning condition.

Impacts of Alternative 1

Under Alternative 1, initial recovery would be slower because the population would be maintained at mid-AML, but still within a thriving natural ecological balance.

Impacts of Alternative 2
Under Alternative 2, initial recovery of riparian areas would likely be quicker, but because only females would receive fertility control, the return to excess numbers would happen more quickly than Alternative 1 and recovery of riparian areas would be halted.

Impacts of Alternative 3
Under Alternative 3, wild horse and burro populations could grow to above upper AML within four years and riparian recovery would cease. Thriving natural ecological balance would fail to be met when wild horse and burro populations rise above high AML.

Impacts of Alternative 4 (No Action)
Implementation of Alternative 4 would allow for increased numbers of wild horses and burros above the established AML range to continue degrading riparian areas. Without a decrease in the wild horse and burro populations, it is likely that the functional ratings of riparian areas would further decrease. It is estimated that with the projected increase in the wild horse and burro population under this alternative over the next five years (based on the average population growth rate), approximately 50 riparian/wetland sites within the HMA could become severely degraded and/or dewatered.

Cumulative Effects
The number of wild horses and burros in the HMA has been above the established AML range for at least 17 years. Data from 2014 through 2018 demonstrates that riparian/wetland sites, especially lentic sources, are being adversely impacted as a result of year-long wild horse and burro use. By removing excess wild horses and burros as described in Alternatives 1, 2, and 3, sites rated as "Functioning at Risk" would have the opportunity to recover and improve in condition, and no cumulative impacts are expected. Sites currently rated as "Proper Functioning Condition" would be able to maintain that condition.

Implementation of Alternative 4 would allow continued overpopulation of wild horses and burros above the established AML range. Without a decrease in wild horse and burro populations, it is likely the functional ratings of riparian areas would decrease, in some cases crossing irreparable ecological thresholds. Riparian areas that are recovering from past overgrazing could become de-watered (reversing improvements that have been made over time), as the vegetation converts from riparian dominated vegetation to upland species. If these changes occur, water sources would stay wetter for a shorter period of time and stand the chance of converting from surface flow (which serves as a water source for horses, burros, livestock and wildlife) to sub-surface flow that is unavailable for drinking water. This would increase impacts on remaining spring sources, as animals would concentrate in ever higher numbers on the remaining available drinking water sites.

4.4.5 Soils
Impacts of Alternatives 1, 2, and 3
Alternatives 1, 2, and 3 would result in the removal of excess horses and burros to return the population to within AML. All three alternatives would result in short-term impacts to soils at gather site locations and temporary holding facilities. Some soils within these sites could become devoid of vegetation and be susceptible to soil erosion, however these areas are of limited size (typically less than 50 acres) and are expected to recover within a short period of time. The short term effects to soils within these sites is outweighed by the long term beneficial impacts to soil resources that would occur as a result of removing excess horses and burros to within the established AML ranges.

Impacts of Alternative 4 (No Action)
Alternative 4 would result in the increase of wild horse and burro numbers, which would increase the level of disturbance to vegetation and soils. Greater than 60 percent vegetation utilization levels as a

result of livestock grazing or wild horse and burro use in areas with sensitive soil types can degrade soils in both the short- and long-term through soil compaction, erosion, sedimentation, and degradation of stream channel conditions (George et al. 2011). Within the HMA, soil compaction and erosion occur in areas where livestock, horses, and burros concentrate (e.g., watering areas, salt locations, fence lines, and corrals) and vegetation has been reduced or removed. As wild horse and burro populations continue to increase, the number of sites that would not meet the upland soils standard of the Standards for Rangeland Health would increase across the HMA.

Cumulative Effects
Cumulative effects to soils under Alternatives 1, 2, and 3 would be minimal and temporary. Some areas such as trap sites and holding facilities would experience some trampling, however these areas are generally small and make up less than one (1) percent of the project area. Once animals are removed from these sites, soils are expected to recover. Reducing the population of wild horses and burros to within the established AML range under Alternatives 1, 2, and 3 would significantly reduce the long-term damage to soils resulting from trampling and overgrazing of vegetation.

Under Alternative 4, wild horse and burro populations would continue to increase and upland sites would become overgrazed by horses and burros resulting in the loss of vegetative cover and litter to protect the soil surface. There would also be a decrease in biological soil crusts and an increase in soil erosion and compaction. Sites currently dominated by annual and invasive grass species would become more degraded and eventually cross ecological thresholds. These degraded sites typically produce lower amounts of plant biomass and cover, are dominated by plants with shallow root systems, and provide little soil stability.

4.4.6 Wildlife
Impacts Common to Action Alternatives 1, 2, and 3
Impacts to wildlife are primarily tied to vegetation and riparian/wetland/water sources. Direct short-term impacts from gather activities include disturbance to wildlife from the presence of people, vehicles, and wild horses and burros throughout the use of the trap locations and temporary holding facilities during gather operations. Ground-nesting species such as the Greater Sage-Grouse and northern harrier, and ground-dwelling species including badger, burrowing owl, and ground squirrel, could experience loss of nests or damage to burrows, or injury or mortality to individuals or their young. Gather activities in potentially suitable habitat for the Carson wandering skipper could result in trampling or consumption of habitat. Intermediate impacts include reduced competition between wild horses and burros and wildlife for forage and water would also result. Indirect impacts would include an increase in the quality and quantity of available forage and water. Over the long-term, ecological resources including the quality and quantity of forage and water, would have a chance to recover and improve habitat for most wildlife species.

Implementation of Alternatives 1, 2, and 3 would provide the greatest benefit to wildlife, as these alternatives return the thriving natural ecological balance by managing wild horses and burros within the established AML range. The habitat would have more time to recover and improve, and there would be less competition for resources between wild horse and burro and wildlife populations.

See Appendix Q for design features that would be applied to be consistent with the BLM Nevada and Northeastern California's Approved Resource Plan Amendment (as amended, 2019).

Impacts of Alternative 4 (No Action)
The direct impacts of this alternative would result in continued damage to habitats and reduced quantity and quality of vegetation and water resources necessary for wildlife. Indirect impacts of this alternative

would result in increasing damage to ecosystems, further increasing competition between animals for resources, and increasing utilization and degradation of vegetation and riparian/water sources. In the long-term, this alternative would have increasingly negative effects on wildlife individuals and populations.

Cumulative Effects

Maintaining a balance of grazing animals and controlling the timing and amount of forage that is consumed each year by livestock and wild horses and burros is crucial to maintaining healthy upland plant communities that provide important wildlife forage and cover. By removing excess wild horses and burros, as described in Alternatives 1, 2, and 3, cumulative impacts to wildlife habitat are expected to be beneficial. Habitat enhancement projects, including the fencing of riparian and spring sites from livestock and wild horses and burros, further improve habitat quality for Greater Sage-Grouse and other wildlife.

Implementation of Alternative 4 would result in the further degradation of riparian/wetland sites. It is estimated that with the projected increase in the wild horse and burro population under this alternative, over the next five years approximately 50 riparian/wetland sites within the HMA could become severely degraded and/or dewatered (based on the average population growth rate). These impacts would cause a rapid decline in the amount and quality of riparian habitat for many wildlife species. Riparian and wetland sites that are currently rated as "Proper Functioning Condition" would also be at risk of degradation. Over time drinking water for wildlife would become nonexistent in some areas, or be of very low quality due to the high amount of sediment in the water from horse and burro trampling. Sage-grouse habitat would become degraded, especially in riparian and wetland communities. Nesting success would be impacted as sites become devoid of native perennial species, and have reduced amounts of plant cover and litter.

4.4.7 Wild Horses and Burros

Impacts of Alternative 1 (Proposed Action)

Under Alternative 1, wild horses and burros would be released back to the range to achieve a post-gather sex ratio of 60 percent stallions and jacks and 40 percent mares and jennies at low AML for the core breeding population. Under this alternative, band size would be expected to decrease, competition for mares and jennies would be expected to increase, recruitment age for reproduction among mares would be expected to decline, and size and number of bachelor bands would be expected to increase. These effects would be slight, as the proposed sex ratio is not an extreme departure from normal sex ratio ranges. Modification of sex ratios for a post-gather population favoring studs would further reduce growth rates in combination with fertility control. In addition, up to 25 percent of the male horses would be released as sterilized animals to bring the population to mid-AML. At no time would the sex ratio exceed 60 percent males.

Effects of Male Sterilization

Various forms of fertility control can be used in wild horse and burro herd management. These can help with the goals of maintaining herds at or near AML, reducing fertility rates, and reducing the frequency of gathers and removals. The Wild Horse and Burro Act of 1971 specifically provides for contraception and sterilization (16 U.S.C. 1333 section 3.b.1). Fertility control measures have been shown to be a cost-effective and humane treatment to slow increases in wild horse herds or, when used in combination with gathers, to reduce herd size (Bartholow 2004, de Seve and Boyles-Griffin 2013, Fonner and Bohara 2017). An extensive body of peer-reviewed scientific literature details the expected impacts of various fertility control methods on wild horses and burros (see Appendix P). No finding of excess animals is required for BLM to pursue sterilization in wild horses or burros.

Although fertility control treatments may be associated with a number of potential physiological, behavioral, demographic, and genetic effects, those impacts are generally minor and transient, do not prevent overall maintenance of a self-sustaining population, and do not generally outweigh the potential benefits of using contraceptive treatments in situations where it is a management goal to reduce population growth rates (Garrott and Oli 2013). Fertility control that affects individual horses and burros does not prevent the BLM from ensuring that there will be self-sustaining populations of wild horses and burros in a single HMA. Although treated individuals may experience long-lasting effects, such as sterility, that does not of itself cause significant impacts at the level of populations, which are the object of BLM management.

Population growth suppression becomes less expensive if fertility control is long-lasting (Hobbs et al. 2000), such as with spaying and neutering. Here, 'neutering' is defined to be the sterilization of a male horse (stallion) or burro (jack), either by removal of the testicles (castration, also known as gelding) or by vasectomy, where the testicles are retained but no sperm leave the body, as a result of severing or blocking the vas deferens or epididymis.

Neutering (gelding)
Though castration (gelding) is a common surgical procedure, some level of minor complications after surgery may be expected (Getman 2009), and it is not always possible to predict when postoperative complications would occur. Fortunately, the most common complications are almost always self-limiting, resolving with time and exercise. Individual impacts to the stallions during and following the gelding process should be minimal and would mostly involve localized swelling and bleeding. Complications may include, but are not limited to: minor bleeding, swelling, inflammation, edema, infection, peritonitis, hydrocele, penile damage, excessive hemorrhage, and eventration (Schumacher 1996, Searle et al. 1999, Getman 2009). A small amount of bleeding is normal and generally subsides quickly, within 2 to 4 hours following the procedure. Some degree of swelling is normal, including swelling of the prepuce and scrotum, usually peaking between 3 to 6 days after surgery (Searle et al. 1999). Swelling should be minimized through the daily movements (exercise) of the horse during travel to and from foraging and watering areas. Most cases of minor swelling should be back to normal within 5 to 7 days, more serious cases of moderate to severe swelling are also self-limiting and are expected to resolve with exercise after 1 to 2 weeks. Older horses are reported to be at greater risk of post-operative edema, but daily exercise can prevent premature closure of the incision, and prevent fluid buildup (Getman 2009). In some cases, a hydrocele (accumulation of sterile fluid) may develop over months or years (Searle et al. 1999). Serious complications (eventration, anesthetic reaction, injuries during handling, etc.) that result in euthanasia or mortality during and following surgery are rare (e.g., eventration rate of 0.2 percent to 2.6 percent noted in Getman 2009, but eventration rate of 4.8 percent noted in Shoemaker et al. 2004) and vary according to the population of horses being treated (Getman 2009). Normally one would expect serious complications in less than 5 percent of horses operated under general anesthesia, but in some populations these rates have been as high as 12 percent (Shoemaker 2004). Serious complications are generally noted within 3 or 4 hours of surgery but may occur any time within the first week following surgery (Searle et al. 1999). If they occur, they would be treated with surgical intervention when possible, or with euthanasia when there is a poor prognosis for recovery.

For intact stallions, testosterone levels appear to vary as a function of age, season, and harem size (Khalil et al 1998). It is expected that testosterone levels will decline over time after castration. Domestic geldings had a significant prolactin response to sexual stimulation, but lacked the cortisol response present in stallions (Colborn et al. 1991). Although libido and the ability to ejaculate tends to be gradually lost after castration (Thompson et al. 1980), some geldings continue to intromit (Rios and Houpt 1995, Schumacher 2006).

Detailed effects of male sterilization are located in Appendix P.

All fertility control methods affect the behavior and physiology of treated animals (NAS 2013), and are associated with potential risks and benefits, including effects of handling, frequency of handling, physiological effects, behavioral effects, and reduced population growth rates (Hampton et al. 2015). Because neutering animals requires capturing and handling, the risks and costs associated with capture and handling of horses may be comparable to those of gathering for removal, but there would be lower adoption and long-term holding costs for neutered animals released back to the HMA.

Impacts of Alternative 2

Alternative 2 would have similar impacts to alternative 1, except that there would be no impacts to individual male animals from capture, neuter and release.

Impacts Common to Alternatives (1 and 2)

Contraception

All fertility control methods in wild animals are associated with potential risks and benefits, including effects of handling, frequency of handling, physiological effects, behavioral effects, and reduced population growth rates (Hampton et al. 2015). Contraception by itself does not remove excess horses from an HMA's population, so if a wild horse and/or burro population is in excess of AML, then contraception alone would result in some continuing environmental effects of overpopulation. Successful contraception reduces future reproduction.

Successful contraception would be expected to reduce the frequency of gather activities, as well as wild horse and burro management costs to taxpayers. Bartholow (2007) concluded that the application of 2 or 3-year contraceptives to wild mares could reduce operational costs in a project area by 12 to 20 percent, or up to 30 percent in carefully planned population management programs. He also concluded that contraceptive treatment would likely reduce the number of horses that must be removed in total, with associated cost reductions in the number of private placements and total holding costs. Population suppression becomes less expensive if fertility control is long-lasting (Hobbs et al. 2000). Although contraceptive treatments may be associated with a number of potential physiological, behavioral, demographic, and genetic effects, detailed in Appendix P, those concerns do not generally outweigh the potential benefits of using contraceptive treatments in situations where it is a management goal to reduce population growth rates (Garrott and Oli 2013).

Fertility Control Vaccines

Fertility control vaccines (also known as immunocontraceptives) meet the BLM requirements for safety to mares and the environment (EPA 2009a, 2012). Because they work by causing an immune response in treated animals, there is no risk of hormones or toxins being taken into the food chain when a treated mare dies.

Porcine Zona Pellucida (PZP) Vaccine

For the PZP-22 vaccine pellet formulation administered during gathers, each released female would receive a single dose of the PZP contraceptive vaccine pellets at the same time as a dose of the liquid PZP vaccine with modified Freund's Complete adjuvant. Most females recover from the stress of capture and handling quickly once released back into the HMA and none are expected to suffer serious long term effects from the injections, other than the direct consequence of becoming temporarily infertile. Injection site reactions associated with fertility control treatments are possible in treated animals (Roelle and Ransom 2009, Bechert et al. 2013, French et al. 2017), but swelling or local reactions at the injection site are expected to be minor in nature. In subsequent years, Native PZP (or currently most effective formulation) could be administered as a booster dose using the one year liquid PZP vaccine by field or remote darting. The dart-delivered formulation produced injection-site reactions of varying intensity, though none of the observed reactions appeared debilitating to the animals (Roelle and Ransom 2009). Joonè et al. (2017a) found that injection site reactions had healed in most mares within 3 months after the booster dose, and that they did not affect movement or cause fever. Application of fertility control treatment would be conducted in accordance with the approved standard operating and post-treatment monitoring procedures (SOPs, Appendix E).

The historically accepted hypothesis explaining PZP vaccine effectiveness posits that when injected as an antigen in vaccines, PZP causes the mare's immune system to produce antibodies that are specific to zona pellucida proteins on the surface of that mare's eggs. The antibodies bind to the mare's eggs surface proteins (Liu et al. 1989), and effectively block sperm binding and fertilization (Zoo Montana, 2000). Because treated mares do not become pregnant but other ovarian functions remain generally unchanged, PZP can cause a mare to continue having regular estrus cycles throughout the breeding season. Other research has shown, though, that there may be changes in ovarian structure and function due to PZP vaccine treatments (e.g., Joonè et al. 2017b, 2017c). Research has demonstrated that contraceptive efficacy of an injected liquid PZP vaccine, such as ZonaStat-H, is approximately 90 percent or more for mares treated twice in one year (Turner and Kirkpatrick 2002, Turner et al. 2008). The highest success for fertility control has been reported when the vaccine has been applied November through February. High contraceptive rates of 90 percent or more can be maintained in horses that are boostered annually with liquid PZP (Kirkpatrick et al. 1992). Approximately 60 percent to 85 percent of mares are successfully contracepted for one year when treated simultaneously with a liquid primer and PZP-22 pellets (Rutberg et al. 2017). The application of PZP for fertility control would reduce fertility in a large percentage of mares for at least one year (Ransom et al. 2011).

Detailed effects of PZP are located in Appendix P.

<u>Gonadotropin Releasing Hormone (GnRH) Vaccine (GonaCon)</u>
GonaCon is an immunocontraceptive vaccine which has been shown to provide multiple years of infertility in several wild ungulate species, including horses (Killian et al., 2008; Gray et al., 2010). GonaCon uses the gonadotropin-releasing hormone (GnRH), a small neuropeptide that performs an obligatory role in mammalian reproduction, as the vaccine antigen. When combined with an adjuvant, the GnRH vaccine stimulates a persistent immune response resulting in prolonged antibody production against GnRH, the carrier protein, and the adjuvant (Miller et al., 2008). The most direct result of successful GnRH vaccination is that it has the effect of decreasing the level of GnRH signaling in the body, as evidenced by a drop in luteinizing hormone levels, and a cessation of ovulation. The lack of estrus cycling that results from successful GonaCon vaccination has been compared to typical winter period of anoestrus in open mares. As anti-GnRH antibodies decline over time, concentrations of available endogenous GnRH increase and treated animals usually regain fertility (Power et al., 2011).

Changes in hormones associated with anti-GnRH vaccination lead to measurable changes in ovarian structure and function. The volume of ovaries reduced in response to treatment (Garza et al. 1986, Dalin et al. 2002, Imboden et al. 2006, Elhay et al. 2007, Botha et al. 2008, Gionfriddo 2011a, Dalmau et al. 2015). Treatment with an anti-GnRH vaccine changes follicle development (Garza et al. 1986, Stout et al. 2003, Imboden et al. 2006, Elhay et al. 2007, Donovan et al. 2013, Powers et al. 2011, Balet et al. 2014), with the result that ovulation does not occur.

Even with one booster treatment of GonaCon-Equine, it is expected that most, if not all, mares would return to fertility at some point, although the average duration of effect after booster doses has not yet been quantified. Although it is unknown what would be the expected rate for the return to fertility rate in mares boosted more than once with GonaCon-Equine, a prolonged return to fertility would be consistent with the desired effect of using GonaCon (e.g., effective contraception).

Injection site reactions associated with immunocontraceptive treatments are possible in treated mares (Roelle and Ransom 2009). Whether injection is by hand or via darting, GonaCon-Equine is associated with some degree of inflammation, swelling, and the potential for abscesses at the injection site (Baker et al. 2018). Swelling or local reactions at the injection site are generally expected to be minor in nature, but some may develop into draining abscesses.

Detailed effects of GonaCon are located in Appendix P.

PZP and GonaCon Indirect Effects
One expected long-term, indirect effect on wild horses treated with fertility control, such as PZP or GonaCon, would be an improvement in their overall health (Turner and Kirkpatrick 2002). Many treated mares would not experience the biological stress of reproduction, foaling and lactation as frequently as untreated mares. The observable measure of improved health is higher body condition scores (Nuñez et al. 2010). After a treated mare returns to fertility, her future foals would be expected to be healthier overall, and would benefit from improved nutritional quality in the mare's milk. This is particularly to be expected if there is an improvement in rangeland forage quality at the same time, due to reduced wild horse population size. Past application of fertility control has shown that the animal's overall health and body condition remains improved even after fertility resumes. Fertility control vaccine treatment may increase mare survival rates, leading to longer potential lifespan (Turner and Kirkpatrick 2002, Ransom et al. 2014a). Changes in lifespan and decreased foaling rates could combine to cause changes in overall age structure in a treated herd (Turner and Kirkpatrick 2002, Roelle et al. 2010), with a greater prevalence of older mares in the herd (Gross 2000). Observations of mares treated in past gathers showed that many of the treated mares were larger than, maintained higher body condition than, and had larger healthy foals than untreated mares.

Impacts of Alternative 3
Implementation of Alternative 3 would result in capturing fewer wild horses than would be captured in Alternative 1. A gate cut removal would be implemented rather than a selective removal (i.e., the gather would end when the number of excess wild horses which requires removal has been captured). Alternative 3 would not involve fertility control; mares would not undergo the additional stress of receiving fertility control injections or freezemarking and would foal at normal rates until the next gather is conducted. The post-gather sex ratio would be about 50:50 mares to studs, or would slightly favor mares. This would be expected to result in fewer and smaller bachelor bands, increased reproduction on a proportional basis within the herd, larger band sizes, and individual mares would likely begin actively producing at a slightly older age.

Impacts Common to Alternatives 1, 2, and 3
For over 40 years, various impacts to wild horses and burros as a result of gather activities have been observed. Under Alternatives 1, 2, and 3 impacts to wild horses and burros would be both direct and indirect, occurring to both individual horses and burros and the population as a whole.

In any given gather, gather-related mortality averages only about one half of one percent (0.5 percent), which is very low when handling wild animals. Approximately, another six-tenths of one percent (0.6 percent) of the captured animals could be humanely euthanized due to pre-existing conditions and in accordance with BLM policy (GAO 2008). These data affirm that the use of helicopters and motorized vehicles has proven to be a safe, humane, effective, and practical means for the gather and removal of excess wild horses and burros from the public lands. The BLM also avoids gathering wild horses and burros by helicopter during the 6 weeks prior to and following the peak foaling season (i.e., March 1 through June 30).

Impacts to Individual Horses and Burros
Individual, direct impacts to wild horses and burros include the handling stress associated with the roundup, capture, sorting, handling, and transportation of the animals. The intensity of these impacts varies by individual and is indicated by behaviors ranging from nervous agitation to physical distress. When being herded to trap site corrals by the helicopter, injuries sustained by wild horses and burros may include bruises, scrapes, or cuts to feet, legs, face, or body from rocks, brush or tree limbs. Rarely, wild horses and burros will encounter barbed wire fences and will receive wire cuts. These injuries are very rarely fatal and are treated on-site until a veterinarian can examine the animal and determine if additional treatment is indicated.

Other injuries may occur after a horse or burro has been captured and is either within the trap site corral, the temporary holding corral, during transport between facilities, or during sorting and handling. Occasionally, horses and burros may sustain spinal injuries or fractured limbs but based on prior gather statistics, serious injuries requiring humane euthanasia occur in less than one horse per every 100 captured. Similar injuries could be sustained if wild horses and burros were captured through bait and/or water trapping, as the animals still need to be sorted, aged, transported, and otherwise handled following their capture. These injuries result from kicks and bites, or from collisions with corral panels or gates.

To minimize the potential for injuries from fighting, the animals are transported from the trap site to the temporary holding facility where they are sorted as quickly and safely as possible, then moved into large holding pens where they are provided with hay and water. On many gathers, no wild horses or burros are injured or die. On some gathers, due to the temperament of the horses and burros, they are not as calm and injuries are more frequent. Overall, direct gather-related mortality averages less than one (1) percent.

Indirect individual impacts are those which occur to individual wild horses and burros after the initial event. These may include miscarriages in mares and jennies, increased social displacement, and conflict between studs. These impacts, like direct individual impacts, are known to occur intermittently during wild horse and burro gather operations. An example of an indirect individual impact would be the brief 1 to 2 minute skirmish between older studs which ends when one stud retreats. Injuries typically involve a bite or kick with bruises which do not break the skin. Like direct individual impacts, the frequency of these impacts varies with the population and the individual. Observations following capture indicate the rate of miscarriage varies, but can occur in about one to five percent of the captured mares, particularly if the mares are in very thin body condition or in poor health.

A few foals may be orphaned during a gather. If the mare rejects the foal, the foal becomes separated from its mother and cannot be matched up following sorting, the mare dies or must be humanely euthanized during the gather, the foal is ill or weak and needs immediate care that requires removal from the mother, or the mother does not produce enough milk to support the foal. On occasion, foals are gathered that were previously orphaned on the range (prior to the gather) because the mother rejected it or died. These foals may be in poor, unthrifty condition. Every effort is made to provide appropriate care to orphan foals. Veterinarians may administer electrolyte solutions or orphan foals may be fed milk replacer as needed to support their nutritional needs. Orphan foals may be placed in a foster home in order to receive additional care. Despite these efforts, some orphan foals may die or be humanely euthanized if the prognosis for survival is very poor.

In some areas, gathering wild horses and burros during the winter may avoid the heat stress that could be associated with a summer gather. By fall and winter, foals are of larger body size and sufficient age to be weaned. Winter gathers are often preferred when terrain and higher elevations make it difficult to gather wild horses and burros during the summer months. Under winter conditions, horses and burros are often located in lower elevations due to snow cover at higher elevations. This typically makes the horses and burros closer to the potential trap sites and reduces the potential for fatigue and stress. While deep snow can tire horses and burros as they are moved to the trap, helicopter pilots allow the horses and burros to travel slowly at their own pace. Trails in the snow are often followed to make it easier for horses and burros to travel to the trap site. On occasion, trails can be plowed in the snow to facilitate the safe and humane movement of horses and burros to a trap. Wild horses and burros may be able to travel farther and over terrain that is more difficult during the winter, even if snow does not cover the ground. Water requirements are lower during the winter months, making distress from heat exhaustion extremely rare. By comparison, during summer gathers, wild horses and burros may travel long distances between water and forage and become more easily dehydrated.

Through the capture and sorting process, wild horses and burros are examined for health, injury and other defects. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy. The BLM Euthanasia Policy IM-2015-070 is used as a guide to determine if animals meet the criteria and should be euthanized. Animals that are euthanized for non-gather related reasons include those with old injuries (broken or deformed limbs) that cause lameness or prevent the animal from being able to maintain an acceptable body condition (greater than or equal to BCS 3); old animals that have serious dental abnormalities or severely worn teeth and are not expected to maintain an acceptable body condition, and wild horses that have serious physical defects such as club feet, severe limb deformities, or sway back. Some of these conditions have a causal genetic component and the animals should not be returned to the range to prevent suffering, as well as to avoid amplifying the incidence of the problem in the population.

Wild horses and burros not captured may be temporarily disturbed and moved into another area during the gather operation. With the exception of changes to herd demographics from removals, direct population impacts have proven to be temporary in nature with most, if not all, impacts disappearing within hours to several days of release. No observable effects associated with these impacts would be expected within one month of release, except for a heightened awareness of human presence.

It is not expected that genetic health would be impacted by the action alternatives. The AML range of 448 to 758 animals should provide for acceptable genetic diversity and if need be will be monitored with further genetic testing (see Appendix N).

By maintaining wild horse and burro population size within the AML, there would be a lower density of wild horses and burros across the HMA, reducing competition for resources and allowing wild horses and burros to utilize their preferred habitat. Maintaining population size within the established AML would be expected to improve forage quantity and quality and promote healthy, self-sustaining populations of wild horses and burros in a thriving natural ecological balance and multiple use relationship on the public lands in the area. Deterioration of the range associated with wild horse and burro overpopulation would be avoided. Managing wild horse and burro populations in balance with the available habitat and other multiple uses would lessen the potential for individual animals or the herd to be affected by drought, and would avoid or minimize the need for emergency gathers, which would reduce stress to the animals and increase the success of these herds over the long-term.

Transport, Off-Range Corral (ORC) Holding, and Adoption (or Sale) Preparation
During transport, potential impacts to individual horses can include stress, as well as slipping, falling, kicking, biting, or being stepped on by another animal. Unless wild horses or burros are in extremely poor condition, it is rare for an animal to be seriously injured or die during transport.

During the preparation process for sale or adoption (e.g. freezemarking, blood samples, vaccination), potential impacts to wild horses and burros are similar to those that can occur during handling and transportation. Serious injuries and deaths from injuries during the preparation process are rare, but can occur.

At ORCs, a minimum of 700 square feet is provided per animal. Mortality at ORCs averages approximately five percent per year (GAO 2008), and includes animals euthanized due to a pre-existing condition; animals in extremely poor condition; animals that are injured and would not recover; animals which are unable to transition to feed; and animals which are seriously injured or accidentally die during sorting, handling, or preparation.

Adoption or Sale with Limitations and Off-Range Pastures (ORP)
Potential impacts to wild horses from transport to adoption, sale, or ORP are similar to those previously described. One difference is that when shipping wild horses for adoption, sale or ORP, animals may be transported for a maximum of 24 hours. Immediately prior to transportation, and after every 18 to 24 hours of transportation, animals are offloaded and provided a minimum of 8 hours on-the-ground rest. During the rest period, each animal is provided access to unlimited amounts of clean water and 25 pounds of good quality hay per horse with adequate bunk space to allow all animals to eat at one time. Most animals are not shipped more than 18 hours before they are rested. The rest period may be waived in situations where the travel time exceeds the 24-hour limit by just a few hours and the stress of offloading and reloading is likely to be greater than the stress involved in the additional period of uninterrupted travel.

ORPs are designed to provide excess wild horses with humane, life-long care in a natural setting off the public rangelands. Animals are segregated into separate pastures by sex except one facility where geldings and mares coexist. Although the animals are placed in ORP, they remain available for adoption or sale to qualified individuals. No reproduction occurs in the ORP, but foals born to pregnant mares are gathered and weaned when they reach about 8 to10 months of age and are then shipped to ORCs where they are made available adoption. Handling by humans is minimized to the extent possible although regular on-the-ground observation and weekly counts of the wild horses to ascertain their numbers, well-being, and safety are conducted. A very small percentage of the animals may be humanely euthanized if they are in very thin condition and are not expected to improve to a BCS of three or greater due to age or other factors. Natural mortality of wild horses in ORP pastures averages approximately eight percent per year, but can be higher or lower depending on the average age of the horses pastured there (GAO 2008).

Euthanasia and Sale without Limitation
Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy (IM 2015-070 or most current edition). Conditions requiring humane euthanasia occur infrequently and are described in more detail in IM 2015-070: https://www.blm.gov/policy/im-2015-070.

Impacts of Alternative 4 (No Action)
Under Alternative 4, there would be no active management to control the population size within the established AML at this time. In the absence of a gather, wild horse and burro populations would continue to grow at an average rate of about 17 percent per year. Without gather and removal now, the wild horse population could reach between 7,488 and 14,604 wild horses within 10 years.

Use by wild horses and burros would continue to exceed the amount of forage allocated for their use. Competition between wildlife, livestock and wild horses for limited forage and water resources would continue. Damage to rangeland resources would continue or increase. Over time, the potential risks to the health of individual horses would increase, and the need for emergency removals to prevent their death from starvation or thirst would also increase. Over the long-term, the health and sustainability of the wild horse population is dependent upon achieving a thriving natural ecological balance and sustaining healthy rangelands. Allowing wild horses to die of dehydration or starvation would be inhumane and would be contrary to the Wild Horse and Burro Act which requires that excess wild horses be immediately removed when necessary to achieve a thriving natural ecological balance. Allowing rangeland damage to continue to result from wild horse overpopulation would also be contrary to the Wild Horse and Burro Act which requires the BLM to "protect the range from the deterioration associated with overpopulation", "remove excess animals from the range so as to achieve appropriate management levels", and "to preserve and maintain a thriving natural ecological balance and multiple-use relationship in that area."

Cumulative Effects
Impacts Common to Action Alternatives (1, 2, and 3)
The cumulative effects associated with the capture and removal of excess wild horses and burros includes gather-related mortality of less than one (1) percent of the captured animals, about five (5) percent per year associated with transportation, short-term holding, adoption or sale with limitations and about eight (8) percent per year associated with long-term holding. This compares with natural mortality on the range ranging from about five to eight percent per year for foals (animals under age 1), about five percent per year for horses ages 1 to 15, and 5 to 100 percent for animals age 16 and older (Jenkins 1996, Garrott and Taylor 1990). In situations where forage and/or water are limited, mortality rates increase, with the greatest impact to young foals, nursing mares and older horses. Animals can experience lameness associated with trailing to/from water and forage, foals may be orphaned (left behind) if they cannot keep up with their mare, or animals may become too weak to travel. After suffering, often for an extended period, the animals may die. Before these conditions arise, the BLM generally removes the excess animals to prevent their suffering from dehydration or starvation.

While humane euthanasia and sale without limitation of healthy horses for which there is no adoption demand is authorized under the Wild Horse and Burro Act, Congress prohibited the use of appropriated funds between 1987 and 2004 and again in 2010 for this purpose.

The other cumulative effects which would be expected when incrementally adding either of the Action Alternatives would include continued improvement of upland vegetation conditions, which would in turn benefit permitted livestock, native wildlife, and wild horse and burro population as forage (habitat) quality and quantity is improved over the current level. Benefits from a reduced wild horse and burro population would include fewer animals competing for limited forage and water resources. Cumulatively, there should be more stable wild horse and burro populations, healthier rangelands, healthier wild horses and burros, and fewer multiple use conflicts in the area over the short and long-term. Over the next 15 to 20 years, continuing to manage wild horses within the established AML range would achieve a thriving natural ecological balance and multiple use relationship on public lands in the area.

Cumulative Impacts of Alternative 1 (Proposed Action)
Application of fertility control, implementation of a non-reproducing portion of the male population and adjustment in sex ratios to favor males should slow population growth and result in fewer gathers and less frequent disturbance to individual wild horses and the herd's social structure. However, return of wild horses back into the HMA could lead to decreased ability to effectively gather horses in the future as released horses learn to evade the helicopter.

Cumulative Impacts of Alternative 2
Application of fertility control will slow population growth and result in fewer gathers and less frequent disturbance to individual wild horses and the herd's social structure. However, return of wild horses back

into the HMA could lead to decreased ability to effectively gather horses in the future as released horses learn to evade the helicopter.

Cumulative Impacts of Alternative 4 (No Action)
Under the No Action Alternative, the wild horse and population could exceed 6,550 wild horses and 1,180 wild burros in four years. Movement outside the HMA and onto private lands would be expected as greater numbers of horses and burros search for food and water for survival, thus impacting larger areas of public lands. Heavy to excessive utilization of the available forage would be expected and the water available for use could become increasingly limited. Eventually, ecological plant communities would be damaged to the extent that they are no longer sustainable and the wild horse population would be expected to crash.

Emergency removals could be expected in order to prevent individual animals from suffering or death as a result of insufficient forage and water. These emergency removals could occur as early as the next drought and perennial water sources become dry early in the season. During emergency conditions, competition for the available forage and water increases. This competition generally impacts the oldest and youngest horses as well as lactating mares first. These groups would experience substantial weight loss and diminished health, which could lead to their prolonged suffering and eventual death. If emergency actions are not taken, the overall population could be affected by severely skewed sex ratios towards stallions as they are generally the strongest and healthiest portion of the population. An altered age structure would also be expected.

Cumulative impacts would result in foregoing the opportunity to improve rangeland health and to properly manage wild horses in balance with the available forage and water and other multiple uses. Attainment of site-specific vegetation management objectives and Standards for Rangeland Health would not be achieved. AML would not be achieved and the opportunity to collect the scientific data necessary to re-evaluate AML levels, in relationship to rangeland health standards, would be foregone.

5.0 Monitoring and Mitigation Measures

The BLM COR and PIs assigned to the gather would be responsible for ensuring contract personnel abide by the contract specifications and the SOPs (Appendix A). Ongoing monitoring of forage condition and utilization, water availability, aerial population surveys, and animal health would continue.

Fertility control monitoring would be conducted in accordance with the SOPs (BLM Instruction Memorandum 2009-090: https://www.blm.gov/policy/im-2009-090). Monitoring the herd’s social behavior would be incorporated into routing monitoring. The objective of this additional monitoring would be to determine if additional studs form bachelor bands or are more aggressive with breeding bands for the forage and water present.

6.0 List of Preparers

The following list identifies the interdisciplinary team member's area of responsibility:

Name	Title
Amanda Gearhart	Wild Horse and Burro Specialist
Patrick Farris	Rangeland Management Specialist
Marilla Martin	Archeologist
Melissa Nelson	Wildlife Biologist
Morgan Weigand	Ranch Technician
Valda Lockie	Ecologist
Andrew Johnson	Geographer
Joshua Huffman	Lead Biological Science Technician
Ashley Phillips	Planning & Environmental Coordinator

7.0 Consultation and Coordination

The BLM began consultation on the Twin Peaks Gather with the Susanville Indian Rancheria, Washoe Tribe of Nevada and California, Pit River Tribe, Pyramid Lake Paiute, Reno Sparks Indian Colony, and Greenville Indian Rancheria via a scoping letter in June 2016. Follow up consultation has occurred since that time in-person or via email, as requested by each tribe on the following dates:

- Susanville Indian Rancheria: 07/08/2016, 10/14/2016, 01/20/2017, 04/6/2017, 07/27/2017, 01/25/2018, 07/19/2018, 02/15/2019 (in-person meetings). Comments made during meetings indicate that SIR supports horse gathers, such as the Twin Peak Gather and the tribe feels that because the horses are non-native and damage cultural resources and water areas, the horses should be gathered. No other comments were received.
- Washoe Tribe of Nevada and California 11/09/2016, 01/24/2017, 02/27/2018, 7/15/2018, 3/15/2019 (in-person & via email). The tribe expressed support for a potential future gather and disappointment that no dates are set yet for the gather. The Washoe Tribe sent a letter of support for the previous 2010 Twin Peaks Horse Gather. No other comments were received.
- The Pit River Tribe: 10/13/2016, 04/13/2017, 07/20/2017, 10/26/2017, 01/24/2018, 3/1/2019 (in-person meetings). The tribe wants be informed and involved in all gathers. No other comments were received.
- Pyramid Lake Paiute Tribe: 01/24/2017, 4/3/2018, 07/06/2018, 03/20/2018 (via email). No comments were received.
- Reno Sparks Indian Colony: 04/03/2018, 07/15/2018 (via email). No comments were received.

- Greenville Indian Rancheria: 04/03/2018, 07/06/2018 (via email). No comments were received.

Consultation with the Tribes will be on-going until completion of the project. However, at this time none of the tribes have identified any Traditional Cultural Properties or issues of cultural concern in the gather area.

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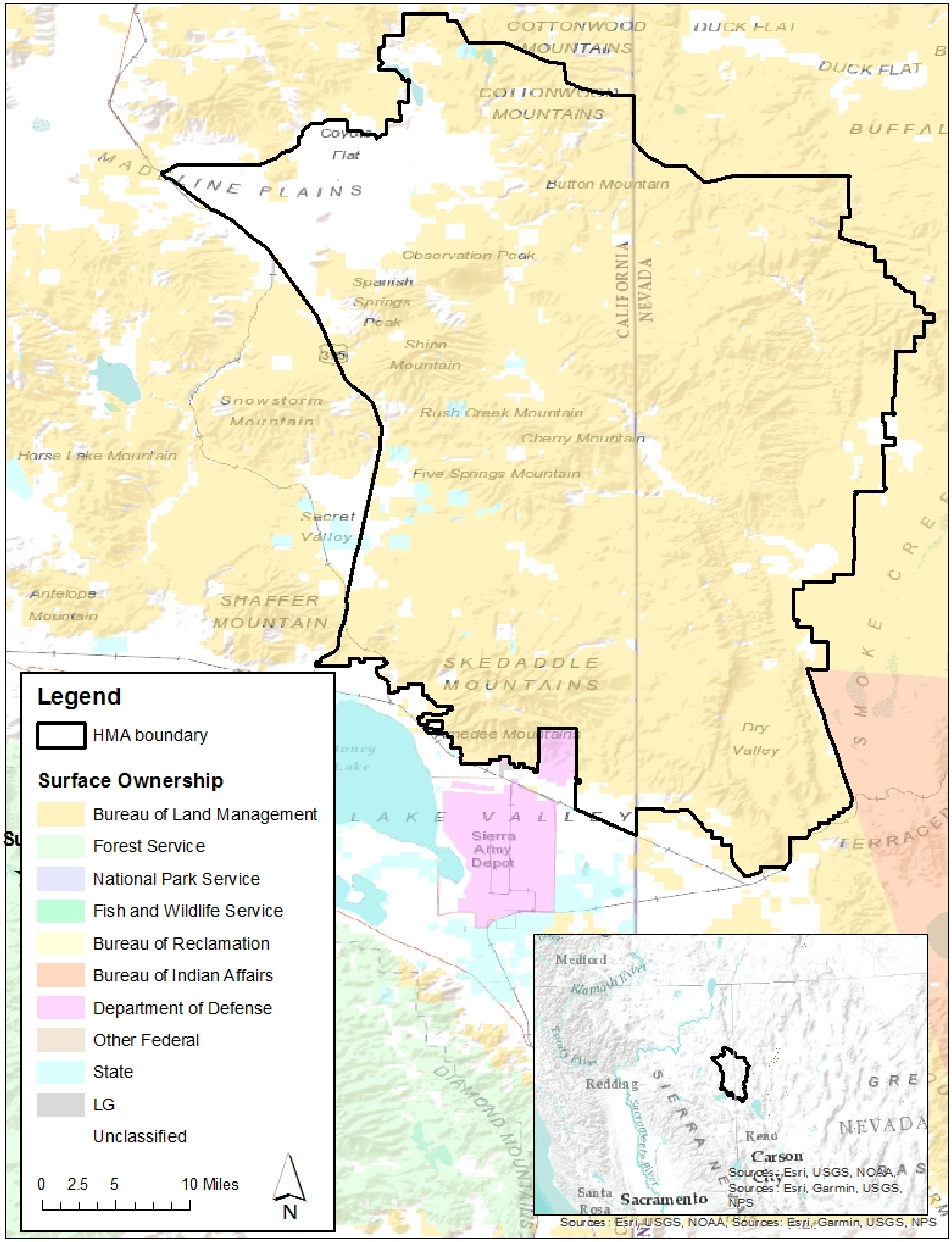
Appendix A. Map of Twin Peaks HMA



Appendix B. 43 CFR § 4700 Applicable Regulations

The Proposed Action is in conformance with the *Wild Free-Roaming Horses and Burros Act of 1971* (as amended), applicable regulations at 43 CFR § 4700, and BLM policies. Included are:

43 CFR § 4710.4 Constraints on Management: Management of wild horses and burros shall be undertaken with the objective of limiting the animals' distribution to herd areas. Management shall be at the minimum feasible level necessary to attain the objectives identified in approved land use plans and herd management area plans.

43 CFR § 4720.1 Removal of excess animals from public lands: Upon examination of current information and a determination by the authorized officer that an excess of wild horses or burros exists, the authorized officer shall remove the excess animals immediately.

43 CFR § 4740.1 Use of motor vehicles or aircraft:

a) Motor vehicles and aircraft may be used by the authorized officer in all phases of the administration of the Act, except that no motor vehicle or aircraft, other than helicopters, shall be used for the purpose of herding or chasing wild horses or burros for capture or destruction. All such use shall be conducted in a humane manner.

b) Before using helicopters or motor vehicles in the management of wild horses or burros, the authorized officer shall conduct a public hearing in the area where such use is to be made.

The Proposed Action is also in conformance with the *Interim Management Policy for Lands under Wilderness Review*, BLM H-8550-1, (July 1995b), Chapter IIIE, Wild Horse and Burro Management, and with other BLM decisions for management of multiple use resources on public lands within this area.

Environmental Assessments, other BLM Documents

The following documents contain information from prior NEPA analyses to which this EA is tiered, and BLM decisions related to land health assessments, livestock grazing, wild horses, and other resources within the Twin Peaks HMA:

1. BLM *Land Health Evaluation and Determination for the Observation Allotment*, 2009
2. BLM *Land Health Evaluation and Determination for the Winter Range California and Nevada Allotments*, 2008
3. BLM Decision Record, *Notice of Final Multiple Use Decision for the Twin Peaks Allotment, January 2001*
4. BLM Report, *Twin Peaks Allotment Monitoring Evaluation Report*, October, 2000
5. BLM Decision Record, *Notice of Final Multiple Use Decision for the Observation Allotment*, August 1998
6. BLM Environmental Assessment, CA-350-1998-14, *Attainment and Maintenance of Appropriate Management Levels of Wild Horses and Burros in the Observation South and Observation North Home Ranges of the Twin Peaks Herd Management Area*, 1998

7. BLM Environmental Assessment, CA-350-1998-20, *Implementation of the Management Recommendations from the Final Observation Allotment Monitoring Evaluation Report*, 1998
8. BLM Environmental Assessment, CA-026-93-09, *Removal and Structuring of the Twin Peaks North Home Range of the Twin Peaks Herd Management Area, 1993*
9. BLM Report, *Twin Peaks Herd Management Area Plan*, CA-242, 1989
10. BLM Land Use Plan, *Land Use Plan Summary, Rangeland Program Summary, and Grazing EIS Record of Decision, Cal-Neva Management Framework Plan*, July 1982

Appendix C. Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers SOPs

In 2015 (IM2015-151), BLM initiated a comprehensive animal welfare program (CAWP) which updated WH&B gather SOPs to formalize the standards, training and monitoring for conducting safe, efficient and successful WH&B gather operations while ensuring humane care and handling of animals gathered. These standards include requirements for trap and temporary holding facility design; capture and handling; transportation; and appropriate care after capture. The standards have been incorporated into helicopter gather contracts as specifications for performance. It includes a requirement that all Incident Commanders (IC), Lead Contracting Officer Representatives (LCOR), Contracting Officer Representatives (COR), Project Inspectors (PI), and contractors must complete a mandatory training course covering all aspects of the CAWP prior to gathers. The goal is to ensure that the responsibility for humane care and treatment of WH&Bs remains a high priority for the BLM and its contractors at all times. The BLM's objective is to use the best available science, husbandry and handling practices applicable for WH&Bs and to make improvements whenever possible, while also meeting our overall gather goals and objectives in accordance with current BLM policy, SOPs and contract requirements.

Gathers would be conducted by utilizing contractors from the Wild Horse Gathers-Western States Contract, or BLM personnel. The following procedures for gathering and handling wild horses would apply whether a contractor or BLM personnel conduct a gather. For helicopter gathers conducted by BLM personnel, gather operations will be conducted in conformance with the *Wild Horse Aviation Management Handbook* (January 2009).

Prior to any gathering operation, the BLM will provide a pre-gather evaluation of existing conditions in the gather area(s). The evaluation will include animal conditions, prevailing temperatures, drought conditions, soil conditions, road conditions, and a topographic map with wilderness boundaries, the location of fences, other physical barriers, and acceptable trap locations in relation to animal distribution. The evaluation will determine whether the proposed activities will necessitate the presence of a veterinarian during operations. If it is determined that a large number of animals may need to be euthanized or gather operations could be facilitated by a veterinarian, these services would be arranged before the gather would proceed. The contractor will be apprised of all conditions and will be given instructions regarding the gather and handling of animals to ensure their health and welfare is protected.

Trap sites and temporary holding sites will be located to reduce the likelihood of injury and stress to the animals, and to minimize potential damage to the natural resources of the area. These sites would be located on or near existing roads whenever possible.

The primary gather methods used in the performance of gather operations include:
1. Helicopter Drive Trapping. This gather method involves utilizing a helicopter to herd wild horses into a temporary trap.

2. Helicopter Assisted Roping. This gather method involves utilizing a helicopter to herd wild horses or burros to ropers.

3. Bait Trapping. This gather method involves utilizing bait (e.g., water or feed) to lure wild horses into a temporary trap.

The following procedures and stipulations will be followed to ensure the welfare, safety and humane treatment of wild horses in accordance with the provisions of 43 CFR 4700.

Helicopter Gather Methods used in the Performance of Gather Contract Operations

The primary concern of the contractor is the safe and humane handling of all animals gathered.

All gather attempts shall incorporate the following:

1. All trap and holding facilities locations must be approved by the Contracting Officer's Representative (COR) and/or the Project Inspector (PI) prior to construction. All trap and holding facilities locations must be approved by the LCOR/COR/PI prior to construction. The Contractor may also be required to change or move trap locations as determined by the LCOR/COR/PI. LCOR/COR/PI will determine when capture objectives are met. All traps and holding facilities not located on public land must have prior written approval of the landowner that will be provided to the LCOR prior to use. Selection of all traps and holding sites will include consideration for public and media observation.

2. The rate of movement and distance the animals travel must not exceed limitations set by the LCOR/COR/PI who will consider terrain, physical barriers, access limitations, weather, condition of the animals, urgency of the operation (animals facing drought, starvation, fire, etc.) and other factors. The trap site shall be moved close to WH&B locations whenever possible to minimize the distance the animals need to travel.

3. All traps, wings, and holding facilities shall be constructed, maintained and operated to handle the animals in a safe and humane manner and be in accordance with the following:

a. When moving the animals from one pasture/allotment to another pasture/allotment, the fencing wire needs to be let down for a distance that is approved by the LCOR on either side of the gate or crossing.

b. If jute is hung on the fence posts of an existing wire fence in the trap wing, the wire should either be rolled up or let down for the entire length of the jute in such a way that minimizes the possibility of entanglement by WH&Bs unless otherwise approved by the LCOR/COR/PI. No modification of existing fences will be made without authorization from the LCOR/COR/PI. The Contractor shall be responsible for restoration of any fence modification which they have made.

c. Building a trail using domestic horses through the fence line, crossing or gate may be necessary to avoid animals hitting the fence.

d. The trap site and temporary holding facility must be constructed of stout materials and must be maintained in proper working condition. Traps and holding facilities shall be constructed of portable panels, the top of which shall not be less than 72 inches high for horses and 60 inches for burros, and the bottom rail of which shall not be more than 12 inches from ground level. All traps and holding facilities shall be oval or round in design with rounded corners.

e. All portable loading chute sides shall be a minimum of 6 feet high and shall be fully covered on the sides with plywood, or metal without holes.

f. All alleyways that lead to the fly chute or sorting area shall be a minimum of 30 feet long and a minimum of 6 feet high for horses, and 5 feet high for burros and the bottom rail must not be more than 12 inches from ground level. All gates and panels in the animal holding and handling pens and alleys of the trap site must be covered with plywood, burlap, plastic snow fence or like material approximately 48" in height to provide a visual barrier for the animals. All materials shall be secured in place. These guidelines apply:

i. For exterior fences, material covering panels and gates must extend from the top of the panel or gate toward the ground.

ii. For alleys and small internal handling pens, material covering panels and gates shall extend from no more than 12 inches below the top of the panel or gate toward the ground to facilitate visibility of animals and the use of flags and paddles during sorting.

iii. The initial capture pen may be left uncovered as necessary to encourage animals to enter the first pen of the trap.

iv. Padding must be installed on the overhead bars of all gates used in single file ally.

v. An appropriate chute designed for restraining WH&B's must be available for necessary procedures at the temporary holding facility. The government furnished portable fly chute to restrain, age, or provide additional care for the animals shall be placed in the alleyway in a manner as instructed by or in concurrence with the LCOR/COR/PI.

vi. There must be no holes, gaps or openings, protruding surfaces, or sharp edges present in fence panels, latches**,** or other structures that may cause escape or possible injury.

vii. Hinged, self-latching gates must be used in all pens and alleys except for entry gates into the trap, which may be secured with tie ropes or chains.

viii. When dust conditions occur within or adjacent to the trap or holding facility, the Contractor shall be required to wet down the ground with water.

All animals gathered shall be sorted into holding pens as to age, size, temperament, sex, condition, and whether animals are identified for removal as excess or retained in the HMA. These holding pens shall be of sufficient size to minimize, to the extent possible, injury due to fighting and trampling as well as to allow animals to move easily and have adequate access to water and feed. All pens will be capable of expansion on request of the LCOR/COR/PI. Alternate pens, within the holding facility shall be furnished by the Contractor to separate mares or Jennies with small foals, sick and injured animals, and private animals from the other animals. Under normal conditions, the BLM will require that animals be restrained to determine an animal's age, sex, and ownership. In other situations restraint may be required to conduct other procedures such as veterinary treatments, restraint for fertility control vaccinations, castration, spaying, branding, blood draw, collection of hair samples for genetic testing, testing for equine diseases, application of GPS collars and radio tags. In these instances, a portable restraining chute may be necessary and will be provided by the government. Alternate pens shall be furnished by the Contractor to hold animals if the specific gathering requires that animals be released back into the capture area(s) following selective removal and/or population suppression treatments. In areas requiring one or more satellite traps, and where a centralized holding facility is utilized, the contractor may be required to provide additional holding pens to segregate animals transported from remote locations so they may be returned to their traditional ranges. Either segregation or temporary marking and later segregation will be at the discretion of the LCOR/COR/PI. The LCOR will determine if the corral size needs to be expanded due to horses staying longer, large.

FEEDING AND WATERING

a. Adult WH&Bs held in traps or temporary holding pens for longer than 12 hours must be fed every morning and evening and provided with drinking water at all times other than when animals are being sorted or worked.

b. Dependent foals must be reunited with their mares/jennies at the temporary holding facility within four hours of capture unless the LCOR/COR/PI authorizes a longer time or foals are old enough to be weaned. If a nursing foal is held in temporary holding pens for longer than 4 hours without their dams, it must be provided with water and good quality weed seed free hay.

c. Water must be provided at a minimum rate of 10 gallons per 1,000 pound animal per day, adjusted accordingly for larger or smaller horses, burros and foals, and environmental conditions, with each trough placed in a separate location of the pen (i.e. troughs at opposite ends of the pen) with a minimum of one trough per 30 horses. Water must be refilled at least every morning and evening when necessary.

d. Good quality weed seed free hay must be fed at a minimum rate of 20 pounds per 1,000 pound adult animal per day, adjusted accordingly for larger or smaller horses, burros and foals.

1. Hay must not contain poisonous weeds or toxic substances.
2. Hay placement must allow all WH&B's to eat simultaneously.

e. When water or feed deprivation conditions exist on the range prior to the gather, the LCOR/COR/PI shall adjust the watering and feeding arrangements in consultation with the onsite veterinarian as necessary to provide for the needs of the animals to avoid any toxicity concerns.

TRAP SITE
A dependent foal or weak/debilitated animal must be separated from other WH&Bs at the trap site to avoid injuries during transportation to the temporary holding facility. Separation of dependent foals from mares must not exceed four hours unless the LCOR/COR/PI authorizes a longer time or the decision is made to wean the foals.

TEMPORARY HOLDING FACILITY
a. All WH&B's in confinement must be observed at least twice daily during feeding time to identify sick or injured WH&Bs and ensure adequate food and water.

b. Non-ambulatory WH&B's must be located in a pen separate from the general population and must be examined by the LCOR/COR/PI and/or on-call or on-site veterinarian no more than 4 hours after recumbency (lying down) is observed. Unless otherwise directed by a veterinarian, hay and water must be accessible to an animal within six hours after recumbency.

c. Alternate pens must be made available for the following:

1. WH&Bs that are weak or debilitated
2. Mares/jennies with dependent foals
3. Aggressive WH&B's that could cause serious injury to other animals.

d. WH&B's in pens at the temporary holding facility shall be maintained at a proper stocking density such that when at rest all WH&B's occupy no more than half the pen area.

e. It is the responsibility of the Contractor to provide security to prevent loss, injury or death of captured animals until delivery to final destination.

f. It is the responsibility of the Contractor to provide for the safety of the animals and personnel working at the trap locations and temporary holding corrals in consultation with the LCOR/COR/PI. This responsibility will not be used to exclude or limit public and media observation as long as current BLM policies are followed.

g. The contractor will ensure that non-essential personnel and equipment are located as to minimize disturbance of WH&Bs. Trash, debris, and reflective or noisy objects shall be eliminated from the trap site and temporary holding facility.

h. The Contractor shall restrain sick or injured animals if treatment is necessary in consultation with the LCOR/COR/PI and/or onsite veterinarian. The LCOR/COR/PI and/or onsite veterinarian will determine if injured animals must be euthanized and provide for the euthanasia of such animals. The Contractor may be required to humanely euthanize animals in the field and to dispose of the carcasses as directed by the LCOR/COR/PI, at no additional cost to the Government.

i. Once the animal has been determined by the LCOR/COR/PI to be removed from the HMA/HA, animals shall be transported to final destination from temporary holding facilities within 48 hours after capture unless prior approval is granted by the LCOR/COR/PI. Animals to be released back into the HMA following gather operations will be held for a specified length of time as stated in the Task Order/SOW. The Contractor shall schedule shipments of animals to arrive at final destination between 7:00 a.m. and 4:00 p.m. unless prior approval has been obtained by the LCOR. No shipments shall be scheduled to arrive at final destination on Sunday and Federal holidays, unless prior approval has been obtained by the LCOR. Animals shall not be allowed to remain standing on gooseneck or semi-trailers while not in transport for a combined period of greater than three (3) hours. Total planned transportation time from the temporary holding to the BLM facility will not exceed 10 hours. Animals that are to be released back into the capture area may need to be transported back to the original trap site per direction of the LCOR.

CAPTURE METHODS THAT MAY BE USED IN THE PERFORMANCE OF A GATHER

Helicopter Drive Trapping

a. The helicopter must be operated using pressure and release methods to herd the animals in a desired direction and shall not repeatedly evoke erratic behavior in the WH&B’s causing injury or exhaustion. Animals must not be pursued to a point of exhaustion; the on-site veterinarian must examine WH&B’s for signs of exhaustion.

b. The rate of movement and distance the animals travel must not exceed limitations set by the LCOR/COR/PI who will consider terrain, physical barriers, access limitations, weather, condition of the animals, urgency of the operation (animals facing drought, starvation, fire, etc.) and other factors.

i. WH&B’s that are weak or debilitated must be identified by BLM staff or the contractors. Appropriate gather and handling methods shall be used according to the direction of the LCOR/COR/PI as defined in this contract.

ii. The appropriate herding distance and rate of movement must be determined the LCOR/COR/PI on a case-by-case basis considering the weakest or smallest animal in the group (e.g., foals, pregnant mares, or horses that are weakened by body condition, age, or poor health) and the range and environmental conditions present.

iii. Rate of movement and distance travelled must not result in exhaustion at the trap site, unless the exhausted animals were already in a severely compromised condition prior to the gather. Where compromised animals cannot be left on the range or where doing so would only serve to prolong their suffering, the LCOR/COR/PI will determine if euthanasia will be performed in accordance with BLM policy.

c. WH&B’s must not be pursued repeatedly by the helicopter such that the rate of movement and distance travelled exceeds the limitation set by the LCOR/COR/PI. Abandoning the pursuit or alternative capture methods may be considered by the LCOR/COR/PI in these cases.

d. The helicopter is prohibited from coming into physical contact with any WH&B regardless of whether the contact is accidental or deliberate.

e. WH&B's may escape or evade the gather site while being moved by the helicopter. If there are mare/dependent foal pairs in a group being brought to a trap and half of an identified pair is thought to have evaded capture, multiple attempts by helicopter may be used to bring the missing half of the pair to the trap or to facilitate capture by roping. In these instances, animal condition and fatigue will be evaluated by the LCOR/COR/PI or on-site veterinarian on a case-by-case basis to determine the number of attempts that can be made to capture an animal.

f. Horse captures must not be conducted when ambient temperature at the trap site is below 10ºF or above 95ºF without approval of the LCOR/COR/PI. Burro captures must not be conducted when ambient temperature is below 10ºF or above 100ºF without approval of the LCOR/COR/PI. The LCOR/COR/PI will not approve captures when the ambient temperature exceeds 105 ºF.

g. The contractor shall assure that dependent foals shall not be left behind. Any animals identified as such will be recovered as a priority in completing the gather.

h. Any adult horse or burro that cannot make it to the trap due to physical limitations shall be identified to the LCOR/COR/PI by the pilot or contractor immediately. An inspection of the animal will be made to determine the problem and the LCOR/COR/PI and/or veterinarian will decide if that animal needs to be humanely euthanized.

ROPING

a. The roping of any WH&B must be approved by the LCOR/COR/PI prior to the action.

b. The roping of any WH&B will be documented by the LCOR/COR/PI along with the circumstances. WH&Bs may be roped under circumstances which include but are not limited to the following: reunite a mare or jenny and her dependent foal; capture nuisance, injured or sick WH&Bs or those that require euthanasia; environmental reasons such as deep snow or traps that cannot be set up due to location or environmental sensitivity; and public and animal safety or legal mandates for removal.

c. Ropers should dally the rope to their saddle horn such that animals can gradually be brought to a stop and must not tie the rope hard and fast to the saddle, which can cause the animals to be jerked off their feet.

d. WH&Bs that are roped and tied down in recumbency must be continuously observed and monitored by an attendant at a maximum of 100 feet from the animal.

e. WH&Bs that are roped and tied down in recumbency must be untied within 30 minutes.

f. If the animal is tied down within the wings of the trap, helicopter drive trapping within the wings will cease until the tied-down animal is removed.

g. Sleds, slide boards, or slip sheets must be placed underneath the animal's body to move and/or load recumbent WH&Bs.

h. Halters and ropes tied to a WH&B may be used to roll, turn, and position or load a recumbent animal, but a WH&B must not be dragged across the ground by a halter or rope attached to its body while in a recumbent position.

i. All animals captured by roping must be marked at the trap site by the contractor for evaluation by the on-site/on-call veterinarian within four hours after capture, and re-evaluation periodically as deemed necessary by the on-site/on-call veterinarian.

HANDLING

Willful Acts of Abuse
The following are prohibited:
a. Hitting, kicking, striking, or beating any WH&B in an abusive manner.

b. Dragging a recumbent WH&B across the ground without a sled, slide board or slip sheet. Ropes used for moving the recumbent animal must be attached to the sled, slide board or slip sheet unless being loaded as specified in Section C 9.2.h

c. Deliberate driving of WH&Bs into other animals, closed gates, panels, or other equipment.

d. Deliberate slamming of gates and doors on WH&Bs.

e. Excessive noise (e.g., constant yelling) or sudden activity causing WH&Bs to become unnecessarily flighty, disturbed or agitated.

General Handling
a. All sorting, loading or unloading of WH&Bs during gathers must be performed during daylight hours except when unforeseen circumstances develop and the LCOR/COR/PI approves the use of supplemental light.

b. WH&Bs should be handled to enter runways or chutes in a forward direction.

c. WH&Bs should not remain in single-file alleyways, runways, or chutes longer than 30 minutes.

d. With the exception of helicopters, equipment should be operated in a manner to minimize flighty behavior and injury to WH&Bs.

Handling Aids
a. Handling aids such as flags and shaker paddles are the primary tools for driving and moving WH&Bs during handling and transport procedures. Contact of the flag or paddle end with a WH&B is allowed. Ropes looped around the hindquarters may be used from horseback or on foot to assist in moving an animal forward or during loading.

b. Routine use of electric prods as a driving aid or handling tool is prohibited. Electric prods may be used in limited circumstances only if the following guidelines are followed:

1. Electric prods must only be a commercially available make and model that uses DC battery power and batteries should be fully charged at all times.
2. The electric prod device must never be disguised or concealed.
3. Electric prods must only be used after three attempts using other handling aids (flag, shaker paddle, voice or body position) have been tried unsuccessfully to move the WH&Bs.
4. Electric prods must only be picked up when intended to deliver a stimulus; these devices must not be constantly carried by the handlers.

5. Space in front of an animal must be available to move the WH&B forward prior to application of the electric prod. 000230 Antelope and Triple B Complexes Gather Plan EA
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6. Electric prods must never be applied to the face, genitals, anus, or underside of the tail of a WH&B.

7. Electric prods must not be applied to any one WH&B more than three times during a procedure (e.g., sorting, loading) except in extreme cases with approval of the LCOR/COR/PI. Each exception must be approved at the time by the LCOR/COR/PI.

8. Any electric prod use that may be necessary must be documented daily by the LCOR/COR/PI including time of day, circumstances, handler, location (trap site or temporary holding facility), and any injuries (to WH&B or human)

MOTORIZED EQUIPMENT

Loading and Unloading Areas

a. Facilities in areas for loading and unloading WH&B's at the trap site or temporary holding facility must be maintained in a safe and proper working condition, including gates that swing freely and latch or tie easily.

b. The side panels of the loading chute must be a minimum of 6 feet high and fully covered with materials such as plywood or metal without holes that may cause injury.

c. There must be no holes, gaps or openings, protruding surfaces, or sharp edges present in fence panels or other structures that may cause escape or possible injury.

d. All gates and doors must open and close properly and latch securely.

e. Loading and unloading ramps must have a non-slip surface and be maintained in a safe and proper working condition to prevent slips and falls**.** Examples of non-slip flooring would include, but not be limited to, rubber mats, sand, shavings, and steel reinforcement rods built into ramp. There must be no holes in the flooring or items that can cause an animal to trip.

f. Trailers must be properly aligned with loading and unloading chutes and panels such that no gaps exist between the chute/panel and floor or sides of the trailer creating a situation where a WH&B could injure itself.

g. Stock trailers shall be positioned for loading or unloading such that there is no more than 12" clearance between the ground and floor of the trailer for burros and 18" for horses. . If animals refuse to load, it may be necessary to dig a tire track hole where the trailer level is closer to ground level.

TRANSPORTATION

A. General

1. All sorting, loading, or unloading of WH&Bs during gathers must be performed during daylight hours except when unforeseen circumstances develop and the LCOR/COR/PI approves the use of supplemental light.

2. WH&Bs identified for removal should be shipped from the temporary holding facility to a BLM facility within 48 hours.

3. Shipping delays for animals that are being held for release to range or potential on-site adoption must be approved by the LCOR/COR/PI.

4. Shipping should occur in the following order of priority; 1) debilitated animals, 2) pairs, 3) weanlings, 4) dry mares and 5) studs.

5. Total planned transport time to the BLM preparation facility from the trap site or temporary holding facility must not exceed 10 hours.

6. WH&Bs should not wait in stock trailers and/or semi-trailers at a standstill for more than a combined period of three hours during the entire journey.

B. Vehicles
1. All motorized equipment employed in the transportation of captured animals shall be in compliance with appropriate State and Federal laws and regulations applicable to the humane transportation of animals. The Contractor shall provide the CO annually, with a current safety inspection (less than one year old) for all motorized equipment and tractor-trailers used to transport animals to final destination.

2. Only tractor-trailers or stock trailers with a covered top or overhead bars shall be allowed for transporting animals from trap site(s) to temporary holding facilities, and from temporary holding facilities to final destination(s). Sides or stock racks of all trailers used for transporting animals shall be a minimum height of 6 feet 6 inches from the floor. Single deck tractor-trailers 40 feet or longer shall have two (2) partition gates providing three (3) compartments within the trailer to separate animals. Tractor-trailers less than 40 feet shall have at least one partition gate providing two (2) compartments within the trailer to separate the animals. Compartments in all tractor-trailers shall be of equal size plus or minus 10 percent. Each partition shall be a minimum of 6 feet high and shall have a minimum 5 foot wide swinging gate. The use of double deck tractor-trailers is prohibited. Only straight deck trailers and stock trailers are to be used for transporting WH&B's.

3. WH&B's must have adequate headroom during loading and unloading and must be able to maintain a normal posture with all four feet on the floor during transport without contacting the roof or overhead bars.

4. The width and height of all gates and doors must allow WH&B's to move through freely.

5. All gates and doors must open and close easily and be able to be secured in a closed position.

6. The rear door(s) of stock trailers must be capable of opening the full width of the trailer.

7. Loading and unloading ramps must have a non-slip surface and be maintained in proper working condition to prevent slips and falls.

8. All partitions and panels inside of trailers must be free of sharp edges or holes that could cause injury to WH&B's.

9. The inner lining of all trailers must be strong enough to withstand failure by kicking that would lead to injuries.

10. Partition gates in transport vehicles shall be used to distribute the load into compartments during travel.

11. Surfaces and floors of trailers must be cleaned of dirt, manure and other organic matter prior to the beginning of a gather.

12. Surfaces and floors of trailers shall have non-slip surface, use of shavings, dirt, and floor mates.

C. Care of WH&B's during Transport Procedures
1. WH&B's that are loaded and transported from the temporary holding facility to the BLM preparation facility must be fit to endure travel per direction of LCOR/COR/PI following consultation with on-site/on-call veterinarian.

2. WH&B's that are non-ambulatory, blind in both eyes, or severely injured must not be loaded and shipped unless it is to receive immediate veterinary care or euthanasia.

3. WH&B's that are weak or debilitated must not be transported without approval of the LCOR/COR/PI in consultation with the on-site veterinarian. Appropriate actions for their care during transport must be taken according to direction of the LCOR/COR/PI.

4. WH&B's shall be sorted prior to transport to ensure compatibility and minimize aggressive behavior that may cause injury.

5. Trailers must be loaded using the minimum space allowance in all compartments as follows:

a. For a 6.8 foot wide; 24 foot long stock trailer 12 to 14 adult horses;
b. For a 6.8 foot wide; 24 foot long stock trailer 18 to 21 adult burros
c. For a 6.8 foot wide; 20 foot long stock trailer 10 to 12 adult horses can be loaded
d. For a 6.8 foot wide; 20 foot long stock trailer 15 to 18 adult burros

For a semi-trailer:
a. 12 square feet per adult horse.
bi. 6.0 square feet per dependent horse foal.
c. 8.0 square feet per adult burro.
d. 4.0 square feet per dependent burro foal

6. Considering the condition of the animals, prevailing weather, travel distance and other factors or if animals are going down on trailers or arriving at their destination down or with injuries or a condition suggesting they may have been down, additional space or footing provisions may be necessary and will be required if directed by the LCOR/COR.

7. The LCOR/COR/PI, in consultation with the receiving Facility Manager, must document any WH&B that is recumbent or dead upon arrival at the destination. Non-ambulatory or recumbent WH&B's must be evaluated on the trailer and either euthanized or removed from the trailers using a sled, slide board or slip sheet.

8. Saddle horses must not be transported in the same compartment with WH&B's.

EUTHANASIA or DEATH

Euthanasia Procedure during Gather Operations

1. An authorized, properly trained, and experienced person as well as a firearm appropriate for the circumstances must be available at all times during gather operations. When the travel time between the trap site and temporary holding facility exceeds one hour or if radio or cellular communication is not reliable, provisions for euthanasia must be in place at both the trap site and temporary holding facility during the gather operation.

2. Euthanasia must be performed according to American Veterinary Medical Association euthanasia guidelines (2013) using methods of gunshot or injection of an approved euthanasia agent.

3. The decision to euthanize and method of euthanasia must be directed by the LCOR/COR/PI who must be on site and may consult with the on-site/on-call veterinarian. In event and rare circumstance that the LCOR/COR/PI is not available, the contractor if properly trained may euthanize an animal as an act of mercy.

4. All carcasses will be disposed of in accordance with state and local laws and as directed by the LCORCOR/PI.

5. Carcasses left on the range should not be placed in washes or riparian areas where future runoff may carry debris into ponds or waterways. Trenches or holes for buried animals should be dug so the bottom of the hole is at least 6 feet above the water table and 4-6 feet of level earth covers the top of the carcass with additional dirt mounded on top where possible.

COMMUNICATIONS

a. The Contractor shall have the means to communicate with the LCOR/COR/PI and all contractor personnel engaged in the capture of wild horses and burros utilizing a VHF/FM Transceiver or VHF/FM portable Two-Way radio.

b. The Contractor shall obtain the necessary FCC licenses for the radio system.

SAFETY AND SECURITY

a. All accidents involving animals or people that occur during the performance of any task order shall be immediately reported to the LCOR/COR/PI.

b. It is the responsibility of the Contractor to provide security to prevent unauthorized release, injury or death of captured animals until delivery to final destination.

c. The contractor must comply with all applicable federal, state and local regulations.

d. Fueling operations shall not take place within 1,000 feet of animals or personnel and equipment other than the refueling truck and equipment.

e. Children under the age of 12 shall not be allowed within the gather's working areas which include near the chute when working animals at the temporary holding facility, or near the pens at the trap site when working and loading of animals. Children under the age of 12 in the non-working area must be accompanied by an adult at either location at all times.

BIOSECURITY

A. Health records for all saddle and pilot horses used on WH&B gathers must be provided to the LCOR during the BLM/Contractor pre-work meeting, including:

1. Certificate of Veterinary Inspection (Health Certificate, within 30 days).
2. Proof of:
    a. A negative test for equine infectious anemia (Coggins or EIA ELISA test) within 12 months.
    b. Vaccination for tetanus, eastern and western equine encephalomyelitis, West Nile virus, equine herpes virus, influenza, *Streptococcus equi*, and rabies within 12 months.

B. Saddle horses and pilot horses must not be removed from the gather operation (such as for an equestrian event) and allowed to return unless they have been observed to be free from signs of infectious disease for a period of at least three weeks and a new Certificate of Veterinary Inspection is obtained after three weeks and prior to returning to the gather.

C. WH&B's, saddle horses, and pilot horses showing signs of infectious disease must be examined by the on-site/on-call veterinarian.

1. Any saddle or pilot horses showing signs of infectious disease (fever, nasal discharge or illness) must be removed from service and isolated from other animals on the gather until such time as the horse is free from signs of infectious disease and approved by the on-site/on-call veterinarian to return to the gather.
2. WH&B's showing signs of infectious disease will normally not be mixed with groups of healthy WH&B's at the temporary holding facility, or during transport..

PUBLIC AND MEDIA INTERACTION

a. Due to heightened public interest in wild horse and burro gathers, the BLM expects an increasing number of requests from the public and media to view the operation. All requests received by the Contractor to view gather operation shall be forwarded to the BLM, who will provide a person with the expertise necessary to escort the public and media. The safety of the WHB's, BLM employees, Contractor crew, Contractor's private animals, and the media and public will be the first priority in determining whether a viewing opportunity will be provided, and if so, the time, location, and conditions associated with the viewing opportunity.

b. Assuming the BLM determines that providing a viewing opportunity for the media and the public is appropriate, the Contractor will establish the viewing area in accordance with instructions from the LCOR/COR/PI and current wild horse and burro program policy and guidance. BLM's observation policy will be discussed with the contractor during the pre-work meeting.

c. Member(s) of the viewing public or media whose conduct interferes with the gather operation in a way that threatens the safety of the WH&B's, BLM employees, contractor crew (including animals), the media, or the public will be warned once to terminate the conduct. If the conduct persists, the offending individual(s) will be asked to leave the viewing area and the gather operation. The LCOR/COR/PI may direct the Contractor to temporarily shut down the gather operation until the situation is resolved.

d. Under no circumstances will the public or any media or media equipment be allowed in or on the gather helicopter or on the trap or holding equipment. The public, media, and media equipment must be at least 500 feet away from the trap during the trapping operation.

e. The public and media may be escorted closer than 500 feet to the trap site if approved by the LCOR/COR and in consultation with the Contractor during the time between gather runs or before or after the gather operation.

f. The Contractor shall not release any information to the news media or the public regarding the activities being conducted under this contract. All communications regarding BLM WH&B management, including but not limited to media, public and local stakeholders, are to come from the BLM unless it expressly authorizes the Contractor to give interviews, etc.

CONTRACTOR-FURNISHED PROPERTY
a. As specified herein, it is the contractor's responsibility to provide all necessary support equipment and vehicles including weed seed free hay and water for the captured animals and any other items, personnel, vehicles (which shall include good condition trucks and stock trailers to haul horses and burros from the trap site to the holding facility and two tractor trailers in good condition to haul horses from the holding facility to the preparation facility), saddle horses, etc. to support the humane and compassionate capture, care, feeding, transportation, treatment, and as appropriate, release of WHB's. Other equipment includes but is not limited to, a minimum 2,500 linear feet of 72-inch high (minimum height) panels for horses or 60-inch high (minimum height) for burros for traps and holding facilities. Separate water troughs shall be provided at each pen where animals are being held meeting the standards in section C.6. Water troughs shall be constructed of such material (e.g., rubber, galvanized metal with rolled edges, rubber over metal) so as to avoid injury to the animals.

b. The Contractor shall provide a radio transceiver to insure communications are maintained with the BLM project PI when driving or transporting the wild horses/burros. The contractor needs to insure communications can be made with the BLM and be capable of operating in the 150 MHz to 174 MHz frequency band, frequency synthesized, CTCSS 32 sub-audible tone capable, operator programmable, 5kHz channel increment, minimum 5 watts carrier power.

c. The Contractor shall provide water and weed seed free hay.

d. The proper operation, service and maintenance of all contractor furnished property is the responsibility of the Contractor.

BLM ROLES AND RESPONSIBILITIES

a. Veterinarian
1. On-site veterinary support must be provided for all helicopter gathers.

2. Veterinary support will be under the direction of the LCOR/COR/PI. Upon request, the on-site/on-call veterinarian will consult with the LCOR/COR/PI on matters related to WH&B health, handling, welfare and euthanasia. All final decisions regarding medical treatment or euthanasia will be made by the on-site LCOR/COR/PI based on recommendations from the on-site veterinarian.

b. Transportation
1. The LCOR/COR/PI shall consider the condition and size of the animals, weather conditions, distance to be transported to the final destination or release, recommendations from the contractor and on-site veterinarian and other factors when planning for the movement of captured animals. The LCOR/COR/PI shall provide for any brand inspection services required for the movement of captured animals to BLM prep facilities. If animals are to be transported over state lines the LCOR will be responsible for obtaining a waiver from the receiving State Veterinarian.

2. If the LCOR/COR/PI determines that conditions are such that the animals could be endangered during transportation, the Contractor will be instructed to adjust speed or delay transportation until conditions improve.

GOVERNMENT FURNISHED EQUIPMENT/SUPPLIES/MATERIALS
a. The government will provide:

1. A portable restraining chute for each contractor to be used for the purpose of restraining animals to determine the age of specific individuals or other similar procedures. The contractor will be responsible for the maintenance of the portable restraining chute during the gather season.
2. All inoculate syringes, freezemarking equipment, and all related equipment for fertility control treatments.
3. A boat to transport burros as appropriate.
4. Sleds, slide boards, or slip sheets for loading of recumbent animals.

b. The Contractor shall be responsible for the security of all Government Furnished Property.

SITE CLEARANCES
a. Prior to setting up a trap or temporary holding facility, BLM will conduct all necessary legal reviews and clearances (NEPA, ARPA, NHPA, etc.). All proposed site(s) must be inspected by a government archaeologist. Once archaeological clearance has been obtained, the trap or temporary holding facility may be set up. Said clearance shall be coordinated and arranged for by the COR/ PI, or other BLM employees.

Water and Bait Trapping Standard Operating Procedures
The work consists of the capture, handling, care, feeding, daily rate and transportation of wild horses and/or burros from the States of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah and Wyoming. The method of capture will be with the use of bait and/or water traps in accordance with the standards identified in the Comprehensive Animal Welfare Program (CAWP) for Wild horse and Burro Gathers, Bureau of Land Management (BLM) Instruction Memorandum 2015-151 (Attachment 1). Items listed in the sections of the Statement of Work (SOW) either are not covered or deviate from the CAWP, the SOW takes precedence over the CAWP when there is conflicting information. Extended care, handling and animal restraint for purposes of population growth suppression treatments may be required for some trapping operations. The contractor shall furnish all labor, supplies, transportation and equipment necessary to accomplish the individual task order requirements with the exception of a Government provided restraint fly chute, as needed for population growth suppression. The work shall be accomplished in a safe and humane manner and be in accordance with the provisions of 43 CFR Part 4700, the CAWP, the specifications and provisions included in this SOW, and any subsequent SOW documents issued with individual task orders. The primary concern of the contractor shall be the safety of all personnel involved and the humane capture and handling of all wild horses and burros. It is the responsibility of the contractor to provide appropriate safety and security measures to prevent loss, injury or death of captured wild horses and burros.

Any reference to hay in this SOW or subsequent SOW documents issued with individual task orders will be implied as certified weed-free hay (grass or alfalfa). The contractor will be responsible for providing certifications upon request from the Government. The COR/PI’s will observe a minimum of at least 25 percent of the trapping activity. BLM reserves the right to place game cameras or other cameras in the capture area to document animal activity and response, capture techniques and procedures, and humane care during trapping. No private/non-BLM camera will be placed within the capture areas.

Trapping activities would be on the HA/HMA/WHBT or outside areas specified in the task order. However, trapping could be required on adjacent land, federal, state, tribal, military, or private property.

If trapping operations include work on military and/or other restricted areas, the BLM will coordinate all necessary clearances, such as background checks, to conduct operations for equipment and personnel.

The permissions to use private/state/tribal lands during task order performance will be coordinated by the BLM, contractor, and landowner. The need for these permissions will be identified in the Task Order SOW and will be obtained in writing.

Prior to any gathering operation, the BLM will provide for a pre-capture evaluation of existing conditions in the gather area(s). The evaluation will include animal conditions, prevailing temperatures, drought conditions, soil conditions, road conditions, and preparation of a topographic map with wilderness boundaries, the location of fences, other physical barriers, and acceptable gather site locations in relation to animal distribution. The evaluation will determine whether the proposed activities will necessitate the presence of a veterinarian during operations. If it is determined that capture operations necessitate the services of a veterinarian, one would be obtained before the capture would proceed. The contractor will be apprised of all conditions and will be given instructions regarding the capture and handling of animals to ensure their health and welfare is protected.

Gather sites and temporary holding sites will be located to reduce the likelihood of undue injury and stress to the animals, and to minimize potential damage to the natural and cultural resources of the area. Temporary holding sites would be located on or near existing roads.

Bait Trapping - Facility Design (Temporary Holding Facility Area and Traps)
All trap and temporary holding facility areas locations must be approved by the COR and/or the Project Inspector (PI) prior to construction and/or operation. The contractor may also be required to change or move trap locations as determined by the COR/PI. All traps and temporary holding facilities not located on public land must have prior written approval of the landowner or other management agency.

Facility design to include traps, wings, alleys, handling pens, finger gates, and temporary holding facilities, etc. shall be constructed, maintained and operated to handle the wild horses and burros in a safe and humane manner in accordance with the standards identified in the Comprehensive Animal Welfare Program (CAWP) for Wild Horse and Burro Gathers, Bureau of Land Management (BLM) Instruction Memorandum 2015-151 (Attachment 1).

Some gather operations will require the construction of an off-site temporary holding facility as identified in specific individual task orders for extended care and handling for purposes of slow trapping conditions or management activities such as research, population growth suppression treatments, etc.

No modification of existing fences will be made without authorization from the COR/PI. The contractor shall be responsible for restoring any fences that are modified back to the original condition.

Temporary holding and sorting pens shall be of sufficient size to prevent injury due to fighting and trampling. These pens shall also allow for captured horses and burros to move freely and have adequate access to water and feed.

All pens will be capable of expansion when requested by the COR/PI.

Separate water troughs shall be provided for each pen where wild horses and burros are being held. Water troughs shall be constructed of such material (e.g., rubber, plastic, fiberglass, galvanized metal with rolled edges, and rubber over metal) so as to avoid injury to the wild horses and burros.

Any changes or substitutions to trigger and/or trip devices previously approved for use by the Government must be approved by the COR prior to use.

Bait Trapping, Animal Care, and Handling
If water is to be used as the bait agent and the Government determines that cutting off other water sources is the best action to take under the individual task order, elimination of other water sources shall not last longer than a period of time approved by the COR/PI.

Hazing/Driving of wild horses and burros for the purpose of trapping the animals will not be allowed for the purposes of fulfilling individual task orders. Roping will be utilized only as directed by the COR.

Darting of wild horses and burros for trapping purposes will not be allowed.

No barbed wire material shall be used in the construction of any traps or used in new construction to exclude horses or burros from water sources.

Captured wild horses and burros shall be sorted into separate pens (i.e. by age, gender, animal health/condition, population growth suppression, etc.).

A temporary holding facility area will be required away from the trap site for any wild horses and burros that are being held for more than 24 hours.

The contractor shall assure that captured mares/jennies and their dependent foals shall not be separated for more than 4 hours, unless the COR/PI determines it necessary.

The contractor shall provide a saddle horse on site that is available to assist with the pairing up of mares/jennies with their dependent foals and other tasks as needed.

Contractor will report any injuries/deaths that resulted from trapping operations as well as preexisting conditions to the COR/PI within 12 hours of capture and will be included in daily gather activity report to the COR.

The COR/PI may utilize contractor constructed facilities when necessary in the performance of individual task orders for such management actions as population growth suppression, and/or selecting animals to return to the range.

In performance of individual task orders, the contractor may be directed by the COR to transport and release wild horses or burros back to the range.

At the discretion of the COR/PI the contractor may be required to delay shipment of horses until the COR/PI inspects the wild horses and burros at the trap site and/or the temporary holding facility prior to transporting them to the designated facility.

Wild Horse and Burro Care and Biosecurity
The contractor shall restrain sick or injured wild horses and burros if treatment is necessary in consultation with the COR/PI and/or veterinarian.

Any saddle or pilot horses used by the contractor will be vaccinated within 12 months of use (EWT, West Nile, Flu/rhino, strangles).

Transportation and Animal Care
The contractor, following coordination with the COR, shall schedule shipments of wild horses and burros to arrive during the normal operating hours of the designated facility unless prior approval has been obtained from the designated facility manager by the COR. Shipments scheduled to arrive at designated facilities on a Sunday or a Federal holiday requires prior facility personnel approval.

All motorized equipment employed in the transportation of captured wild horses and burros shall be incompliance with appropriate State and Federal laws and regulations.

Sides or dividers of all trailers used for transporting wild horses and burros shall be a minimum height of 6 feet 6 inches from the floor. A minimum of one full height partition is required in each stock trailer. All trailers shall be covered with solid material or bars to prevent horses from jumping out.

The contractor shall consider the condition and size of the wild horses and burros, weather conditions, distance to be transported, or other factors when planning for the movement of captured wild horses and burros.

The Government shall provide for any brand and/or veterinary inspection services required for captured wild horses and burros. Prior to shipping across state lines the Government will be responsible for coordinating with the receiving state veterinarian to transport the animals without a health certificate or coggins test. If the receiving state does not agree to grant entry to animals without a current health certificate or coggins test, the Government will obtain them prior to shipment.

When transporting wild horses and burros, drivers shall inspect for downed animals a minimum of every two hours when travelling on gravel roads or when leaving gravel roads onto paved roads and a minimum of every four hours when travelling on paved roads. a)

Euthanasia or Death
The COR/PI will determine if a wild horse or burro must be euthanized and will/may direct the contractor to destroy the animal in accordance with the BLM Animal Health, Maintenance, Evaluation, and Response Instruction Memorandum, 2015-070 (Attachment 2). Any contractor personnel performing this task shall be trained as described in this Memorandum.

Pursuant to the IM 2015-070 the contractor may be directed by the Authorized Officer and/or COR to humanely euthanize wild horses and burros in the field and to dispose of the carcasses in accordance with state and local laws.

Safety and Communication
The nature of work performed under this contract may involve inherently hazardous situations. The primary concern of the contractor shall be the safety of all personnel involved and the humane handling of all wild horses and burros. It is the responsibility of the contractor to provide appropriate safety and security measures to prevent loss, injury or death of captured wild horses and burros until delivery to the final destination.

The BLM reserves the right to remove from service immediately any contractor personnel or contractor furnished equipment which, in the opinion of the COR and/or CO violate contract rules, are unsafe or otherwise unsatisfactory. In this event, BLM will notify the contractor to furnish replacement personnel or equipment within 24 hours of notification. All such replacements must be approved in advance by the COR and/or CO.

Contractor personnel who utilize firearms for purposes of euthanasia will be required to possess proof of completing a State or National Rifle Association firearm safety certification or equivalent (conceal carry, hunter safety, etc.).

All accidents involving wild horses and burros or people that occur during the performance of any task order shall be immediately reported to the COR/PI.

The contractor shall have the means to communicate with the COR/PI and all contractor personnel engaged in the capture of wild horses and burros utilizing a cell/satellite phone or radio at all times during the trapping operations. The Contractor will be responsible for furnishing all communication equipment for contractor use. BLM will provide the frequency for radio communications.

The contractor will provide daily gather activity reports to the COR/PI if they are not present.

Public and Media
Due to increased public interest in the Wild Horse and Burro Gathers, any media or visitation requests received by the contractor shall be forwarded to the COR immediately. Only the COR or CO can approve these requests.

The Contractor shall not post any information or images to social media networks or release any information to the news media or the public regarding the activities conducted under this contract.

If the public or media interfere in any way with the trapping operation, such that the health and well-being of the crew, or horses and burros are threatened, the contractor will immediately report the incident to the COR and trapping operations will be suspended until the situation is resolved as directed by the COR.

1. All motorized equipment employed in the transportation of captured animals shall be in compliance with appropriate State and Federal laws and regulations applicable to the humane transportation of animals. The Contractor shall provide the COR/PI with a current safety inspection (less than one year old) for all motorized equipment and tractor-trailers used to transport animals to final destination.

2. All motorized equipment, tractor-trailers, and stock trailers shall be in good repair, of adequate rated capacity, and operated so as to ensure that captured animals are transported without undue risk or injury.

3. Only tractor-trailers or stock trailers with a covered top shall be allowed for transporting animals from gather site(s) to temporary holding facilities and from temporary holding facilities to final destination(s). Sides or stock racks of all trailers used for transporting animals shall be a minimum height of 6 feet 6 inches from the floor. Single deck tractor-trailers 40 feet or longer shall have two (2) partition gates providing three (3) compartments within the trailer to separate animals. Tractor-trailers less than 40 feet shall have at least one partition gate providing two (2) compartments within the trailer to separate the animals. Compartments in all tractor-trailers shall be of equal size plus or minus 10 percent. Each partition shall be a minimum of 6 feet high and shall have a minimum 5 foot wide swinging gate. The use of double deck tractor-trailers is unacceptable and shall not be allowed.

4. All tractor-trailers used to transport animals to final destination(s) shall be equipped with at least one (1) door at the rear end of the trailer which is capable of sliding either horizontally or vertically. The rear door(s) of tractor- trailers and stock trailers must be capable of opening the full width of the trailer. Panels facing the inside of all trailers must be free of sharp edges or holes that could cause injury to the animals. The material facing the inside of all trailers must be strong enough so that the animals cannot push their

hooves through the side. Final approval of tractor-trailers and stock trailers used to transport animals shall be held by the COR/PI.

5. Floors of tractor-trailers, stock trailers and loading chutes shall be covered and maintained with wood shavings to prevent the animals from slipping.

6. Animals to be loaded and transported in any trailer shall be as directed by the COR/PI and may include limitations on numbers according to age, size, sex, temperament and animal condition. The following minimum square feet per animal shall be allowed in all trailers:

a. 11 square feet per adult horse (1.4 linear foot in an 8 foot wide trailer);
b. 8 square feet per adult burro (1.0 linear foot in an 8 foot wide trailer);
c. 6 square feet per horse foal (.75 linear foot in an 8 foot wide trailer);
d. 4 square feet per burro foal (.50 linear feet in an 8 foot wide trailer).

7. The COR/PI shall consider the condition and size of the animals, weather conditions, distance to be transported, or other factors when planning for the movement of captured animals. The COR/PI shall provide for anybrand and/or inspection services required for the captured animals.
8. If the COR/PI determines that dust conditions are such that the animals could be endangered during transportation, the Contractor will be instructed to adjust speed.

Safety and Communications
1. The Contractor shall have the means to communicate with the COR/PI and all contractor personnel engaged in the capture of wild horses and burros utilizing a VHF/FM Transceiver or VHF/FM portable Two-Way radio. If communications are ineffective the government will take steps necessary to protect the welfare of the animals.

a. The proper operation, service and maintenance of all contractor furnished property are the responsibility of the Contractor. The BLM reserves the right to remove from service any contractor personnel or contractor furnished equipment which, in the opinion of the contracting officer or COR/PI violate contract rules, are unsafe or otherwise unsatisfactory. In this event, the Contractor will be notified in writing to furnish replacement personnel or equipment within 48 hours of notification. All such replacements must be approved in advance of operation by the Contracting Officer or his/her representative.
b. The Contractor shall obtain the necessary FCC licenses for the radio system
c. All accidents occurring during the performance of any task order shall be immediately reported to the COR/PI.

Public and Media
Due to heightened public interest in wild horse and burro gathers, the BLM/Contractor may expect an increasing number of requests from the public and media to view the operation.

1. Due to this type of operation (luring wild horses and burros to bait) spectators and viewers will be prohibited as it will have impacts on the ability to capture wild horses and burros. Only essential personnel (COR/PI, veterinarian, contractor, contractor employees, etc.) will be allowed at the trap site during operations.

2. Public viewing of the wild horses and burros trapped may be provided at the staging area and/or the BLM preparation facility by appointment.

3. The Contractor agrees that there shall be no release of information to the news media regarding the removal or remedial activities conducted under this contract.

4. All information will be released to the news media by the assigned government public affairs officer.

5. If the public or media interfere in any way with the trapping operation, such that the health and wellbeing of the crew, horses and burros is threatened, the trapping operation will be suspended until the situation is resolved.

COR/PI Responsibilities
a. In emergency situations, the COR/PI will implement procedures to protect animals as rehab is initiated, i.e. rationed feeding and watering at trap and or staging area.

b. The COR/PI will authorize the contractor to euthanize any wild horse or burros as an act of mercy.

c. The COR/PI will ensure wild horses or burros with pre-existing conditions are euthanized in the field according to BLM policy.

d. Prior to setting up a trap or staging area on public land, the BLM and/or Forest Service will conduct all necessary clearances (archaeological, T&E, etc.). All proposed sites must be inspected by a government archaeologist or equivalent. Once archaeological clearance has been obtained, the trap or staging area may be set up. Said clearances shall be arranged for by the COR/PI.

e. The COR/PI will provide the contractor with all pertinent information on the areas and wild horses and burros to be trapped.

f. The COR/PI will be responsible to establish the frequency of communicating with the contractor.

g. The COR/PI shall inspect trap operation prior to Contractor initiating trapping.

h. The Contractor shall make all efforts to allow the COR/PI to observe a minimum of at least 25 percent of the trapping activity.

i. The COR/PI is responsible to arrange for a brand inspector and/or veterinarian to inspect all wild horses and burros prior to transporting to a BLM preparation facility when legally required.

j. The COR/PI will be responsible for the establishing a holding area for administering PZP, gelding of stallions, holding animals in poor condition until they are ready of shipment, holding for EIA testing, etc.

k. The COR/PI will ensure the trailers are cleaned and disinfected before WH&B's are transported. This will help prevent transmission of disease into our populations at a BLM Preparation Facility.

Responsibility and Lines of Communication
The Wild Horse Specialist (COR) or delegate has direct responsibility to ensure human and animal safety. The Field Manager will take an active role to ensure that appropriate lines of communication are established between the field, field office, state office, national program office, and BLM holding facility offices.

All employees involved in the gathering operations will keep the best interests of the animals at the forefront at all times.

All publicity and public contact and inquiries will be handled through the Office of Communications. These individuals will be the primary contact and will coordinate with the COR on any inquiries.

The BLM delegate will coordinate with the off range corrals to ensure animals are being transported from the capture site in a safe and humane manner and are arriving in good condition.

The BLM require humane treatment and care of the animals during removal operations. These specifications are designed to minimize the risk of injury and death during and after capture of the animals. The specifications will be vigorously enforced.

Resource Protection
Gather sites and holding facilities would be located in previously disturbed areas whenever possible to minimize potential damage to the natural and cultural resources.

Gather sites and temporary holding facilities would not be constructed on wetlands or riparian zones.

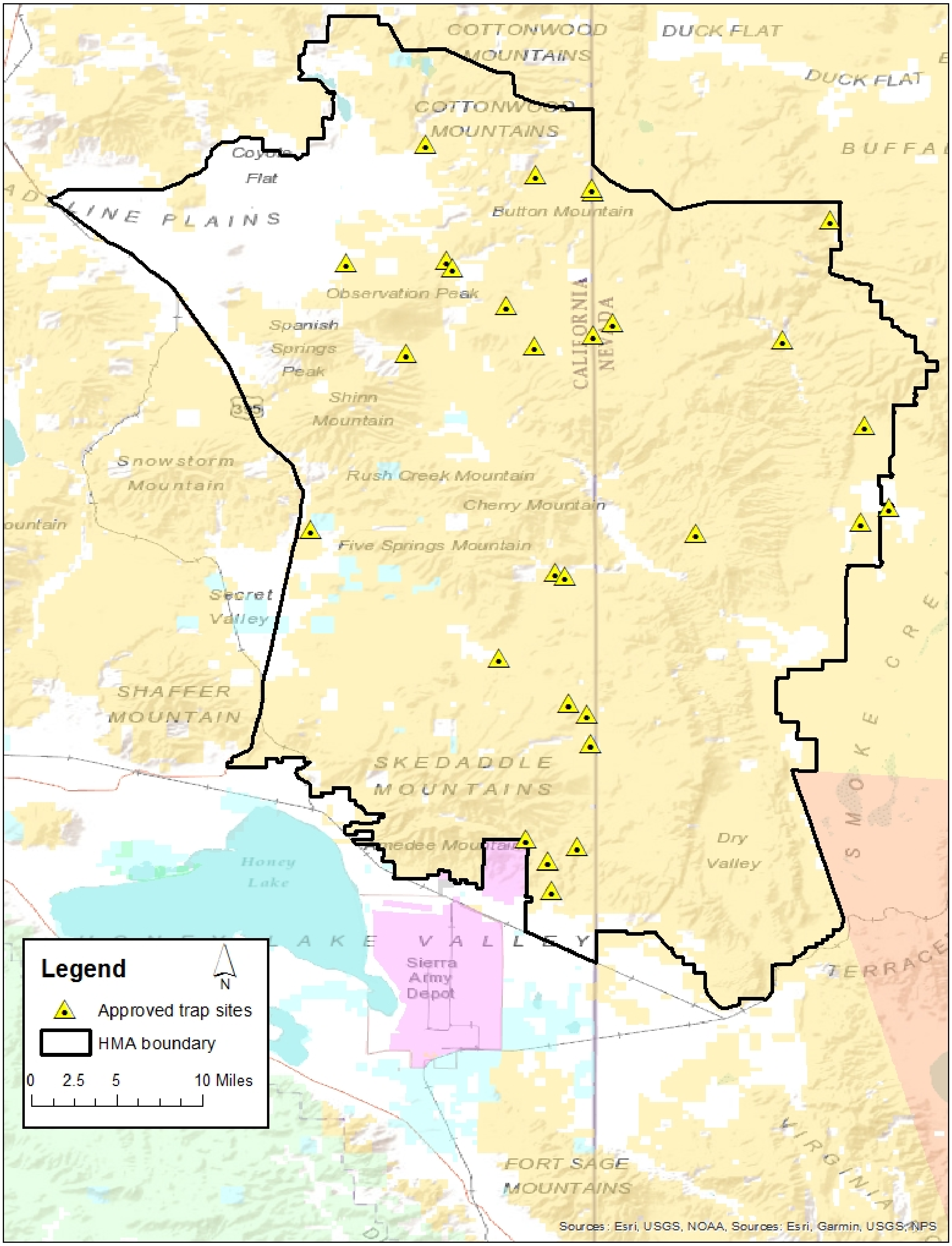
Prior to implementation of gather operations, gather sites and temporary holding facilities would be evaluated to determine their potential for containing cultural resources. All gather facilities (including gather sites, gather run- ways, blinds, holding facilities, camp locations, parking areas, staging areas, etc.) that would be located partially or totally in new locations (i.e. not at previously used gather locations) or in previously undisturbed areas would be inventoried by a BLM archaeologist or Field Office archaeological technician before initiation of the gather. A buffer of at least 30 meters would be maintained between gather facilities and any identified cultural resources.

Gather sites and holding facilities would not be placed in known areas of Native American concern.

The contractor would not disturb, alter, injure or destroy any scientifically important paleontological remains; any historical or archaeological site, structure, building, grave, object or artifact; or any location having Native American traditional or spiritual significance within the project area or surrounding lands. The contractor would be responsible for ensuring that its employees, subcontractors or any others associated with the project do not collect artifacts and fossils, or damage or vandalize archaeological, historical or paleontological sites or the artifacts within them.

Should damage to cultural or paleontological resources occur during the period of gather due to the unauthorized, inadvertent or negligent actions of the contractor or any other project personnel, the contractor would be responsible for costs of rehabilitation or mitigation. Individuals involved in illegal activities may be subject to penalties under the Archaeological Resources Protection

Appendix D. Map of Previous Trap Site Locations



Appendix E. Fertility Control Treatment Standard Operating Procedures (SOPs)

The following management and monitoring requirements are part of the Proposed Action and Alternative 2:

1. PZP vaccine would be administered by trained BLM personnel.

2. The fertility control drug is administered with two separate injections: (1) a liquid dose of PZP is administered using an 18-gauge needle primarily by hand injection; (2) the pellets are preloaded into a 14-gauge needle. These are loaded on the end of a trocar (dry syringe with a metal rod) which is loaded into the jab-stick which then pushes the pellets into the breeding mares being returned to the range. The pellets and liquid are designed to release the PZP over time similar to a time release cold capsule.

3. Delivery of the vaccine would be as an intramuscular injection while the mares are restrained in a working chute. Half a cubic centimeter (cc) of the PZP vaccine would be emulsified with half a cc of adjuvant (a compound that stimulates antibody production) and loaded into the delivery system. The pellets would be loaded into the jab-stick for the second injection. With each injection, the liquid and pellets would be propelled into the left hindquarters of the mare, just below the imaginary line that connects the point of the hip and the point of the buttocks.

4. All treated mares would be freezemarked on the hip to enable researchers to positively identify the animals during the research project as part of the data collection phase.

5. At a minimum, monitoring of reproductive rates using helicopter flyovers will be conducted in years two through four by checking for the presence or absence of foals. The flight scheduled for year four will also assist in determining the percentage of mares that have returned to fertility. In addition, field monitoring will be routinely conducted as part of other regular ground-based monitoring activities.

6. A field data sheet will be used by the field applicators to record all the pertinent data relating to identification of the mare including a photograph when possible, date of treatment, type of treatment (1 or 2 year vaccine, adjuvant used) and HMA. The original form with the data sheets will be forwarded to the Authorized Officer at National Program Office (NPO) in Reno, Nevada. A copy of the form and data sheets and any photos taken will be maintained at the district office.

7. A tracking system will be maintained by NPO detailing the quantity of PZP issued, the quantity used, and disposition of any unused PZP, the number of treated mares by HMA, district office, and state along with the freezemark applied by HMA.

8. The field office will assure that treated mares do not enter the adoption market for 3 years following treatment. In the rare instance, due to unforeseen circumstance, treated mare(s) are removed from an HMA before 3 years has lapsed, they will be maintained in either a BLM facility or BLM-contracted Long-Term Pastures (LTPs) until expiration of the 3-year holding period. In the event it is necessary to remove treated mares, their removal and disposition will be coordinated through NPO. After expiration of the 3-year holding period, the animal may be placed in the adoption program or sent to long-term pastures.

Appendix F. Standard Operating Procedures for Field Castration (Gelding) of Stallions

Gelding will be performed with general anesthesia and by a veterinarian. The combination of pharmaceutical compounds used for anesthesia, method of physical restraint, and the specific surgical technique used will be at the discretion of the attending veterinarian with the approval of the authorized officer (I.M. 2009-063).

Pre-surgery Animal Selection, Handling and Care

1. Stallions selected for gelding will be greater than 6 months of age and less than 20 years of age.
2. All stallions selected for gelding will have a Henneke body condition score of 3 or greater. No animals which appear distressed, injured or in failing health or condition will be selected for gelding.
3. Stallions will not be gelded within 36 hours of capture and no animals that were roped during capture will be gelded at the temporary holding corrals for rerelease.
4. Whenever possible, a separate holding corral system will be constructed on site to accommodate the stallions that will be gelded. These gelding pens will include a minimum of 3 pens to serve as a working pen, recovery pen(s), and holding pen(s). An alley and squeeze chute built to the same specifications as the alley and squeeze chutes used in temporary holding corrals (solid sides in alley, minimum 30 feet in length, squeeze chute with non-slip floor) will be connected to the gelding pens.
5. When possible, stallions selected for gelding will be separated from the general population in the temporary holding corral into the gelding pens, prior to castration.
6. When it is not possible or practical to build a separate set of pens for gelding, the gelding operation will only proceed when adequate space is available to allow segregation of gelded animals from the general population of stallions following surgery. At no time will recently anesthetized animals be returned to the general population in a holding corral before they are fully recovered from anesthesia.
7. All animals in holding pens will have free access to water at all times. Water troughs will be removed from working and recovery pens prior to use.
8. Prior to surgery, animals in holding pens may be held off feed for a period of time (typically 12-24 hours) at the recommendation and direction of the attending veterinarian.
9. The final determination of which specific animals will be gelded will be based on the professional opinion of the attending veterinarian in consultation with the Authorized Officer.
10. Whether the procedure will proceed on a given day will be based on the discretion of the attending veterinarian in consultation with the Authorized Officer taking into consideration the prevailing weather, temperature, ground conditions and pen set up. If these field situations can’t be remedied, the procedure will be delayed until they can be, the stallions will be transferred to a prep facility, gelded, and later returned, or they will be released to back to the range as intact stallions.

Gelding Procedure

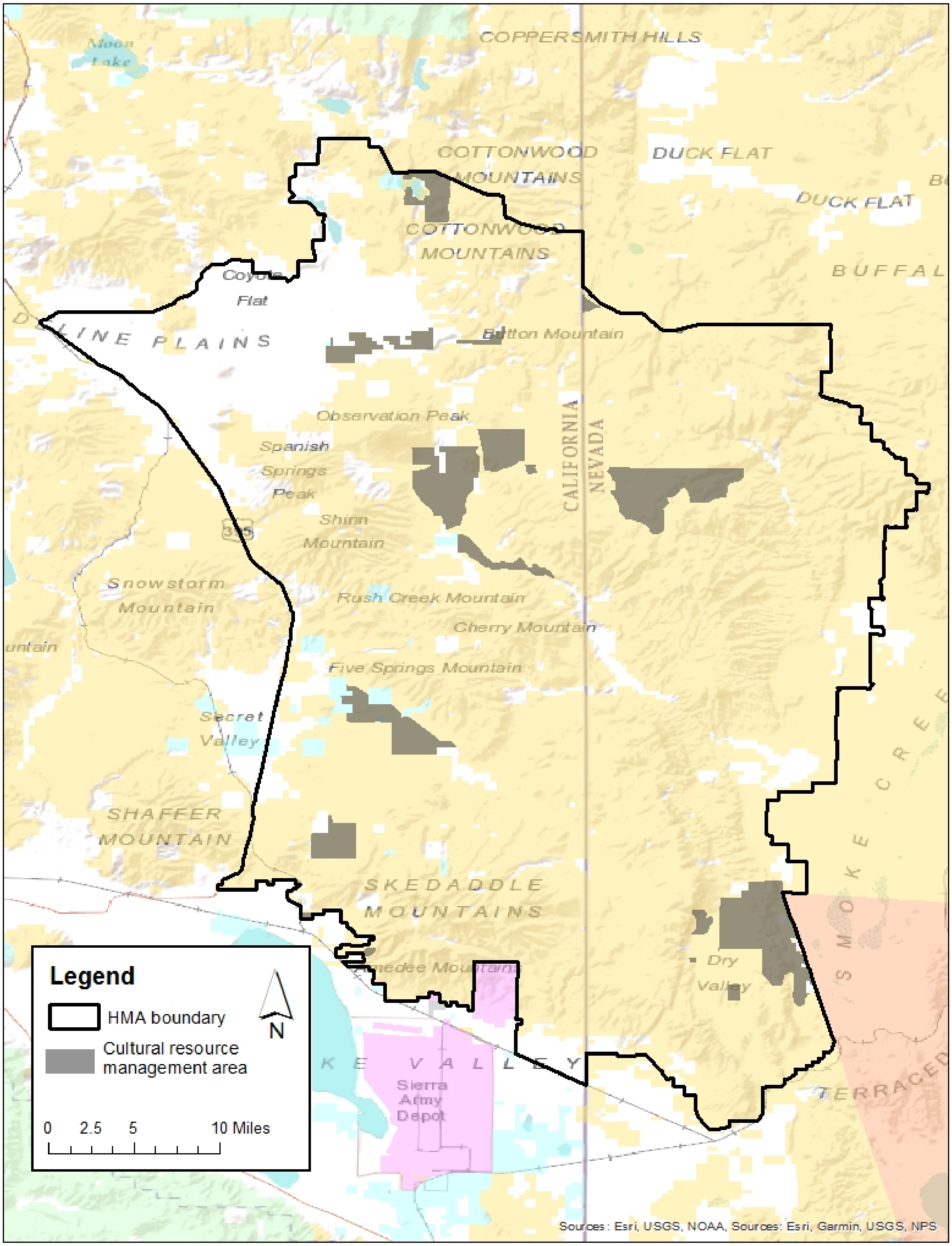
1. All gelding operations will be performed under a general anesthetic administered by a qualified and experienced veterinarian. Stallions will be restrained in a portable squeeze chute to allow the veterinarian to administer the anesthesia.
2. The anesthetics used will be based on a Xylazine/ketamine combination protocol. Drug dosages and combinations of additional drugs will be at the discretion of the attending veterinarian.
3. Animals may be held in the squeeze chute until the anesthetic takes effect or may be released into the working pen to allow the anesthesia to take effect. If recumbency and adequate anesthesia is not achieved following the initial dose of anesthetics, the animal will either be redosed or the surgery will not be performed on that animal at the discretion of the attending veterinarian.
4. Once recumbent, rope restraints or hobbles will be applied for the safety of the animal, the handlers and the veterinarian.
5. The specific surgical technique used will be at the discretion of the attending veterinarian.
6. Flunixin meglamine or an alternative analgesic medication will be administered prior to recovery from anesthesia at the professional discretion of the attending veterinarian.
7. Tetanus prophylaxis will be administered at the time of surgery.

The animal would be sedated then placed under general anesthesia. Ropes are placed on one or more limbs to help hold the animal in position and the anesthetized animals are placed in either lateral or dorsal recumbency. The surgical site is scrubbed and prepped aseptically. The scrotum is incised over each testicle, and the testicles are removed using a surgical tool to control bleeding. The incision is left open to drain. Each animal would be given a Tetanus shot, antibiotics, and an analgesic.

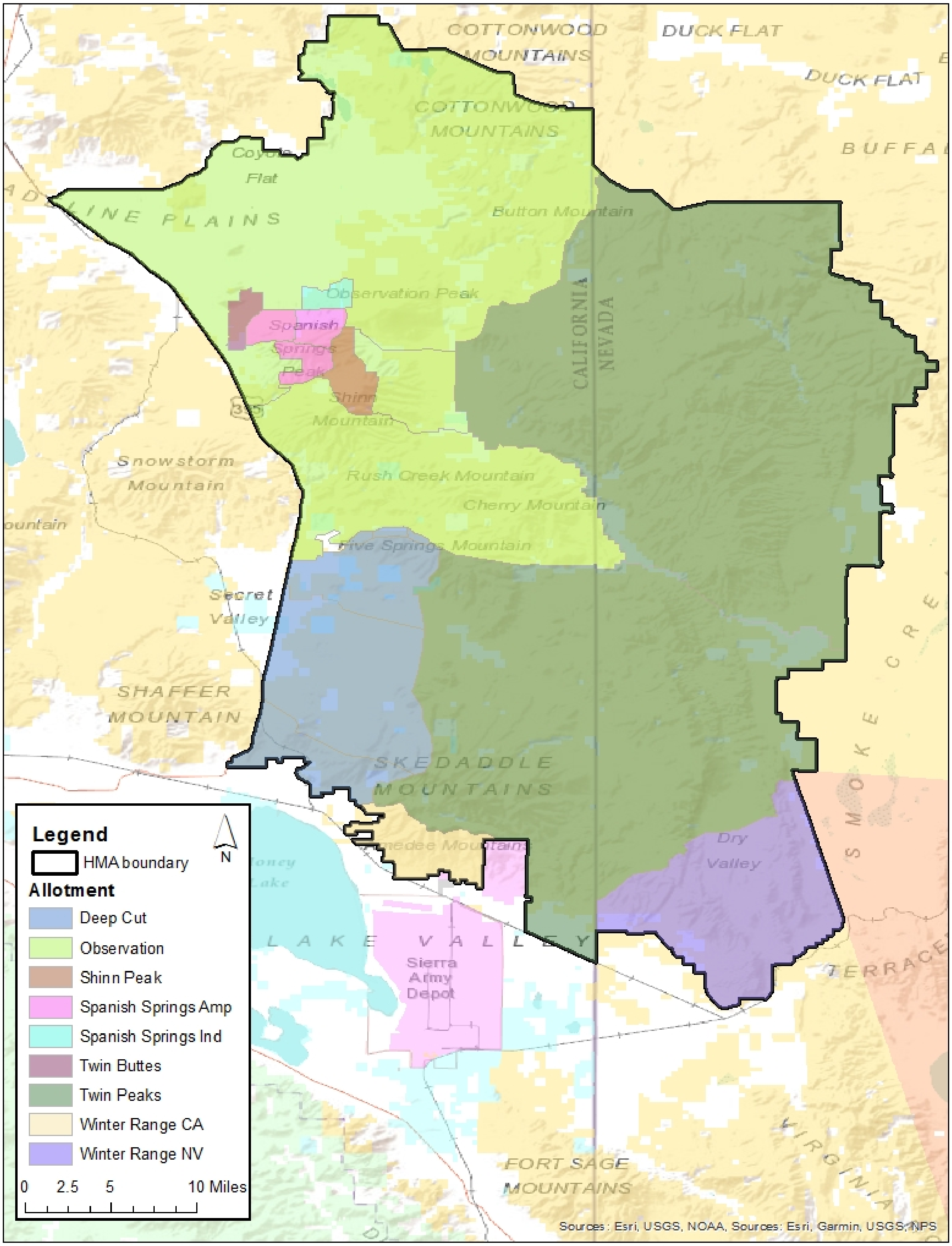
Any males that have inguinal or scrotal hernias would be removed from the population, sent to a regular BLM facility and be treated surgically as indicated, if possible, or euthanized if they have a poor prognosis for recovery (IM 2009-041, IM 2009-063). Horses with only one descended testicle may be removed from the population and managed at a regular BLM facility according to BLM policy or anesthetized with the intent to locate the undescended testicle for castration. If an undescended testicle cannot be located, the animal may be recovered and removed from the population if no surgical exploration has started. Once surgical exploration has started, those that cannot be completely castrated would be euthanized prior to recovering them from anesthesia according to BLM policy (IM 2009-041, IM 2009-063). All animals would be rechecked by a veterinarian the day following surgery. Those that have excessive swelling, are reluctant to move or show signs of any other complications would be held in captivity and treated accordingly. Once released no further veterinary interventions would be possible.

Selected stallions would be shipped to the facility, gelded, and returned to the range within 30 days. Gelded animals could be monitored periodically for complications for approximately 7-10 days following release. In the proposed alternatives, gelding is not part of a research study, but additional monitoring on the range could be completed either through aerial reconnaissance, if available, or field observations from major roads and trails. It is not anticipated that all the geldings would be observed but if the goal is to detect complications on the range, then this level of casual observation may help BLM determine if those are occurring. Periodic observations of the long term outcomes of gelding could be recorded during routine resource monitoring work. Such observations could include but not be limited to band size, social interactions with other geldings and harem bands, distribution within their habitat, forage utilization and activities around key water sources. Periodic population inventories and future gather statistics could provide additional anecdotal information about how logistically effective it is to manage a portion of the herd as non-breeding animals.

Appendix G. Map of Cultural Resource Management Areas within the Twin Peaks HMA



Appendix H. Map of Grazing Allotments within the Twin Peaks HMA



Appendix I. Grazing Management Actions between 1990 and 2019

Livestock Grazing Allotment Name	Reduction in Livestock AUMs	Increase of Livestock AUMs	Change in Season of Use/ Livestock Class	Change in Grazing Strategy	Riparian Area Restrictions/ Other Restrictions
Twin Peaks	0	0	Current:4/01-1/31 Defer one pasture until 07/01 each year Past: 3/01-12/31; No deferment	Management of 15 grazing sub-units; Alternate annual turnout locations; Movement of livestock based on utilization levels	10 riparian areas excluded from livestock by fencing; 18 spring exclosures; Fencing along 7 miles of Upper Smoke Creek to exclude livestock and horses; Restrictions on areas for sheep grazing
Observation	Cattle – reduced by 298 AUMs Allotment was temporarily closed to cattle grazing in 2000 and 2004 due to wildfire	0	NA	Current: Deferred Rotation System Past: 3-Pasture Rest Rotation	Planned fencing for 15 riparian areas to exclude livestock and horses.
Deep Cut	0	0	Current: 4/1-6/15 (75 days) Past: 4/16-10/31 (195 days)	Current: 3-Pasture Rest Rotation Past: Rotation System	Riparian Restrictions
Winter Range Nevada	0	0	Current: 40 cattle 03/01-03/31, 11/01-02/28 Past: 2000 sheep 03/17-03/31 03/01-03/31	NA	Annual grazing application required for Thousand Springs area. Reduced AUMs in Smoke Creek Desert Complex CRMA and North Dry Valley ACEC.

Livestock Grazing Allotment Name	**Reduction in Livestock AUMs**	**Increase of Livestock AUMs**	**Change in Season of Use/ Livestock Class**	**Change in Grazing Strategy**	**Riparian Area Restrictions/ Other Restrictions**
Winter Range California	0	0	Current: 3/1-4/10, 1/10-2/28 Past: 3/1-4/30, 2/1-2/28	NA	NA
Spanish Springs AMP	Allotment was temporarily closed to livestock grazing in 2002-2003 due to wildfire	0	NA	NA	NA
Shinn Peak	Allotment was temporarily closed to livestock grazing in 2002-2003 due to wildfire	0	NA	NA	Livestock grazing prohibited in 3 exclosures.
Twin Buttes	Allotment was temporarily closed to livestock grazing in 2002-2003 due to wildfire	0	NA	NA	NA
Spanish Springs Ind.	Allotment was temporarily closed to livestock grazing in 2002-2003 due to wildfire in 2002	0	NA	NA	NA

Table 3.4.4 Reduction of Livestock AUMs in the Twin Peaks HMA, 1967 to 1985

Action	Original Active AUMs	Revised Active AUMs	Reduction in AUMS
1967 Adjudication	62,943	39,552	23,391
1975-1979 Unauthorized Use	3,600	0	3,600
1979 Livestock Grazing Permit Cancellation	39,552	30,320	9,232
1985 Livestock Grazing Permit Cancellation	30,320	26,242	4,078
		Total Reduction	**40,301**

Appendix J. Livestock and Wild Horse and Burro Actual Use Tables 2010-2018

CAL-NEVA PLANNING UNIT GRAZING ALLOTMENTS					Varies within Dates		ANNUAL ACTUAL USE BY ALLOTMENT								
Allotment Number	Allotment Name	Livestock Number	AUMS	Livestock Kind Cd	Period Begin Date	Period End Date	2010	2011	2012	2013	2014	2015	2016	2017	2018
00701	TWIN PEAKS	2000-4000	2828	SHEEP	4/1	10/31	11370	12062	8460	5696	6748	8307	8947	11218	11746
		1087	10576	CATTLE	4/1/	1/31									
	Cattle/Sheep AUMs		13404												
00702	WINTER RANGE NV	562	1495	CATTLE	11/1	3/31	145	204	1338	1221	1129	1400	358	934	Still Grazing
03737	WINTER RANGE CA	1000	599	SHEEP	2/1	4/30	0	0	0	0	0	0	0	0	?
00703	OBSERVATION	2000-4000	888	SHEEP	6/1	9/30	2656	1487	1063	295	534	4245	2309	3756	4110
	OBSERVATION	922	6006	CATTLE	4/15	10/31									
	Cattle/Sheep AUMs		6894												
00704	DEEP CUT	875	2400	CATTLE	4/1	6/15	0	1995	879	610	1460	83	1526	1356	1985
00708	SPANISH SPRINGS IND.	49	259	CATTLE	5/1	11/30	228	232	229	0	0	146	187	166	243
00709	TWIN BUTTES	35	212	CATTLE	5/1	11/15	0	138	0	0	0	0	122	87	153
00710	SPANISH SPRINGS AMP	221	1111	CATTLE	5/16	11/15	682	293	1487	0	0	490	558	215	51
00711	SHINN PEAK	2000	270	SHEEP	6/1	11/30	164	101	23	0	0	26	30	62	43
Total Livestock Use			26644				15245	16512	13479	7822	9871	21061	14037	17794	18331
WH&B Avg annual use							20,524	14,043	15,915	18,076	21,689	24,545	29,454	36,620	43,944

Appendix K. 2018 Twin Peaks HMA Riparian Report

Methods

Springs: Byers, Cherry II, Pete's, Sage Hen (by Shinn Ranch), Selic, Stove, and Upper Wilcox. Alteration and utilization were completed at each springs three to five times between July and October, leaving at least two weeks between visits.

Alteration and Utilization

- We placed two 15-meter transects along the wetted edges of the riparian zone. Transects followed the general path of the thalweg where discernable.
- Where springs were enclosed by any type of fencing, we began transects within 1-2 meters of where the water exited from under the fence. At springs with no fencing, transects were placed as close to the discernible spring source as possible.
    - Placement of transects varied from spring to spring and from visit to visit depending on the location of the water.
    - Although we placed the transects starting with a 0 meter point on our tape, we began surveys at meter one
- 15 measurements per transect (30 total per spring)
- Alteration:
    - Measured at each meter (15 per transect, 30 total per spring)
    - Counted the number of fresh hoofprints that intersected lines marked on the MIM frame.
        - Counts only ranged from 0 to 5
    - If a hoofprint intersected more than one line, we only counted it once.
- Utilization:
    - Measurements were taken at each meter (15 per transect, 30 total per spring)
    - We measured the average height of the dominant forage species
    - If there was bare ground, a rock, or a non-forage species under the meter mark, we measured (in inches) the distance outwards (perpendicular from the meter tape) to forgeable vegetation that was both rooted and substantial
        - We bypassed tiny clumps or single stems

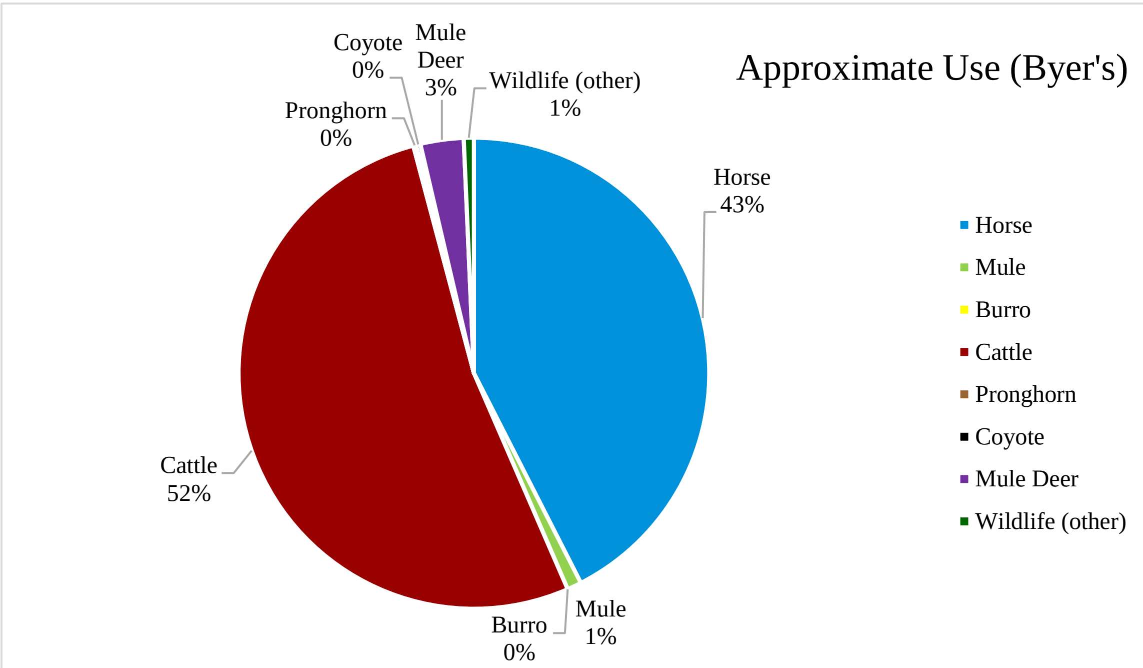
Game Camera Data

- We placed trail cameras were placed at each spring, facing downstream and capturing the majority of the riparian zone where possible
- We set each camera for motion trigger with 5 minute intervals (so as to take a photo every five minutes until the motion stopped)
- We analyzed each picture and stored the data in an Excel worksheet
- Information recorded:
    - HMA of the spring
    - Spring Name/Identifier
    - Year
    - Date
    - Time (hours and minutes)
    - Picture number
    - The numbers of individuals for certain species (horses, mules, burros, cattle, pronghorn, coyote, mule deer) and general wildlife
        - Each species had its own designated column
- It should be noted, although some game cameras included an external temperature sensor, camera placement significantly affected accuracy of these measurements, leading to false readings. For this reason, temperature data were not used for any analysis.

Byers Spring

We completed alteration and utilization surveys at Byers Spring five times during the 2018 field season (7/4, 7/31, 8/27, 10/1, and 10/22). The first time we visited, a new head box had been recently installed, and the spring head was and remained unfenced for the duration of our field season. We observed the headwaters of the spring to have a moderately high amount of alteration, and the trough below showed signs of heavy use, with many tracks visible and very little vegetation remaining. We conducted all of our alteration and utilization surveys beginning approximately 1-2 meters below the spring box so as to avoid the disturbance from its installation. Surveys and visual observation both demonstrated evidence of heavy grazing, with roughage such as Nebraska sedge, *Juncus*, and bluegrass all present but grazed down to near the ground.

Photo data at Byer's suggests that the majority of use at the spring is from large ungulates such as cattle and horses. At the beginning to the summer cattle were most prevalent, but horses began using the spring more heavily toward the later part of the summer, particularly in September and October. Mule deer frequented this spring, as well as a single coyote. Given the topography of the spring, along with the way we chose to position our camera, it is also possible that other small mammals and birds may also have been present, but were not captured in our photos.



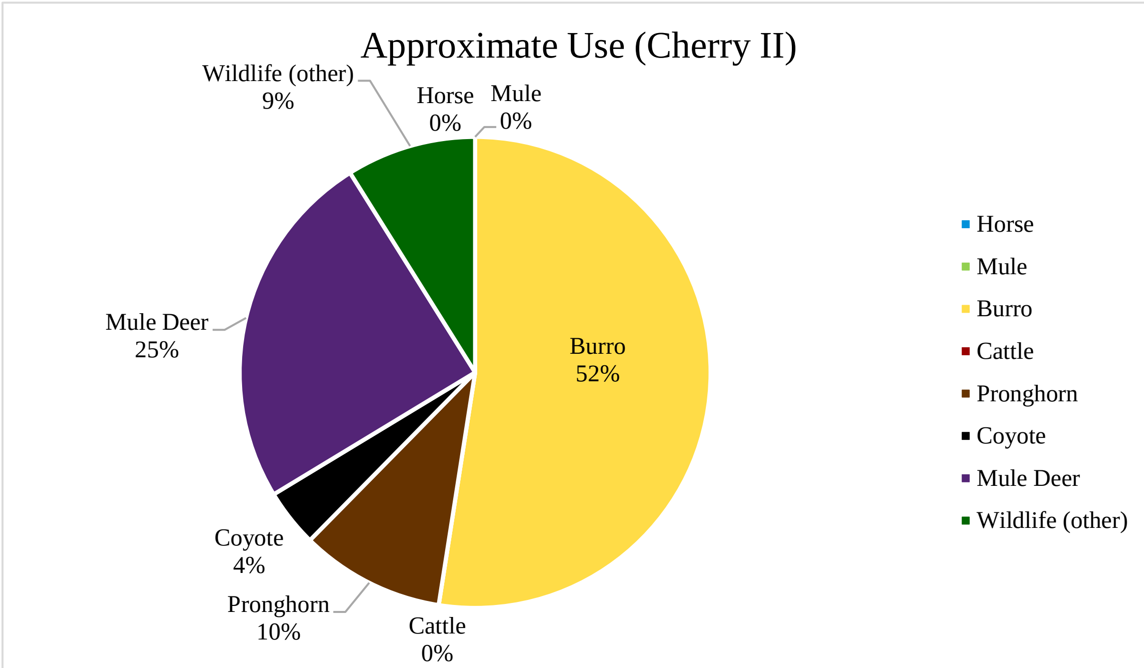
Proportion of visitation by wildlife species at Byer's Spring in Twin Peaks HMA based on number of individuals of a species expressed as a percentage of the total number of individuals from all species.

Cherry II Spring (Shinn Ranch)

We visited Cherry II Spring four times throughout the season (7/25, 8/15, 9/6, and 10/2). As a good portion of the headwaters are enclosed with bison fence, we began alteration and utilization surveys just downstream of where the spring crosses underneath. Plants along the greenline tended to be quite robust, without much if any evidence of alteration from cattle or wild horses. In fact, this was perhaps the only example of our fenced sites where there was little to no observable difference in plant communities on either side of the fence.

Transect tape 0 m placement outside of exclosure fence

Relative to other sites, Cherry II was infrequently used by ungulates and other vertebrates. This apparent lack of use may be due to the length of the thalweg stretching far beyond the area of effect of our camera, or simply because it is in a location not often visited by these animals. Of the large herbivores, pronghorn and mule deer were the most represented in photo data. This changed toward the end of the summer when a group of five burros began frequenting the site. The presence of the burros seemed to potentially correspond with an increase in the grazing pressure and alteration of the site. Robust growth of vegetation (particularly grasses) at the site appeared to decrease quite dramatically at the same time.



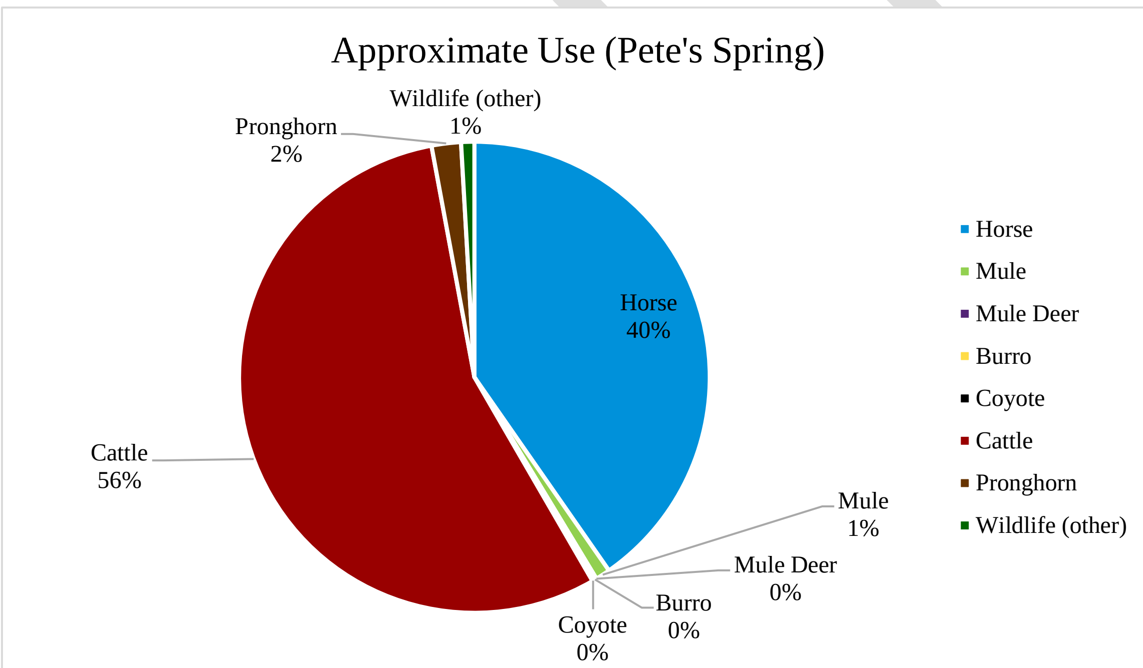
Proportion of visitation by wildlife species at Cherry II in Twin Peaks HMA based on number of individuals of a species expressed as a percentage of the total number of individuals from all species.

Pete's Spring

We conducted surveys at Pete's five times (7/4, 7/31, 8/27, 10/1, and 10/22). Because the source was fenced off to prevent cattle use, we began alteration and utilization surveys less than a meter outside of the fence. It was among our most heavily altered springs, with significant hummocking in and along the thalweg, and a sizeable patch of bare ground to one side. Plants along the stream were heavily grazed upon (with an average height of about 2 inches based on a quick Excel calculation), and very few Nebraska or other sedge species were present.

During the July 4th visit, the trough downhill of the spring was intact, although much of the dirt around it and the pipes had eroded away. However, when we checked on the camera a week later, the trough had been knocked to the side and the pipes dislodged. It remained disconnected and empty until mid-early September, and we noticed a fair amount of change in the shape/flow pattern of the stream until then, possibly as a result of the extra water and continued animal use directly along the stream channel.

Usage at this site was quite extensive, with the majority of visitors to the site being horses and cattle. This site was also popular with pronghorn, though not in the same quantities as horses and cows. Other more rare visitors included a badger and a few sage grouse. Horses visited this site almost daily during the summer months. Between the beginning of July and October 1st alone, we recorded 12897 horses from trail camera photos of the site. They almost always appeared in the morning hours and then returned in the early afternoon with a steady stream of visitors until sunset. Of those that we have camera data for, Pete's is plausibly our most visited spring by far. Cattle used this site as a resting spot, with the group often laying in the same spots for several hours. Both photo data and in person observations during site visits well confirm the presence of many large dust devils at this site, oftentimes with multiple occurrences in a single day. Thusly, we believe that this site may be particularly prone to extensive wind erosion due to a lack of vegetation.



Proportion of visitation by wildlife species at Pete's Spring in Twin Peaks HMA based on number of individuals of a species expressed as a percentage of the total number of individuals from all species.

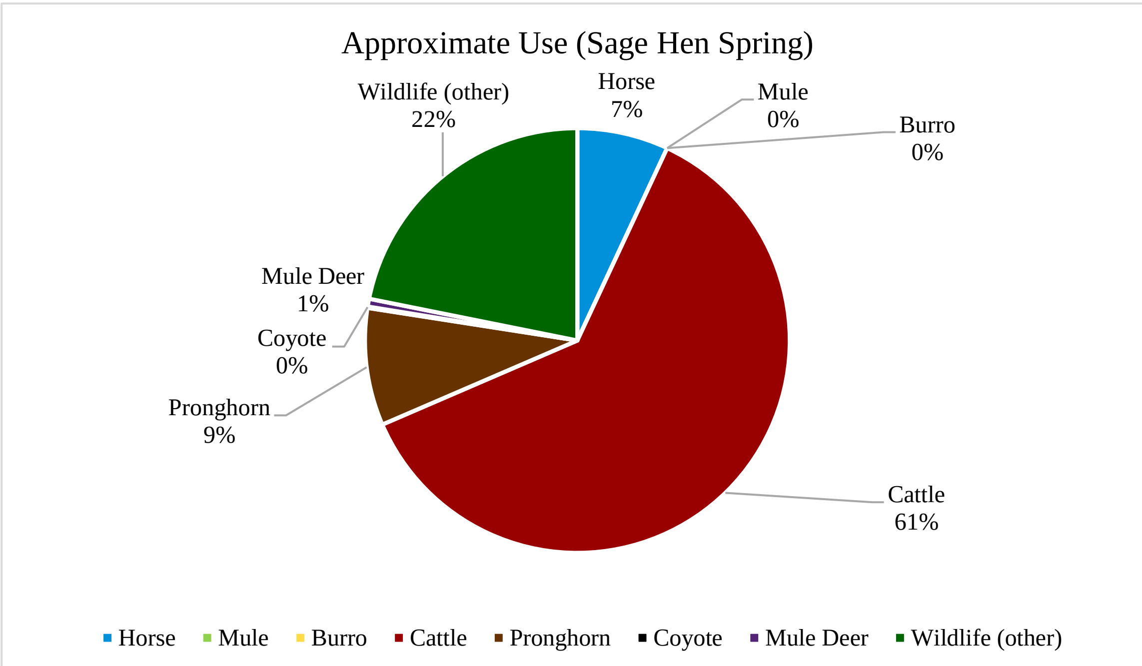
Sage Hen Spring (near Shinn Ranch)

We completed surveys at Sage Hen Spring on July 25th, August 15th, September 6th, and October 15th for a total of four visits. At the time of surveys, Sage hen Spring consisted of one fence entirely enclosing the headwaters, as well as an additional property fence approximately ten to fifteen meters downstream. We conducted alteration and utilization surveys just downstream of the second property fence.

Site setup at Sage hen – transect start in pink

Sage Hen spring appeared to be rather popular with a wide variety of wildlife species. Cattle were the most frequent visitors, often loafing, grazing, and generally knocking things over in the same spot for several hours at a time. Towards the end of the summer, we saw fewer and fewer cows, which may have simply been due to a change in ranching practices. Horses were fairly rare at this site; for the most part horse visitation was limited to a small group of four individuals visited occasionally, but did not stay for long. Birds seemed especially drawn to this site as well. We observed several different species, including sage grouse, and they were often captured bathing in the stream below the camera. A number of sage grouse were recorded here as well. A cougar was potentially photographed earlier in the summer. However, the photo was blurry, so it could not be clearly identified. Pronghorn and mule deer frequented this site as well.

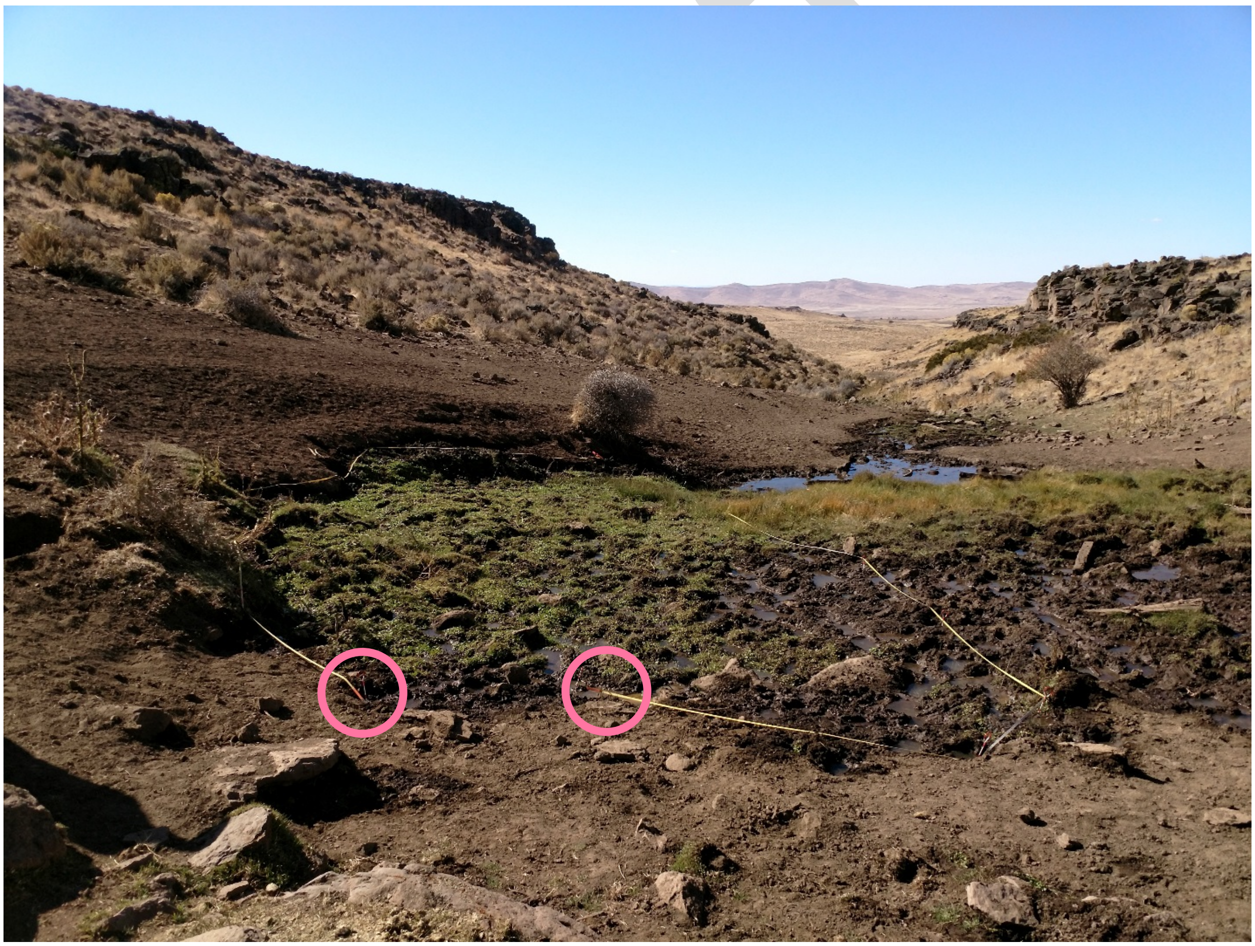
This, combined with data from surveys indicated a moderate amount of use at this site. There was evidence of grazing along the streambank, but not to the extent of some of our other springs such as Pete's. Plant species indicative of a healthy system, including multiple rushes, grasses, and sedges were present, but not fully established throughout, and were more robust within the headwater enclosure. One unique aspect of this spring was the abundance of (well grazed) coyote willow along the transect, a feature that we have encountered at very few of our other locations.



Proportion of visitation by wildlife species at Sage Hen Spring in Twin Peaks HMA based on number of individuals of a species expressed as a percentage of the total number of individuals from all

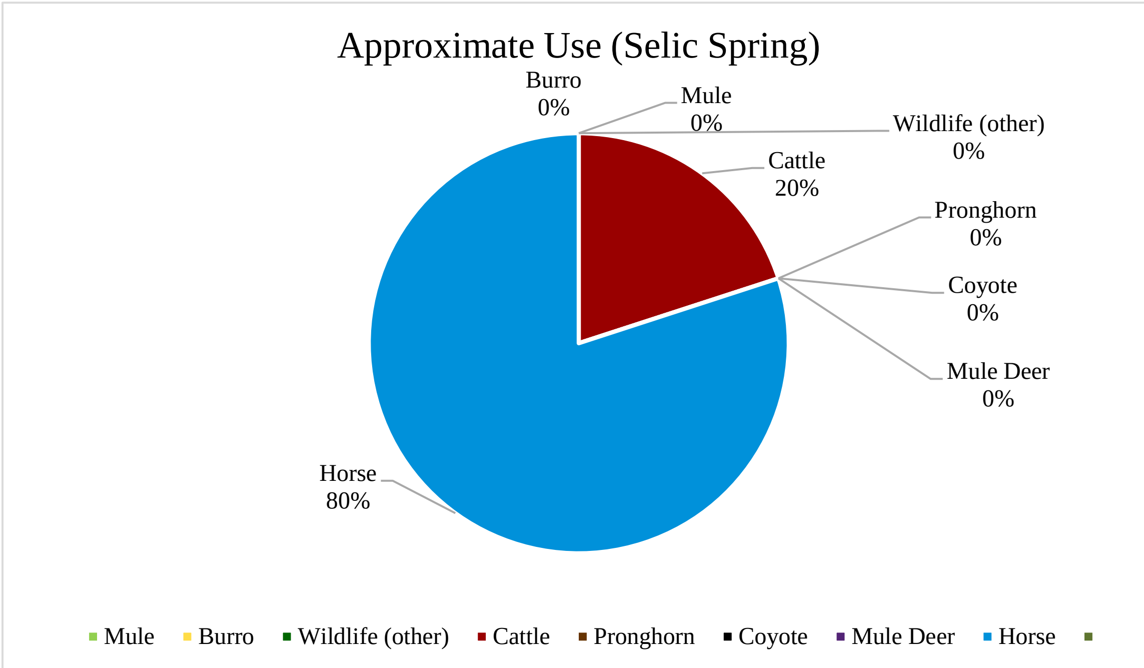
Selic Spring

We conducted alteration and utilization measurements at Selic four times during the 2018 field season (7/4, 8/21, 10/1, and 10/22). We set the 0 meter point about one meter downstream from the source each time, and set our transect so that it followed the wetted edge of the thalweg rather than the edge of the entire wetted area. Because the thalweg of the spring did vary throughout the season, so we modified the placement of line two (the line on the right in the figure below) with each site visit. Selic Spring was another of our heavily altered sites, with substantial bare patches on either side and the effects of heavy grazing evident along the greenline. Plants along the wetted edge of the entire system were sparse and fully grazed down, but towards the center grew taller and more robust, despite heavy hummocking throughout. One of the most notable features of this site is the fen located not far from the spring headwaters.



Transect placement with 0 meter marked by pink circles (taken 10/22)

Because we did not deploy the camera at Selic until October, we were only able to analyze about twelve days' worth of photo data to. This data indicated that the site is exclusively utilized by horses and cattle in a four to one ratio, but more photos will send further light on the true usage of the spring.



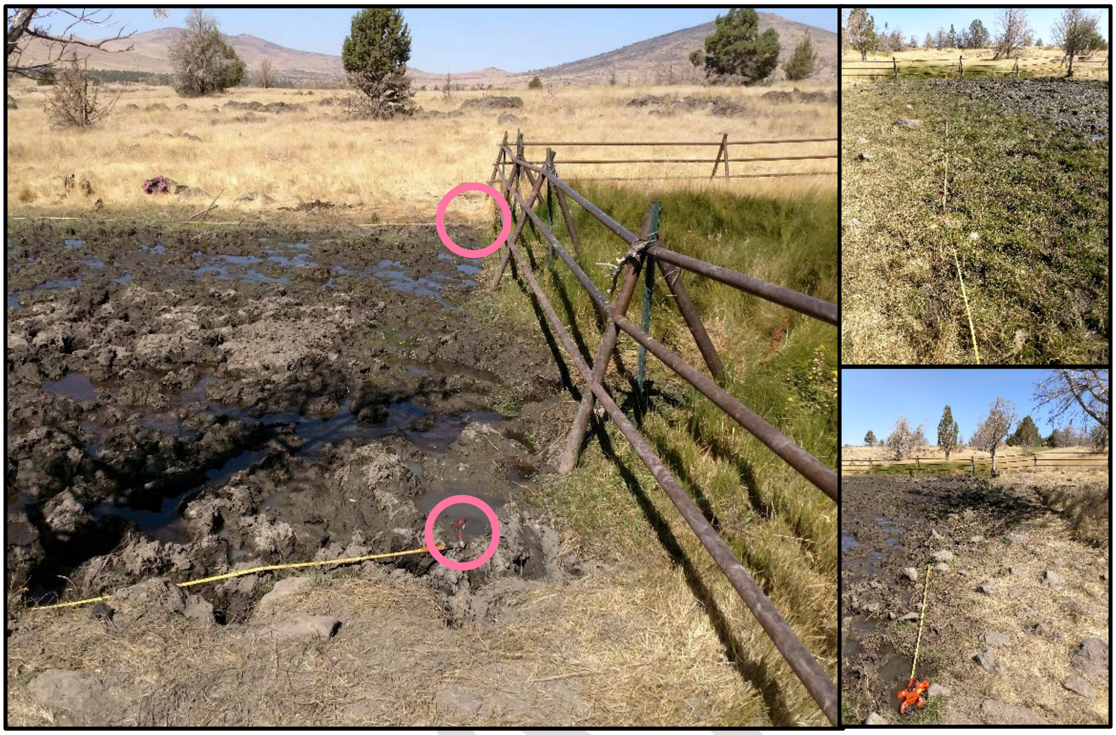
Proportion of visitation by wildlife species at Selic spring in Twin Peaks HMA based on number of individuals of a species expressed as a percentage of the total number of individuals from all species.

Stove Spring

We began transects at Stove Spring less than a meter outside of the bison fence each time we surveyed (three times on 8/2, 8/30, and 10/15). Unlike the inside of the enclosure, which was somewhat channelized and full of tall vegetation, the portion of the spring located outside of the fence was wide and extremely muddy, with essentially no vegetation within the thalweg of the stream. Surveys indicated a strong presence of fairly well grazed rushes and Kentucky bluegrass, but little else. The vegetation on either edge grew taller as it progressed farther away from the center, but often lay flat from trampling and possibly wind.

We were not able to get back out to this camera to collect the photo data, so we are not able to provide photographic evidence of use at this time. However, based on the large size and shape of the hoofprints, it is a relatively safe assumption that some variety of heavy-set ungulate used the riparian area below the fence. The high number of hoofprints observed during each visit also suggests heavy use, most likely by multiple individuals.

View of Stove taken from the same point on the bison fence facing both upstream (L) and



Transect placement at 0 m (pink).

Upper Wilcox Spring

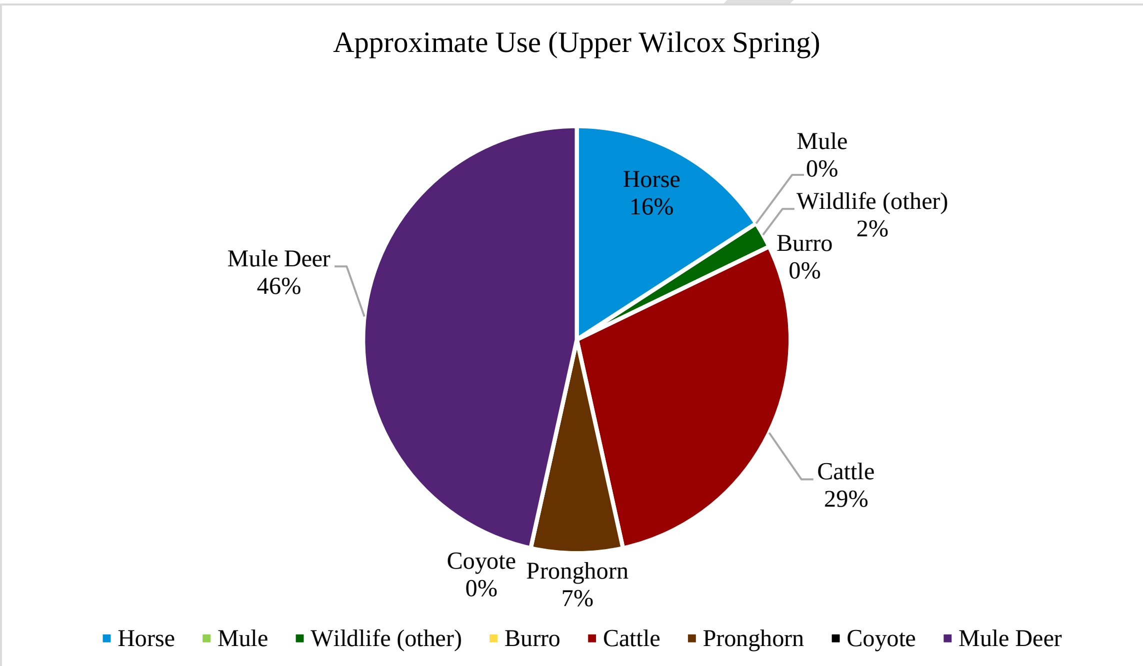
Unlike many of our other springs, we did not set transects at Wilcox at the farthest accessible point upstream. In order to both correlate with previously collected site data, as well as to obtain the most representative results based on site characteristics, we chose to begin measurements at a source about 40 meters downstream from the first aboveground occurrence of the spring. As with Selic Spring, the thalweg of Upper Wilcox experienced a number of small changes throughout the season, and we had to adjust the path of our transect accordingly during each of our four visits (7/19, 8/21, 10/1, and 10/22).

Of the four springs we surveyed in the Painter's flat area, Upper Wilcox arguably demonstrated the greatest variety in plant types, with multiple grass, forb, and rush species accounted for in surveys. At least one carex species was present as well; we visually observed multiple specimens within the stream system, although it was never present along our transect.

Transect setup for Upper Wilcox spring (0 m points in pink)

Despite the high species diversity, many of the plants we observed were heavily grazed and affected by alteration. Just over half of our data points were bare ground, and the individuals that we recorded were conspicuously short – the tallest plant we recorded all season was a seven-inch tall foxtail. However, there is hope that this system will have a chance to recover over the next few years, owing to the bison fence that was recently erected around a large portion of the headwaters.

We deployed the camera on the 10th of October, and returned to retrieve data on the 22nd. Analysis of photo data revealed that mule deer, followed by cattle and horses, were the heaviest users of this site. However, given the small sample size of 12 days, this may not be representative of the season as a whole. This is especially true given that we did not install the camera until after bison fencing was put up in mid-late summer. It is probable that before the fence was erected horse and cattle use would have been more predominant.



Relative visitation of wildlife species at Upper Wilcox Spring in Twin Peaks HMA calculated as a percentage of total animal visits from trail camera photo data

Beyers


MOULTRIE
24.12 inHg - 90°F 09/02/2018 05:09PM MOULTRIECAM


MOULTRIE
24.44 inHg - 32°F 09/20/2018 08:17AM MOULTRIECAM

Cherry II


MOULTRIE
25.24 inHg - 70°F 09/06/2018 07:17PM MOULTRIECAM


MOULTRIE
25.08 inHg - 77°F 08/29/2018 06:25PM MOULTRIECAM

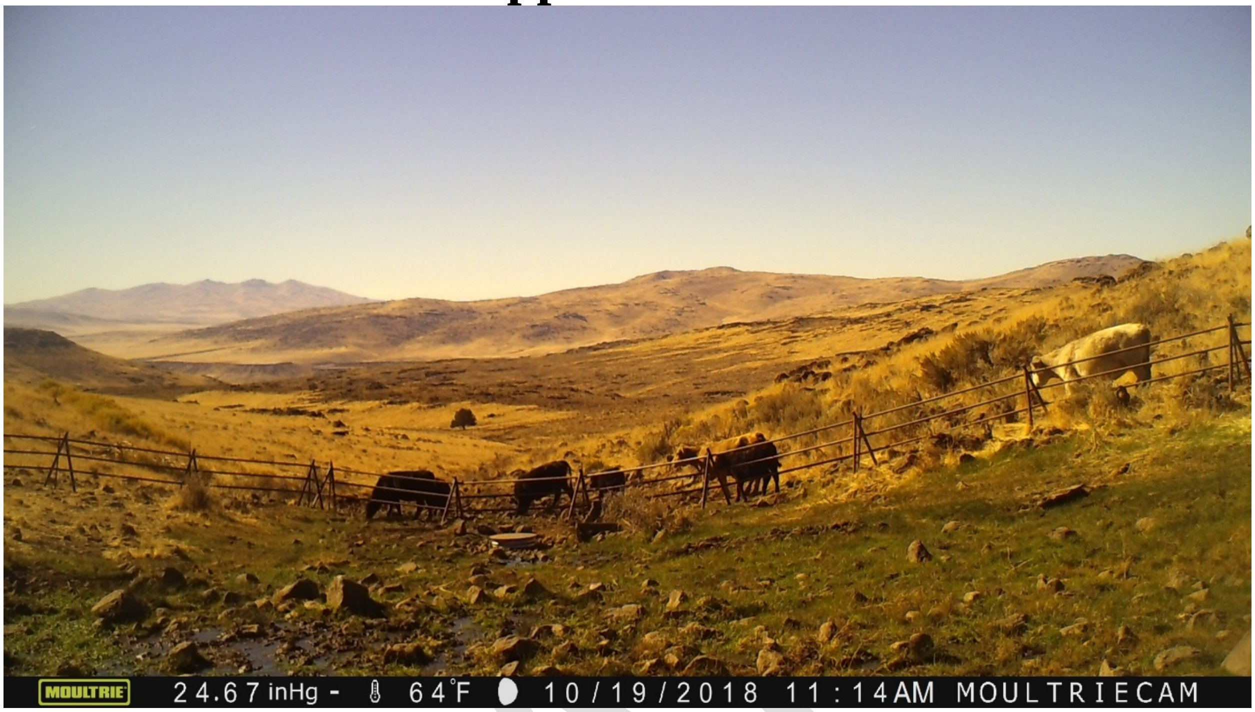

MOULTRIE
25.20 inHg - 90°F 08/13/2018 10:37AM MOULTRIECAM

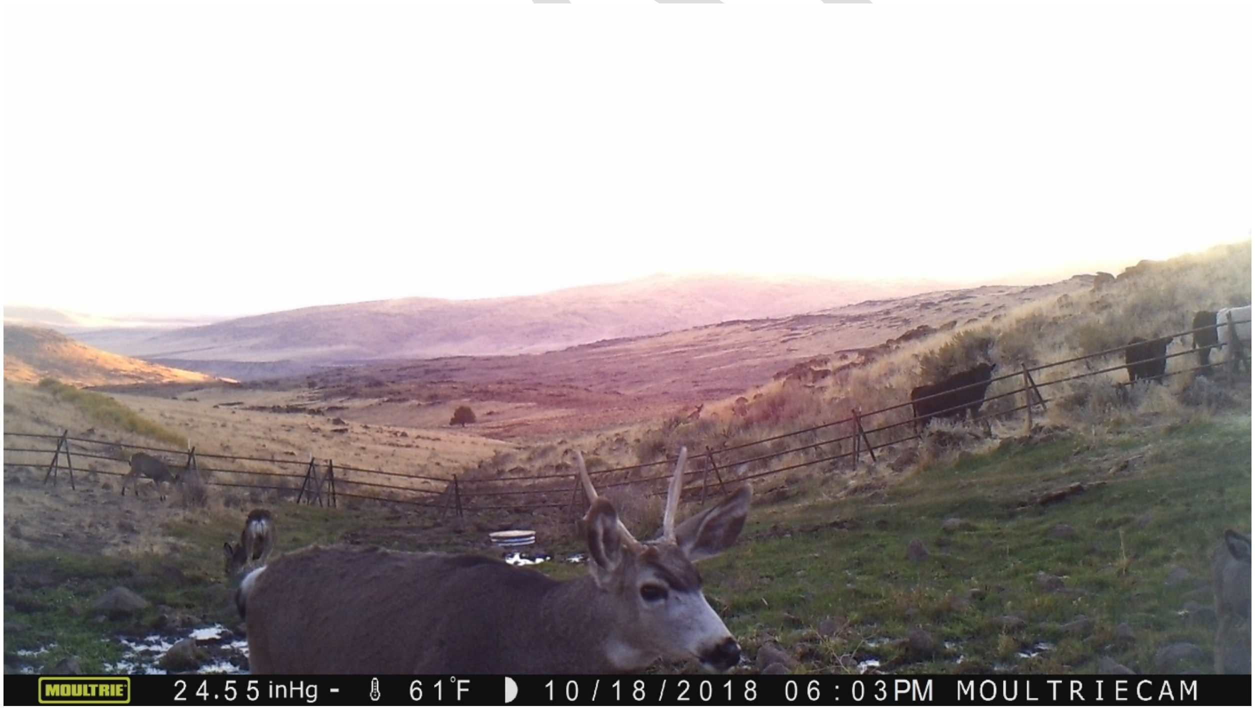
Selic

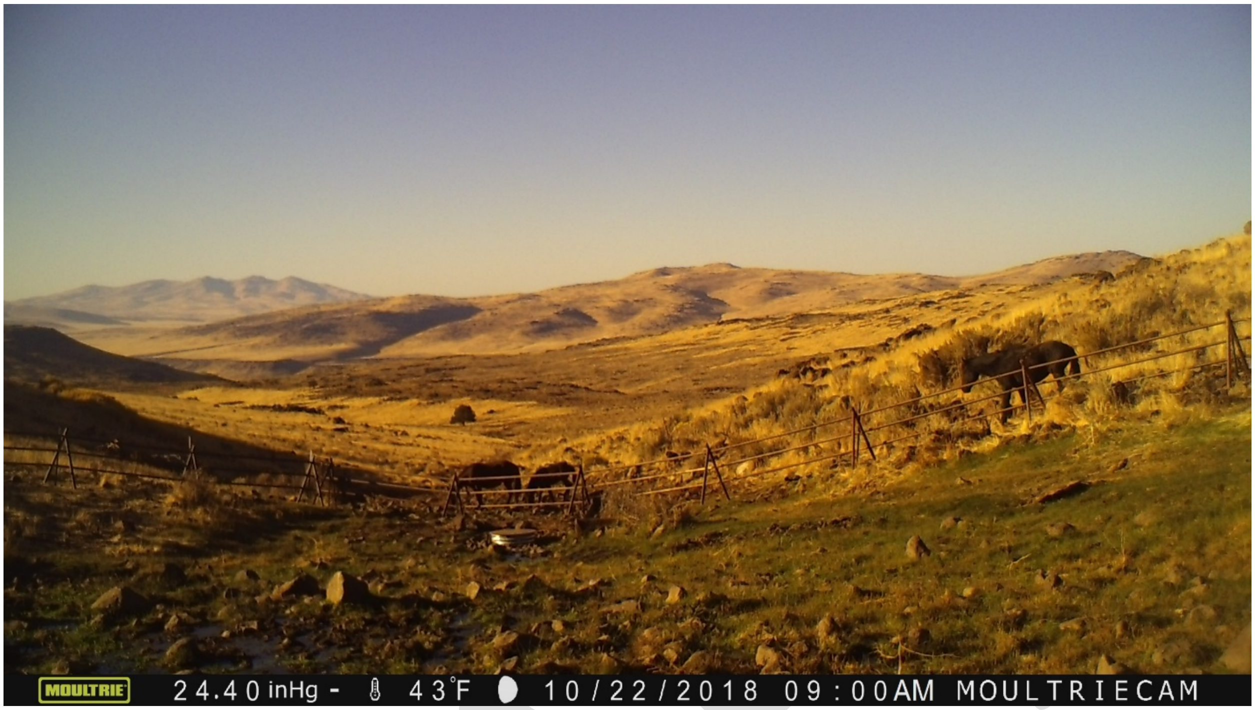

AttackIR
10/16/2018 3:21 PM
Cuddeback


AttackIR
10/15/2018 10:25 AM
Cuddeback

Upper Wilcox

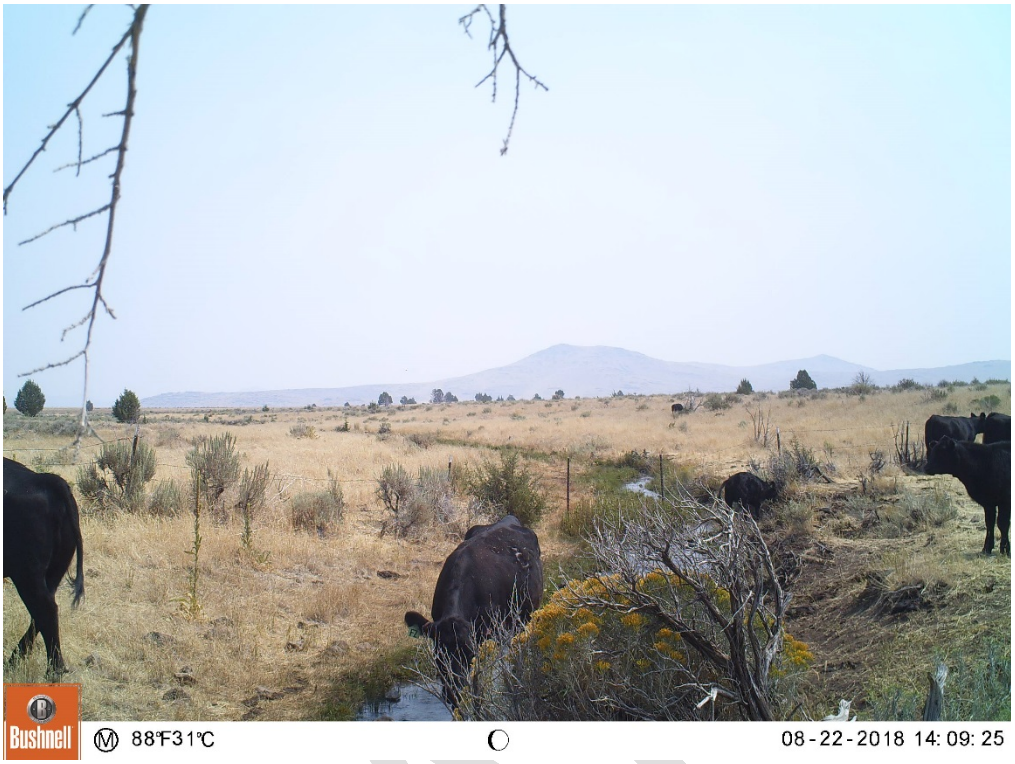





MOULTRIE
24.40 inHg - 43°F 10/22/2018 09:00AM MOULTRIECAM


MOULTRIE
24.57 inHg - 79°F 10/16/2018 04:10PM MOULTRIECAM

Sage Hen (Twin Peaks)


Bushnell
88°F31°C
08-22-2018 14:09:25


Bushnell
86°F30°C
09-01-2018 15:07:38


Bushnell
86°F30°C
08-03-2018 13:47:50


Bushnell
91°F32°C
08-07-2018 18:39:46

Pete's


Bushnell
106°F41°C
07-11-2018 17:55:04


Bushnell
84°F28°C
08-01-2018 19:50:22


Bushnell
104°F40°C
07-11-2018 18:38:37

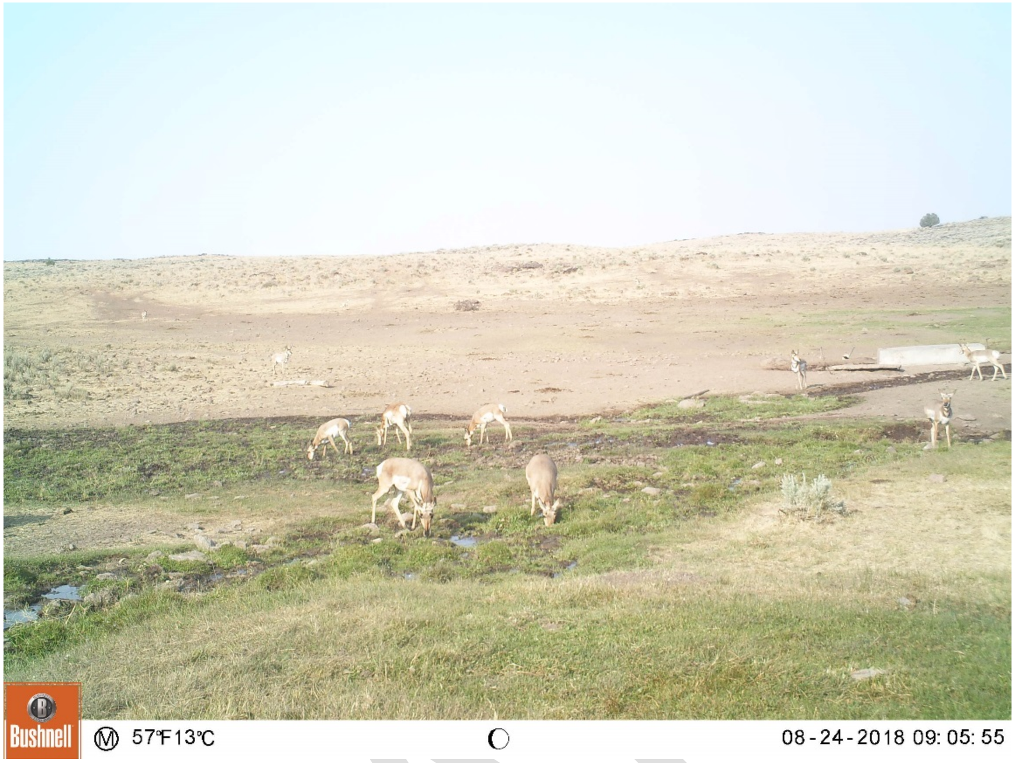

Bushnell
113°F45°C
07-14-2018 16:15:09


Bushnell
70°F21°C
07-15-2018 08:19:13


Bushnell
62°F16°C
07-17-2018 08:04:14


Bushnell
93°F33°C
07-20-2018 13:57:30


Bushnell
89°F31°C
07-20-2018 19:41:04


Bushnell
57°F13°C
08-24-2018 09:05:55


Bushnell
98°F36°C
07-24-2018 17:07:18

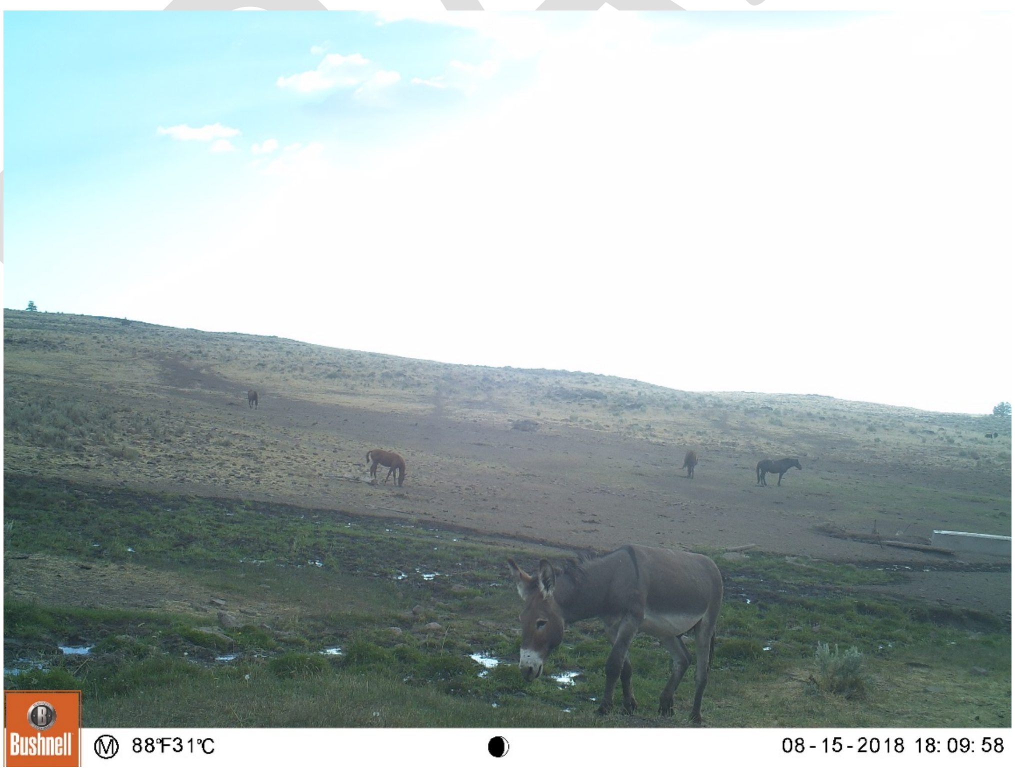

Bushnell
80°F26°C
08-02-2018 12:55:00


Bushnell
95°F35°C
08-03-2018 15:42:15

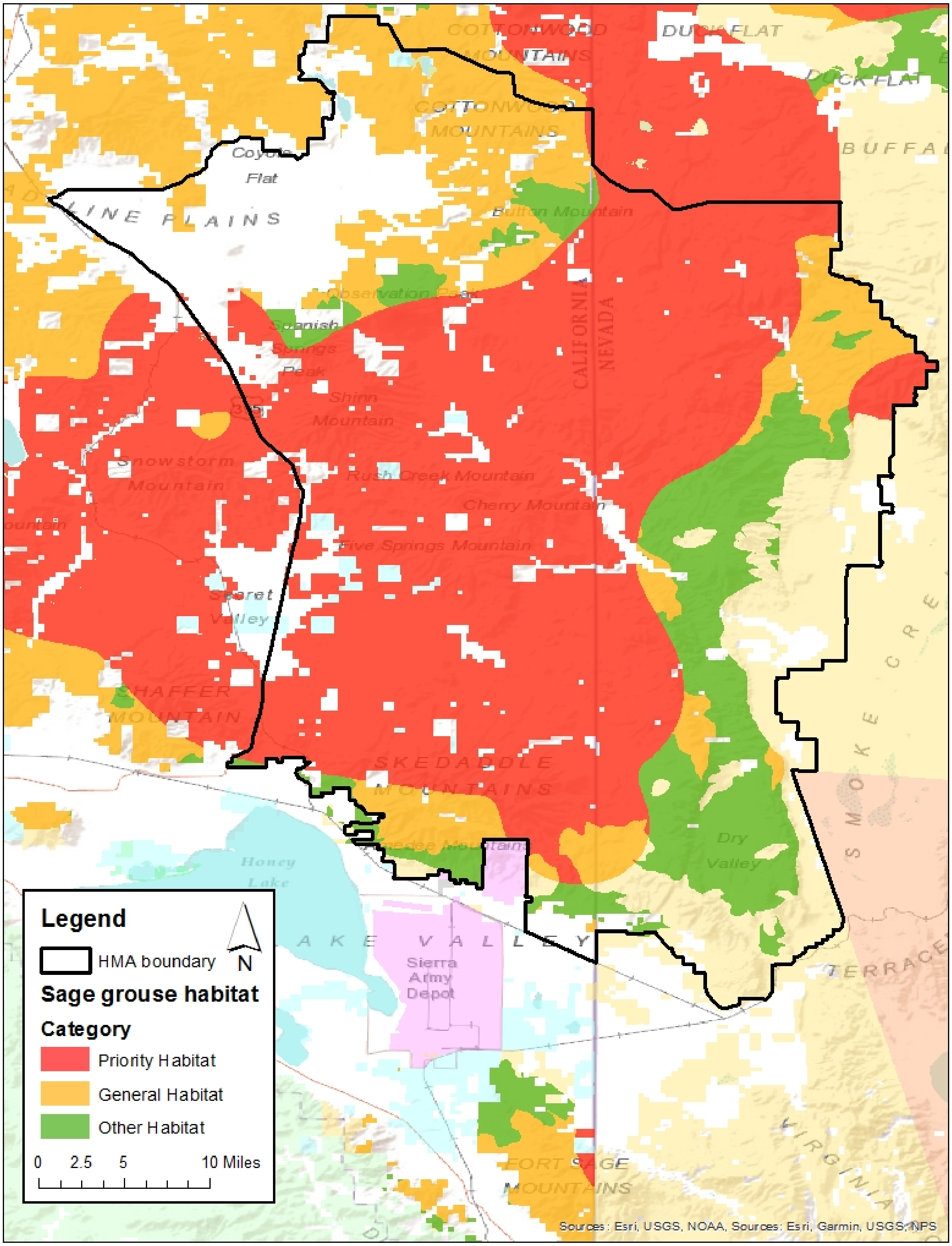

Bushnell
93°F33°C
07-31-2018 13: 17: 32


Bushnell
75°F23°C
08-11-2018 09: 43: 24


Bushnell
98°F36°C
08-12-2018 15:59:27


Bushnell
88°F31°C
08-15-2018 18:09:58

Appendix L. Map of Greater Sage-Grouse Habitat with the Twin Peaks HMA



Appendix M. Historical Gather and Release Record from Twin Peaks HMA

	Gathered			Released*		
	Horses	Burros	Mules	Horses	Burros	Mules
1981	1					
1982	3	1				
1983	1					
1984	1					
1985	2					
1986	4					
1987	253	62		26		
1988	334	2	2	41		
1989	260	57		18		
1990				71		
1991	160	1	7	57	1	
1992	202	50	4	75	6	1
1993	279		2	96		
1994	2			7		
1995	256	19		120	1	
1996	1			4		
1997	355					
1998	480		1			
1999	135			198		
2000	779	48		54		
2001	759	9	27			
2002	636	28	4			
2003	228	83		51	4	
2004	1		1	5		
2005	863					
2006	1		9			
2007	2					
2008	2					
2009	1552	50				
2010	1	161	23			
2011	3			8	1	11
2012		3				
2013		19				
2014		13				
2015	2					
2016						
2017		30				
2018		32				
2019		50				

*Numbers in the "Released" columns do not include horses and burros released from temporary trap site locations.

Appendix N. 2010 Twin Peaks HMA Genetic Report

Genetic Analysis of the
Twin Peaks HMA, CA

E. Gus Cothran

April 28, 2011

Department of Veterinary Integrative Bioscience
Texas A&M University
College Station, TX 77843-4458

The following is a report of the genetic analysis of the Twin Peaks HMA, CA.

A few general comments about the genetic variability analysis based upon DNA microsatellites compared to blood typing. The DNA systems are more variable than blood typing systems, thus variation levels will be higher. Variation at microsatellite loci is strongly influenced by allelic diversity and changes in variation will be seen in allelic measures more quickly that at heterozygosity, which is why more allelic diversity measures are calculated. For mean values, there are a greater proportion of rare domestic breeds included in the estimates than for blood typing so relative values for the measures are lower compared to the feral horse values. As well, feral values are relatively higher because the majority of herds tested are of mixed ancestry which results in a relatively greater increase in heterozygosity values based upon the microsatellite data. There are no specific variants related to breed type so similarity is based upon the total data set.

METHODS

A total of 94 samples were received by Texas A&M University, Equine Genetics Lab on March 21, 2011. There were three sampling locations identified (Gilman Springs, Skedaddle/Dry Valley and S. Observation) and these locations were analyzed individually and combined. DNA was extracted from the samples and tested for variation at 12 equine microsatellite (mSat) systems. These were *AHT*4, *AHT*5 *ASB*2, *ASB*17, *ASB*23, *HMS*3, *HMS*6, *HMS*7, *HTG*4, *HTG*10, *LEX*33, and *VHL*20. These systems were tested using an automated DNA sequencer to separate Polymerase Chain Reaction (PCR) products. One sample was duplicated (Skedaddle/Dry Valley group); therefore results are presented based on 93 sample analysis.

A variety of genetic variability measures were calculated from the gene marker data. The measures were observed heterozygosity *(Ho)* which is the actual number of loci heterozygous per individual; expected heterozygosity *(He)*, which is the predicted number of heterozygous loci based upon gene frequencies; effective number of alleles *(Ae)* which is a measure of marker system diversity; total number of variants *(TNV)*; mean number of alleles per locus (*MNA*); the number of rare alleles observed which are alleles that occur with a frequency of 0.05 or less (*RA*); the percent of rare alleles (*%RA*); and estimated inbreeding level *(Fis)* which is calculated as 1-*Ho/He*.

Genetic markers also can provide information about ancestry in some cases. Genetic resemblance to domestic horse breeds was calculated using Rogers' genetic similarity coefficient, *S.* This resemblance was summarized by use of a restricted maximum likelihood (RML) procedure.

RESULTS AND DISCUSSION

Variants present and allele frequencies are given in Table 1. No variants were observed which have not been seen in horse breeds. Table 2 gives the values for the genetic variability measures of the Twin Peaks HMA herd. Also shown in Table 2 are values from a representative group of domestic horse breeds. The breeds were selected to cover the range of variability measures in domestic horse populations. Mean values for feral herds (based upon data from 126 herds) and mean values for domestic breeds (based upon 80 domestic horse populations) also are shown.

Mean genetic similarity of the Twin Peaks HMA herd to domestic horse breed types are shown in Table 3. A dendrogram of relationship of the Twin Peaks HMA herd to a standard set of domestic breeds is shown in Figure 1.

Genetic Variants: A total of 97 variants were seen in the Twin Peaks HMA herd which exceeds by one the maximum number seen for herds and is well above the mean for domestic breeds. This high number is due to sampling across three locations, which all show fairly high values and these values are directly correlated with the sample size for the location. There were in general a high percentage of rare alleles in each area with the S. Observation herd having an exceptionally high percentage of variants at risk of loss. Allelic diversity as represented by *Ae* and *MNA* is high in each subpopulation and higher in the total group, as expected.

Genetic Variation: Observed heterozygosity in the Twin Peaks HMA herd is below the feral mean while *He* is greatly higher than average. This is what would be expected when calculating *He* for a subdivided population such as this one. Within the individual populations, *Ho* is close to average for Gilman Springs and S. Observation but well below average for Skedaddle/Dry Valley. For all three *Ho* is well below *He* which suggests that there is interchange of individuals among the herds but this may be a recent phenomena since the herds are genetically subdivided.

Genetic Similarity: Overall similarity of the Twin Peaks HMA herd to domestic breeds was about average for feral herds and the subpopulations showed similar patterns as the combined sample. Highest mean genetic similarity of the Twin Peaks HMA herd was with Light Racing and Riding breeds, followed by the North American breeds. As seen in Fig. 1, however, the Twin Peaks HMA herds pair with the Brazillian Criollo (an Iberian breed) in a separate cluster that connects with the above breed groups. These results combined with the variability indicate a herd with mixed origins likely from American stock. The three subpopulations are more like each other than like anything else which indicates common origin and likely interbreeding to some extent.

SUMMARY

Genetic variability of this herd is high both for the total herd and the individual subpopulations sampled. Allelic diversity is relatively higher than heterozygosity with the later approaching concern levels in the individual sample groups. Genetic similarity results suggest a herd with mixed ancestry primarily of North American origin.

RECOMMENDATIONS

Current variability levels are high enough that no action is needed at this point but the heterozygosity levels are near concern values. However, if population subdivision is maintain with some limited mixing among groups this should not be a problem.

Table 1. Allele frequencies of genetic variants observed in Twin Peaks HMA feral horse herd.

VHL20

	I	J	K	L	M	N	O	P	Q	R	S
TWIN PEAKS CA ALL	0.161	0.000	0.016	0.135	0.135	0.188	0.059	0.183	0.048	0.075	0.000
GILMAN SPRINGS	0.154	0.000	0.038	0.038	0.192	0.347	0.000	0.154	0.000	0.077	0.000
SKEDADDLE DRY WALLEY	0.197	0.000	0.036	0.089	0.107	0.196	0.036	0.196	0.107	0.036	0.000
S OBSERVATION	0.144	0.000	0.000	0.183	0.134	0.144	0.087	0.183	0.029	0.096	0.000

HTG4

	I	J	K	L	M	N	O	P	Q	R
TWIN PEAKS CA ALL	0.000	0.000	0.161	0.102	0.629	0.081	0.000	0.027	0.000	0.000
GILMAN SPRINGS	0.000	0.000	0.077	0.269	0.539	0.115	0.000	0.000	0.000	0.000
SKEDADDLE DRY WALLEY	0.000	0.000	0.125	0.143	0.572	0.089	0.000	0.071	0.000	0.000
S OBSERVATION	0.000	0.000	0.202	0.038	0.683	0.067	0.000	0.010	0.000	0.000

AHT4

	H	I	J	K	L	M	N	O	P	Q	R
TWIN PEAKS CA ALL	0.210	0.027	0.284	0.075	0.011	0.000	0.065	0.323	0.005	0.000	0.000
GILMAN SPRINGS	0.269	0.038	0.269	0.115	0.000	0.000	0.000	0.309	0.000	0.000	0.000
SKEDADDLE DRY WALLEY	0.231	0.018	0.250	0.179	0.000	0.000	0.054	0.268	0.000	0.000	0.000
S OBSERVATION	0.183	0.029	0.306	0.010	0.019	0.000	0.087	0.356	0.010	0.000	0.000

HMS7

	I	J	K	L	M	N	O	P	Q	R
TWIN PEAKS CA ALL	0.000	0.054	0.022	0.375	0.070	0.280	0.194	0.000	0.005	0.000
GILMAN SPRINGS	0.000	0.038	0.038	0.386	0.077	0.231	0.192	0.000	0.038	0.000
SKEDADDLE DRY WALLEY	0.000	0.071	0.018	0.375	0.000	0.250	0.286	0.000	0.000	0.000
S OBSERVATION	0.000	0.048	0.019	0.375	0.106	0.308	0.144	0.000	0.000	0.000

AHT5

	I	J	K	L	M	N	O	P	Q	R
TWIN PEAKS CA ALL	0.071	0.198	0.088	0.049	0.093	0.337	0.143	0.016	0.005	0.000
GILMAN SPRINGS	0.000	0.115	0.154	0.077	0.077	0.269	0.308	0.000	0.000	0.000
SKEDADDLE DRY WALLEY	0.054	0.125	0.125	0.089	0.054	0.464	0.089	0.000	0.000	0.000
S OBSERVATION	0.100	0.260	0.050	0.020	0.120	0.280	0.130	0.030	0.010	0.000

HMS6

	I	J	K	L	M	N	O	P	Q	R
TWIN PEAKS CA ALL	0.000	0.000	0.038	0.108	0.134	0.059	0.070	0.591	0.000	0.000
GILMAN SPRINGS	0.000	0.000	0.038	0.154	0.115	0.192	0.077	0.424	0.000	0.000
SKEDADDLE DRY WALLEY	0.000	0.000	0.036	0.018	0.054	0.107	0.071	0.714	0.000	0.000
S OBSERVATION	0.000	0.000	0.038	0.144	0.183	0.000	0.067	0.568	0.000	0.000

ASB2

	B	I	J	K	L	M	N	O	P	Q	R
TWIN PEAKS CA ALL	0.000	0.097	0.000	0.220	0.000	0.242	0.194	0.102	0.005	0.070	0.070
GILMAN SPRINGS	0.000	0.077	0.000	0.347	0.000	0.154	0.115	0.077	0.000	0.192	0.038
SKEDADDLE DRY WALLEY	0.000	0.036	0.000	0.250	0.000	0.214	0.268	0.071	0.000	0.107	0.054
S OBSERVATION	0.000	0.135	0.000	0.173	0.000	0.278	0.173	0.125	0.010	0.019	0.087

HTG10

	H	I	J	K	L	M	N	O	P	Q	R	S	T
TWIN PEAKS CA ALL	0.000	0.134	0.000	0.091	0.070	0.108	0.032	0.307	0.000	0.000	0.258	0.000	0.000
GILMAN SPRINGS	0.000	0.231	0.000	0.154	0.077	0.231	0.038	0.269	0.000	0.000	0.000	0.000	0.000
SKEDADDLE DRY WALLEY	0.000	0.143	0.000	0.107	0.071	0.125	0.018	0.339	0.000	0.000	0.197	0.000	0.000
S OBSERVATION	0.000	0.106	0.000	0.067	0.067	0.067	0.038	0.298	0.000	0.000	0.357	0.000	0.000

HMS3

	H	I	J	K	L	M	N	O	P	Q	R	S
TWIN PEAKS CA ALL	0.000	0.286	0.000	0.000	0.000	0.118	0.134	0.027	0.215	0.161	0.059	0.000
GILMAN SPRINGS	0.000	0.232	0.000	0.000	0.000	0.192	0.038	0.077	0.192	0.154	0.115	0.000
SKEDADDLE DRY WALLEY	0.000	0.214	0.000	0.000	0.000	0.179	0.107	0.036	0.304	0.089	0.071	0.000
S OBSERVATION	0.000	0.337	0.000	0.000	0.000	0.067	0.173	0.010	0.173	0.202	0.038	0.000

ASB17

	D	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
TWIN PEAKS CA ALL	0.000	0.000	0.118	0.054	0.011	0.016	0.038	0.000	0.177	0.135	0.016	0.011	0.075	0.258	0.059	0.000	0.000	0.000	0.000	0.000	0.032
GILMAN SPRINGS	0.000	0.000	0.077	0.038	0.000	0.038	0.038	0.000	0.155	0.155	0.000	0.000	0.000	0.346	0.115	0.000	0.000	0.000	0.000	0.000	0.038
SKEDADDLE DRY WALLEY	0.000	0.000	0.161	0.089	0.000	0.018	0.054	0.000	0.160	0.125	0.018	0.000	0.018	0.250	0.071	0.000	0.000	0.000	0.000	0.000	0.036
S OBSERVATION	0.000	0.000	0.106	0.038	0.019	0.010	0.029	0.000	0.192	0.135	0.019	0.019	0.125	0.241	0.038	0.000	0.000	0.000	0.000	0.000	0.029

ASB23

	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
TWIN PEAKS CA ALL	0.038	0.005	0.054	0.237	0.231	0.156	0.011	0.000	0.000	0.000	0.000	0.005	0.145	0.000	0.118	0.000
GILMAN SPRINGS	0.038	0.000	0.038	0.155	0.192	0.155	0.038	0.000	0.000	0.000	0.000	0.038	0.115	0.000	0.231	0.000
SKEDADDLE DRY WALLEY	0.071	0.000	0.071	0.268	0.125	0.161	0.000	0.000	0.000	0.000	0.000	0.000	0.143	0.000	0.161	0.000
S OBSERVATION	0.019	0.010	0.048	0.240	0.298	0.154	0.010	0.000	0.000	0.000	0.000	0.000	0.154	0.000	0.067	0.000

LEX33

	F	G	K	L	M	N	O	P	Q	R	S	T
TWIN PEAKS CA ALL	0.000	0.011	0.108	0.226	0.000	0.000	0.140	0.011	0.348	0.145	0.000	0.011
GILMAN SPRINGS	0.000	0.038	0.038	0.308	0.000	0.000	0.077	0.038	0.463	0.038	0.000	0.000
SKEDADDLE DRY WALLEY	0.000	0.018	0.125	0.143	0.000	0.000	0.036	0.000	0.482	0.196	0.000	0.000
S OBSERVATION	0.000	0.000	0.115	0.250	0.000	0.000	0.212	0.010	0.250	0.144	0.000	0.019

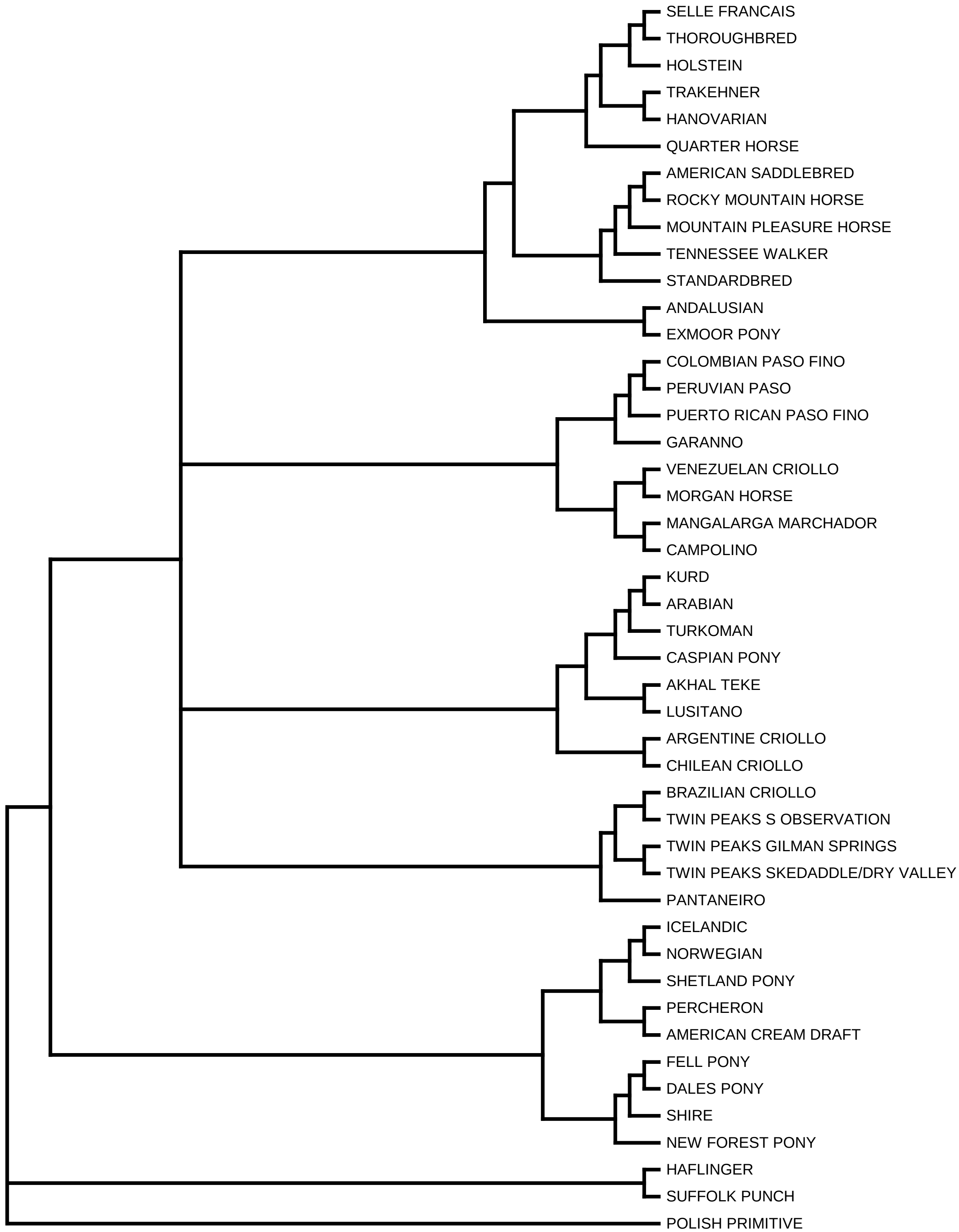
Table 2. Genetic variability measures.

	N	*Ho*	*He*	*Fis*	*Ae*	*TNV*	*MNA*	*Ra*	*%Ra*
TWIN PEAKS CA ALL	***93***	***0.701***	***0.768***	***0.088***	***4.82***	***97***	***8.08***	***28***	***0.289***
GILMAN SPRINGS	***13***	***0.724***	***0.764***	***0.052***	***4.49***	***80***	***6.67***	***22***	***0.275***
SKEDADDLE/DRY VALLEY	***28***	***0.673***	***0.744***	***0.096***	***4.47***	***83***	***6.92***	***16***	***0.193***
S. OBSERVATION	**52**	**0.710**	**0.754**	**0.058**	**4.60**	**92**	**7.67**	**33**	**0.359**
Cleveland Bay	47	0.610	0.627	0.027	2.934	59	4.92	16	0.271
American Saddlebred	576	0.740	0.745	0.007	4.25	102	8.50	42	0.412
Andalusian	52	0.722	0.753	0.041	4.259	79	6.58	21	0.266
Arabian	47	0.660	0.727	0.092	3.814	86	7.17	30	0.349
Exmoor Pony	98	0.535	0.627	0.146	2.871	66	5.50	21	0.318
Friesian	304	0.545	0.539	-0.011	2.561	70	5.83	28	0.400
Irish Draught	135	0.802	0.799	-0.003	5.194	102	8.50	28	0.275
Morgan Horse	64	0.715	0.746	0.041	4.192	92	7.67	33	0.359
Suffolk Punch	57	0.683	0.711	0.038	3.878	71	5.92	13	0.183
Tennessee Walker	60	0.666	0.693	0.038	3.662	87	7.25	34	0.391
Thoroughbred	1195	0.734	0.726	-0.011	3.918	69	5.75	18	0.261
Feral Horse Mean	126	0.716	0.710	-0.012	3.866	72.68	6.06	16.96	0.222
Standard Deviation		0.056	0.059	0.071	0.657	13.02	1.09	7.98	0.088
Minimum		0.496	0.489	-0.284	2.148	37	3.08	0	0
Maximum		0.815	0.798	0.133	5.253	96	8.00	33	0.400
Domestic Horse Mean	80	0.710	0.720	0.012	4.012	80.88	6.74	23.79	0.283
Standard Deviation		0.078	0.071	0.086	0.735	16.79	1.40	10.11	0.082
Minimum		0.347	0.394	-0.312	1.779	26	2.17	0	0
Maximum		0.822	0.799	0.211	5.30	119	9.92	55	0.462

Table 3. Rogers' genetic similarity of the Twin Peaks HMA feral horse herd to major groups of domestic horses.

		Mean *S*	Std	Minimu	Maximum
Light Racing and Riding Breeds	TWIN PEAKS CA ALL	0.820	0.023	0.790	0.856
	GILMAN SPRINGS	0.799	0.017	0.772	0.819
	SKEDADDLE DRY WALLEY	0.793	0.020	0.772	0.821
	S OBSERVATION	0.806	0.025	0.774	0.842
Oriental and Arabian Breeds	TWIN PEAKS CA ALL	0.801	0.043	0.746	0.851
	GILMAN SPRINGS	0.779	0.043	0.721	0.817
	SKEDADDLE DRY WALLEY	0.778	0.040	0.719	0.823
	S OBSERVATION	0.787	0.040	0.741	0.838
Old World Iberian Breeds	TWIN PEAKS CA ALL	0.795	0.009	0.785	0.806
	GILMAN SPRINGS	0.769	0.013	0.749	0.781
	SKEDADDLE DRY WALLEY	0.781	0.007	0.771	0.788
	S OBSERVATION	0.778	0.010	0.766	0.791
New World Iberian Breeds	TWIN PEAKS CA ALL	0.791	0.038	0.715	0.838
	GILMAN SPRINGS	0.770	0.029	0.720	0.816
	SKEDADDLE DRY WALLEY	0.776	0.038	0.695	0.814
	S OBSERVATION	0.775	0.036	0.703	0.821
North American Gaited Breeds	TWIN PEAKS CA ALL	0.810	0.022	0.772	0.834
	GILMAN SPRINGS	0.788	0.027	0.747	0.827
	SKEDADDLE DRY WALLEY	0.783	0.024	0.746	0.818
	S OBSERVATION	0.798	0.017	0.766	0.814
Heavy Draft Breeds	TWIN PEAKS CA ALL	0.767	0.032	0.728	0.810
	GILMAN SPRINGS	0.749	0.023	0.726	0.781
	SKEDADDLE DRY WALLEY	0.749	0.027	0.715	0.788
	S OBSERVATION	0.755	0.034	0.712	0.800
True Pony Breeds	TWIN PEAKS CA ALL	0.722	0.058	0.643	0.780
	GILMAN SPRINGS	0.722	0.058	0.639	0.789
	SKEDADDLE DRY WALLEY	0.708	0.055	0.629	0.763
	S OBSERVATION	0.708	0.056	0.636	0.761

Figure 1. Partial RML tree of genetic similarity to domestic horse breeds.



Appendix 1. DNA data for the Twin Peaks HMA, CA herd.

Twin Peaks, Gilman Springgs

AID	Name	VHL20	HTG4	AHT4	HMS7	AHT5	HMS6	ASB2	HTG10	HMS3	ASB17	ASB23	LEX33	LEX3
51645	1	NN	MM	HJ	LL	KL	NP	KQ	MM	II	GR	LU	GQ	FF
51646	2	MP	MN	JK	LN	OO	NO	KQ	IO	NQ	NS	JK	LQ	MM
51647	3	PP	MM	OO	LO	KN	NN	KK	IM	PQ	MR	GU	KR	OO
51648	4	IN	LM	HJ	NN	JL	PP	MQ	IO	MM	HJ	KU	QQ	II
51649	5	NN	KM	HJ	LL	NN	LM	MN	IL	IQ	NR	KM	LQ	OO
51650	6	KN	MN	HO	LO	KO	PP	OQ	OO	IP	SY	LU	QQ	MM
51651	7	MR	LM	HK	JO	NN	LP	IK	II	MM	KN	JS	LQ	OO
51652	8	IL	LL	KO	LN	OO	PP	KM	KN	OO	MN	KL	QQ	OO
51653	9	IM	LL	HJ	MO	OO	PP	IK	KK	IR	MR	LU	LO	FF
51654	10	NR	KM	JO	MN	MO	KM	KO	MO	QR	MR	JS	LP	PP
51655	11	MP	MM	OO	KN	JN	LL	KR	OO	PP	RR	KS	LL	FF
51656	12	NN	MM	HJ	LO	KM	NP	NQ	KM	IM	RS	IU	QQ	OO
51657	13	IM	LN	IO	LQ	JN	MO	MN	LM	PR	GR	JR	LO	PP

Twin Peaks, Skedaddle/Dry Valley

AID	Name	VHL20	HTG4	AHT4	HMS7	AHT5	HMS6	ASB2	HTG10	HMS3	ASB17	ASB23	LEX33	LEX3
51659	1777	NP	MM	JK	OO	NO	PP	NN	MO	PQ	GS	IU	KQ	OO
51660	1779	PP	LM	HO	NO	IN	PP	MQ	IO	MP	GS	JS	QQ	II
51661	1780	IR	KM	JJ	LN	NN	KP	KM	II	MR	KR	JU	QQ	LO
51662	1782	IM	KK	HO	JL	JJ	MO	MR	KM	MN	NR	SS	RR	HH
51663	1783	IM	KM	HO	JJ	JN	MO	MR	KM	MN	RR	SS	RR	HH
51664	1784	LO	KM	HJ	LO	JJ	PP	IN	RR	NN	NQ	LL	QQ	MN
51665	1795	NN	MM	HK	LN	KL	PP	NN	OO	IP	GS	SU	QQ	FM
51666	1876	PQ	MP	HO	LO	KM	NP	NO	KR	IO	RR	LU	QR	FP
51667	1877	IQ	MM	HN	LN	LN	MO	NR	LM	RR	MR	LS	QR	HH
51668	1878	LO	KN	JO	LL	JJ	PP	IK	RR	NP	HN	LL	QQ	MM
51669	1879	LL	MN	HN	LO	NN	PP	KK	LR	PQ	GR	JK	OQ	FO
51670	1800	MN	MN	HJ	NO	NO	PP	QQ	OO	IP	NY	KL	KQ	IM
51671	1880	IP	LL	HO	NN	LN	PP	MN	OR	MP	HM	JL	KR	IN
51672	1881	NN	MM	HK	LN	KL	PP	NN	OO	IP	GS	SU	QQ	FM
51673	1795	IL	MM	JN	LL	NN	PP	KK	IR	QQ	OR	JJ	LQ	MO
51674	1882	NN	MM	JK	LL	MN	NP	KM	MO	MP	GR	JJ	LR	FP
51675	1883	PR	MP	KK	LO	KK	PP	KK	II	QR	KK	JU	QQ	FO
51676	1884	MP	MN	KK	LN	NO	NN	OQ	IN	NO	NN	KU	GL	FM
51677	1885	NP	LL	HO	NN	LN	PP	MM	IO	MP	HH	JU	KQ	II
51678	1886	NQ	MM	KO	JN	KN	LP	KM	MO	II	JR	KS	LL	HN
51679	1887	IK	MM	HK	OO	IO	PP	KN	LR	MP	MS	GJ	QQ	HI
51680	1888	NP	MM	HO	LO	IN	PP	KM	OR	PP	MR	JJ	LQ	IP
51681	1889	IQ	MM	OO	LO	NN	PP	MN	KO	IP	GM	IJ	QQ	II
51682	1890	IQ	KM	JO	KL	MN	NP	NN	KM	II	NR	GI	LR	NO
51683	1891	KM	MP	JJ	OO	KN	PP	OQ	OO	IP	GM	GU	QR	II
51684	1892	NN	NP	JO	LN	KN	PP	KN	OO	II	GM	KU	QQ	IN
51685	1893	PQ	LM	JO	NN	LO	PP	MO	KO	IM	HM	IJ	KL	II
51686	1894	IP	LM	IO	LO	NN	KO	NN	LR	PP	MR	KL	KO	LN
51687	1895	IM	LM	JK	LO	NN	NP	KQ	OO	MP	GY	GK	KR	IM

Twin Peaks, S. Observation

AID	Name	VHL20	HTG4	AHT4	HMS7	AHT5	HMS6	ASB2	HTG10	HMS3	ASB17	ASB23	LEX33	LEX3
51688	1906	IL	MM	HH	LL	JN	PP	KK	MM	PP	MR	KL	QQ	MN
51689	1907	LM	MP	HJ	KM	MO	PP	KM	RR	PP	HN	KS	LL	HM
51690	1913	NP	MM	JJ	LL	IO	OP	NR	LO	NQ	JR	KS	LO	FH
51691	1925	MN	MN	JO	LL	NN	PP	MO	IK	QQ	SY	KL	LO	NN
51692	1934	IL	MM	HO	LM	MO	LP	KN	MO	PP	QR	KK	LQ	FM
51693	1936	IQ	MM	HO	MN	KN	PP	KM	LR	IR	KM	KU	KK	HM
51694	1938	IL	MM	JO	LO	NN	MP	IM	IN	IP	GH	IL	KT	NO
51695	1940	NN	KK	JK	MN	OO	PP	IM	RR	IN	QR	UU	KK	FP
51696	1945	NN	KM	HJ	LN	JJ	MP	KO	OO	MN	NR	KS	LO	LM
51697	1948	PR	MM	JO	LN	HI	PP	MM	KO	IQ	MR	LS	KO	HL
51698	1958	PR	MM	JJ	LN	MO	PP	MO	OO	II	MR	JK	KL	HL
51699	1966	LP	MM	JJ	LN	OP	PP	IO	OO	II	QR	JJ	KL	OO
51700	1968	LQ	KN	JN	NN	NN	OP	MO	RR	NR	MP	JJ	QQ	FM
51701	1981	MR	MM	OO	LL	IP	PP	IM	KR	QQ	NQ	JS	LO	FL
51702	1988	OP	MN	NO	NN	JN	PP	IO	OO	II	MR	KS	KQ	LL
51703	1991	LO	MM	OO	NN	JN	LP	MO	OO	II	GM	JJ	QR	LL
51704	1992	MN	MM	JJ	JM	JJ	KP	KQ	LR	II	MM	UU	LL	FF
51705	1996	OO	LM	HJ	LM	MN	LP	KR	LR	MP	QR	JL	OQ	MO
51706	2004	PQ	KM	JO	LN	JN	LM	MM	IR	MP	NQ	KK	QR	FI
51707	2009	LP	MM	OO	NN	HI	LP	IN	OR	II	GM	JK	OR	NO
51708	2012	MM	MM	NO	LO	HJ	MM	NO	RR	IM	MN	LM	LO	MN
51709	2013	LP	MM	OO	NO	IJ	LO	IN	NO	IQ	MR	JS	OR	HN
51710	2017	OR	MM	NO	LN	IN	OP	IN	RR	NQ	GQ	JK	LR	LM
51711	2019	LP	MM	OO	NN	MO	PP	IM	KO	IN	GN	JK	KL	LO
51712	2024	LP	MM	OO	LN	IQ	PP	RR	NO	IN	MR	JK	LO	FO
51713	2048	NP	KM	HH	NN	JN	LM	NO	IR	IN	NS	LU	OR	NN
51714	2057	IM	MM	JJ	LO	KN	MP	KO	IR	II	OY	KL	OO	MM
51715	2063	LP	KK	JJ	JN	KN	LP	KM	LO	PP	OP	JK	LO	NN
51716	2071	OR	KN	LO	LN	JO	PP	IN	IO	NR	MR	JL	QQ	FF
51717	2075	IP	KM	IJ	KN	NO	MP	IN	NR	IQ	MN	JK	LQ	FF
51718	2076	IO	KN	HJ	LM	JJ	LP	KR	RR	NP	QS	IS	PR	OO
51719	2078	MM	KM	NO	LO	JM	KM	KM	IM	IM	QR	GS	LR	NN
51720	2079	IL	KM	OP	MO	JL	MM	KM	OO	NQ	GH	JL	QR	FF
51721	2082	IR	MM	OO	LL	IN	LM	MN	IR	IQ	GR	IS	OT	OO
51722	2084	LP	KM	JO	LN	NN	PP	IO	RR	IQ	GM	JK	QR	LL
51723	2086	IN	MM	HN	NO	JJ	MM	MO	MO	NP	NR	KS	LL	LL
51724	2088	LP	KK	JN	JJ	JN	KP	MN	OR	IP	GI	KK	RR	OO
51725	2089	IN	KM	HI	NO	JJ	LO	NN	MR	OQ	MM	SU	KO	PP
51726	2090	PR	MM	JO	LN	IM	PP	MM	OO	IQ	GR	JS	OO	LL
51727	2091	IO	LM	HO	LL	MM	PP	IR	LR	MN	NR	KK	OQ	NN
51728	2093	II	MM	HJ	LN	JO	OP	NO	RR	PQ	QR	KL	LQ	MM
51729	2100	LM	MN	JO	LM	IN	MM	NQ	KR	IP	MS	IJ	QR	NN
51730	2103	LM	KM	HH	MM	KO	LP	MN	RR	PQ	NR	HS	LQ	MM
51731	2105	MM	MM	OO	LL	MP	LP	MR	KO	QQ	NQ	JL	OO	LL
51732	2107	NN	KM	HO	LO	JK	PP	KR	IR	MQ	NQ	LS	QQ	NN
51733	2108	MO	MN	JO	LO	JL	LO	KR	OR	NQ	GR	IK	OQ	MM
51734	2109	LR	LL	NO	OO	MN	LP	MP	KO	II	RY	GL	LL	FF
51735	2110	PP	KM	JO	JN	NN	MP	KM	IR	IP	IQ	KK	QR	FF
51736	2111	PR	MM	JO	LL	MO	PP	IM	OO	II	RR	JK	LL	LL
51737	2112	LR	MM	HI	NO	JN	KP	NN	IL	NN	MN	JL	QQ	OO
51738	2114	IN	KM	JN	OO	JN	MP	KM	OR	NQ	HK	JS	KQ	LL
51739	2095	NN	MM	HL	LL	HN	MP	KM	MR	NR	KR	KL	QR	MM

Appendix O. Win Equus Population Modeling Results

To complete the population modeling for the Twin Peaks HMA, version 1.40 of the WinEquus program, created 02 April 2002 was utilized. This model was run using projected numbers based on the 2019 population estimate of 3,506 wild horses. WinEquus lacks a feature to model burro populations.

Objectives of Population Modeling

Review of data output for each of the simulations provided useful comparisons of possible outcomes for each alternative. Some questions that need to be answered through the modeling include:

- Do any of the alternatives “crash” the population
- Wat effect does fertility control have on the population growth rate?
- What effects do the different alternatives have on the average population size?
- What effects do the different alternatives have on the genetic health of the herd?

Population Data, Criteria, and Parameters Utilized for Population Modeling

All simulations used the survival probabilities supplied with the WinEquus population model for the Garfield Flat, Nevada (1993) for age-sex ratios and the Garfield Flat for foaling rates and survival probabilities. Age-sex ratio data were derived from horses gathered and marked in 1993 at Garfield Flat, Nevada. Survival probability values were calculated from data reported by Garrott and Taylor in 1990 (Journal of Wildlife Management 54:603-612) based on their 11-year study of the horse population at Pryor Mountain, Montana between 1976 and 1986. The calculations of average survival probabilities exclude one year in which there was catastrophic mortality of greater than 50% of the population due to severe winter weather. The foaling rates for 1976 to 1986 for horses at Garfield Flat, NV. Specific rates for the Twin Peaks HMA are not available.

<u>Contraception Parameters (Alternatives 1 and 2):</u>
Modeled data were run with assumed efficacies of 94% in year 1, 82% in year 2, and 68% in year 3.

Age	Percentages for Fertility Treatment
Foal	0%
1	0%
2	100%
3	100%
4	100%
5	100%
6	100%

Age	Percentages for Fertility Treatment
7	100%
8	100%
9	100%
10-14	100%
15-19	100%
20+	100%

Population Modeling Criteria

The following summarizes the population modeling criteria that are common to all action Alternatives:

- Starting Year: 2019
- Initial gather year: 2019
- Starting population size: 3506
- Gather interval: regular interval of three years
- Gather for fertility treatment regardless of population size: No
- Continue to gather after reduction to treat females: Yes
- Sex ratio at birth: 49% males
- Percent of the population that can be gathered: 60%
- Minimum age for long term holding facility horses: Not Applicable
- Foals are not included in the AML
- Simulations were run for 10 years with 100 trials each

Population Modeling Parameter

Modeling Parameter	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Management by removal, 60:40 sex ratio adjustment, fertility control	Yes	Yes	No	N/A
Management by removal only	No	No	Yes	N/A
Threshold population size following gathers	758	758	758	N/A
Target population size following gathers	650	448	448	N/A
Gather for fertility control regardless of population size	No	No	No	N/A
Gathers continue after removals to treat additional females	Yes	Yes	No	N/A
Fertility control efficacy: Year 1	94%	94%	N/A	N/A
Fertility control efficacy: Year 2	82%	82%	N/A	N/A
Fertility control efficacy: Year 3	68%	68%	N/A	N/A

Results of WinEquus Population Modeling

Population modeling was completed for the proposed action and alternatives. One hundred trials were run, simulating population growth and herd demographics to determine the projected herd structure. The computer program used simulates the population dynamics of wild horses. It was written by Dr. Stephen H. Jenkins, Department of Biology, University of Nevada, Reno, under a contract from the National Wild Horse and Burro Program of the Bureau of Land Management and is designed for use in comparing various management strategies for wild horses.

To date, one herd has been studied using the 2-year PZP vaccine. The Clan Alpine study, in Nevada, was started in January 2000 with the treatment of 96 mares. The test resulted in fertility rates in treated mares of 6% year one and 18% year two.

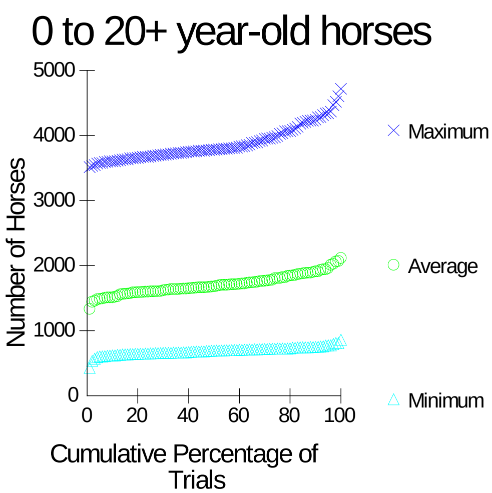
Results – Alternative 1 – Gather, Removal of Excess Wild Horses and Burros to Low-AML, Sex Ratio Adjustment and Population Growth Suppression

Explanation

Alternative 1 was not modeled through WinEquus, as there are not parameters that allow for modeling with a non-breeding herd component. Therefore, Alternative 1 cannot be accurately modeled to show future population, gathers, and growth rate trajectory.

Results – Alternative 2 – Phased-in Gather, Selective Removal of Excess Wild Horses and Burros to Low AML, Sex Ratio Adjustment, and Population Growth Suppression

Starting population 3506, gather when population exceeds 758, reduce population to 448, gather every 3 years, foals not included in AML, effectiveness of fertility control year 1 = 94%, year 2 = 82%, year 3 = 68%, after that 0, no fertility control to 0-1 years, all age classes = 100% efficacy, 60% of population can be gathered

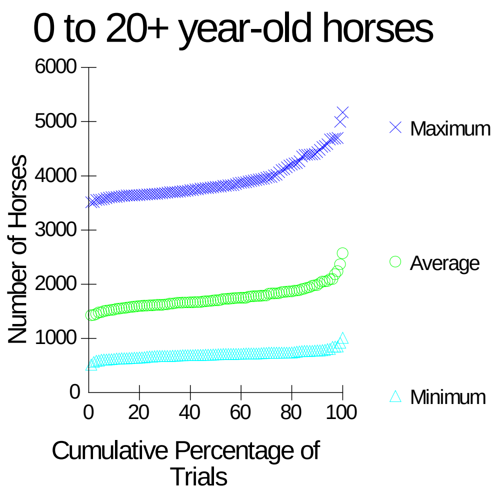


	Minimum	Average	Maximum
Lowest trial	428	1,335	3,513
10th percentile	620	1,518	3,604
25th percentile	652	1,604	3,682
Median trial	694	1,685	3,783
75th percentile	724	1,809	4,010
90th percentile	752	1,312	4,261
Highest trial	862	2,117	4,718

Results – Alternative 3 – Gather and Removal Only

Explanation

Starting population 3506, gather when population exceeds 758, reduce population to 448, gather every 3 years, foals not included in AML, 60% of population can be gathered



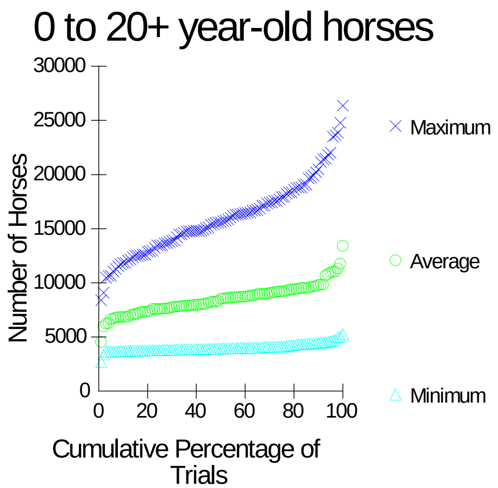
	Minimum	Average	Maximum
Lowest trial	514	1,426	3,512
10th percentile	624	1,537	3,609
25th percentile	668	1,610	3,664
Median trial	706	1,702	3,798
75th percentile	736	1,842	4,086
90th percentile	776	1,999	4,456
Highest trial	1,011	2,568	5,168

Results – Alternative 4 – Deferred Gather

Explanation

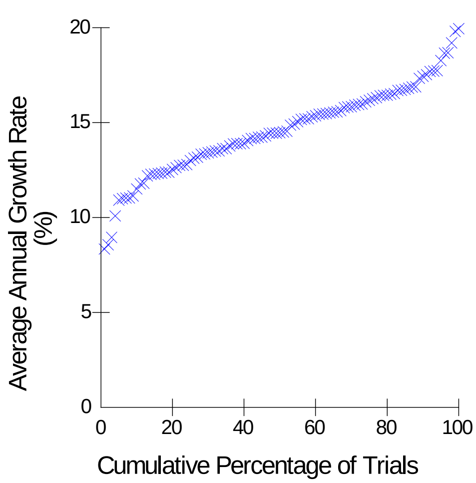
In 11 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 3,513 and the highest was 33,591. The average population size across 10 years ranged from 7,488 to 14,604.

Population Sizes in 10 Years*
*0 to 20+ year-old horses



	Minimum	Average	Maximum
Lowest trial	3,513	7,488	14,540
10th percentile	3,580	9,256	17,793
25th percentile	3,670	10,101	20,206
Median trial	3,799	11,237	23,117
75th percentile	4,006	12,389	26,252
90th percentile	4,202	13,219	29,412
Highest trial	4,547	14,604	33,591

Average growth rate in 10 years



Lowest trial	13.9%
10th percentile	117.1%
25th percentile	18.1%
Median trial	19.2%
75th percentile	20.3%
90th percentile	21.6%
Highest trial	23.5%

Appendix P. Effects of PZP, GonaCon, and Gelding and Literature Reviews

Porcine Zona Pellucida (PZP) Vaccine

PZP vaccines have been used on dozens of horse herds by the National Park Service, US Forest Service, Bureau of Land Management, and Native American tribes and its use is approved by the EPA for free-ranging wild horses. Taking into consideration available literature on the subject, the National Research Council concluded in their 2013 report that PZP was one of the preferable available methods for contraception in wild horses and burros (NRC 2013). PZP use can reduce the need for gathers and removals (Turner et al. 1997). PZP vaccines meet most of the criteria that the National Research Council (2013) used to identify promising fertility control methods, in terms of delivery method, availability, efficacy, and side effects. It has been used extensively in wild horses (NRC 2013), and in feral burros on Caribbean islands (Turner et al. 1996, French et al. 2017). PZP is relatively inexpensive, meets BLM requirements for safety to mares and the environment, and is produced as ZonaStat-H, an EPA-registered commercial product (EPA 2012, SCC 2015), or as PZP-22, which is a formulation of PZP in polymer pellets that can lead to a longer immune response (Turner et al. 2002, Rutberg et al. 2017). ‘Native’ PZP proteins can be purified from pig ovaries (Liu et al. 1989). Recombinant ZP proteins may be produced with molecular techniques (Gupta and Minhas 2017, Joonè et al. 2017a). It can easily be remotely administered in the field in cases where mares are relatively approachable. Use of remotely delivered (dart-delivered) vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached within 50 m (BLM 2010).

The BLM currently uses two PZP formulations for fertility control of wild horse mares, ZonaStat-H (PZP Native) and PZP-22. As other formulations are approved for use by BLM, they may be applied through future gathers or darting activities. For the purpose of this management plan, field or remote darting refers to applying the vaccine using a dart. Darting can be implemented when animals are gathered into corrals or opportunistically by applicators near water sources or along main WH&B trails out on the range. Blinds may be used to camouflage applicators to allow efficient treatment of as many mares as possible. PZP can also be applied via hand injections using plastic syringes when animals are gathered into corrals and chutes. In keeping with the EPA registration for ZonaStat-H (EPA 2012; reg. no. 86833-1), certification through the Science and Conservation Center in Billings Montana is required to apply that vaccine to equids.

When applying native PZP (i.e., ZonaStat-H), first the primer with modified Freund’s Complete adjuvant is given and then the booster with Freund’s Incomplete adjuvant is given 2-6 weeks later. Preferably, the timing of the booster dose is at least 1-2 weeks prior to the onset of breeding activity. Following the initial 2 inoculations, annual boosters are required to maintain contraception. For maximum effectiveness, PZP would be administered within the December to February timeframe. The procedures to be followed for application of PZP are detailed in Appendix E. *Standard Operating Procedures for Population-level Porcine Zona Pellucida Fertility control treatments.*

For the PZP-22 formulation administered during gathers, each released mare would receive a single dose of the PZP-22 contraceptive vaccine pellets at the same time as a dose of the liquid PZP vaccine with modified Freund’s Complete adjuvant. The pellets are applied to the mare with a large gauge needle and jab-stick into the hip. Although PZP-22 pellets have been delivered via darting in trial studies (Rutberg et al 2017), BLM does not plan to use darting for PZP-22 delivery in this HMA until there is more demonstration that PZP-22 can be reliably delivered via dart. Therefore, WH&Bs must be gathered for each application of this formulation.

PZP Direct Effects

The historically accepted hypothesis explaining PZP vaccine effectiveness posits that when injected as an antigen in vaccines, PZP causes the mare's immune system to produce antibodies that are specific to zona pellucida proteins on the surface of that mare's eggs. The antibodies bind to the mare's eggs surface proteins (Liu et al. 1989), and effectively block sperm binding and fertilization (Zoo Montana, 2000). Because treated mares do not become pregnant but other ovarian functions remain generally unchanged, PZP can cause a mare to continue having regular estrus cycles throughout the breeding season. More recent observations support a complementary hypothesis, which posits that PZP vaccination causes reductions in ovary size and function (Mask et al. 2015, Joonè et al. 2017b, Joonè et al. 2017c). Antibodies specific to PZP protein do not crossreact with tissues outside of the reproductive system (Barber and Fayrer-Hosken 2000).

Research has demonstrated that contraceptive efficacy of an injected liquid PZP vaccine, such as ZonaStat-H, is approximately 90 percent or more for mares treated twice in one year (Turner and Kirkpatrick 2002, Turner et al. 2008). The highest success for fertility control has been reported when the vaccine has been applied November through February. High contraceptive rates of 90 percent or more can be maintained in horses that are boostered annually (Kirkpatrick et al. 1992). Approximately 60 percent to 85 percent of mares are successfully contracepted for one year when treated simultaneously with a liquid primer and PZP-22 pellets (Rutberg et al. 2017). Application of PZP for fertility control would reduce fertility in a large percentage of mares for at least one year (Ransom et al. 2011).

The contraceptive result for a single application of the liquid PZP vaccine primer dose along with PZP vaccine pellets (PZP-22), based on winter applications, can be expected to fall in the approximate efficacy ranges as follows (based on figure 2 in Rutberg et al. 2017). Below, the approximate efficacy is measured as the relative decrease in foaling rate for treated mares, compared to control mares:

Year 1	Year 2	Year 3
0 (developing fetuses come to term)	~30-75 percent	~20-50 percent

If mares that have been treated with PZP-22 vaccine pellets subsequently receive a booster dose of either the liquid PZP vaccine or the PZP-22 vaccine pellets, the subsequent contraceptive effect is apparently more pronounced and long-lasting. The approximate efficacy following a booster dose can be expected to be in the following ranges (based on figure 3 in Rutberg et al. 2017).

Year 1	Year 2	Year 3	Year 4
0 (developing fetuses come to term)	~50-90 percent	~55-75 percent	~40-75 percent

The efficacies noted above, which are based on results in Rutberg et al. (2017), call into question population and economic models that assume PZP-22 can have an 85 percent efficacy in years 2 and 3 after immunization, such as Fonner and Bohara (2017).

The fraction of mares treated in a herd can have a large effect on the realized change in growth rate due to PZP contraception, with an extremely high portion of mares required to be treated to lead prevent population-level growth (e.g., Turner and Kirkpatrick 2002). Gather efficiency would likely not exceed 85 percent via helicopter, and may be less with bait and water trapping, so there would be a portion of the female population uncaptured that is not treated in any given year. Additionally, some mares may not respond to the fertility control vaccine, but instead may continue to foal normally.

Reversibility and Effects on Ovaries

In most cases, PZP contraception appears to be temporary and reversible, with most treated mares returning to fertility over time (Kirkpatrick and Turner 2002). The NRC (2013) criterion by which PZP is not optimal for wild horse contraception was duration. The ZonaStat-H formulation of the vaccine tends to confer only one year of efficacy per dose. Some studies have found that a PZP vaccine in long-lasting pellets (PZP-22) can confer multiple years of contraception (Turner et al. 2007), particularly when boostered with subsequent PZP vaccination (Rutberg et al. 2017). Other trial data, though, indicate that the pelleted vaccine may only be effective for one year (J. Turner, University of Toledo, Personal Communication).

The purpose of applying PZP treatment is to prevent mares from conceiving foals, but BLM acknowledges that long-term infertility, or permanent sterility, could be a result for some number of wild horses receiving PZP vaccinations. The rate of long-term or permanent sterility following vaccinations with PZP is hard to predict for individual horses, but that outcome appears to increase in likelihood as the number of doses increases (Kirkpatrick and Turner 2002). Permanent sterility for mares treated consecutively 5-7 years was observed by Nuñez et al. (2010, 2017). In a graduate thesis, Knight (2014) suggested that repeated treatment with as few as three to four years of PZP treatment may lead to longer-term sterility, and that sterility may result from PZP treatment before puberty. Repeated treatment with PZP led long-term infertility in Przewalski's horses receiving as few as one PZP booster dose (Feh 2012). However, even if some number of mares become sterile as a result of PZP treatment, that potential result would be consistent with the contraceptive purpose that motivates BLM's potential use of the vaccine.

In some mares, PZP vaccination may cause direct effects on ovaries (Gray and Cameron 2010, Joonè et al. 2017b, Joonè et al. 2017c, Joonè et al. 2017d). Joonè et al. (2017a) noted reversible effects on ovaries in mares treated with one primer dose and booster dose. Joonè et al. (2017c) documented decreased anti-Mullerian hormone (AMH) levels in mares treated with native or recombinant PZP vaccines; AMH levels are thought to be an indicator of ovarian function. Bechert et al. (2013) found that ovarian function was affected by the SpayVac PZP vaccination, but that there were no effects on other organ systems. Mask et al. (2015) demonstrated that equine antibodies that resulted from SpayVac immunization could bind to oocytes, ZP proteins, follicular tissues, and ovarian tissues. It is possible that result is specific to the immune response to SpayVac, which may have lower PZP purity than ZonaStat or PZP-22 (Hall et al. 2016). However, in studies with native ZP proteins and recombinant ZP proteins, Joonè et al. (2017a) found transient effects on ovaries after PZP vaccination in some treated mares; normal estrus cycling had resumed 10 months after the last treatment. SpayVac is a patented formulation of PZP in liposomes that led to multiple years of infertility in some breeding trials (Killian et al. 2008, Roelle et al. 2017, Bechert and Fraker 2018), but unacceptably poor efficacy in a subsequent trial (Kane 2018). Kirkpatrick et al. (1992) noted effects on horse ovaries after three years of treatment with PZP. Observations at Assateague Island National Seashore indicate that the more times a mare is consecutively treated, the longer the time lag before fertility returns, but that even mares treated 7 consecutive years did eventually return to ovulation (Kirkpatrick and Turner 2002). Other studies have reported that continued applications of PZP may result in decreased estrogen levels (Kirkpatrick et al. 1992) but that decrease was not biologically significant, as ovulation remained similar between treated and untreated mares (Powell and Monfort 2001). Permanent sterility for mares treated consecutively 5-7 years was observed by Nuñez et al. (2010, 2017). Bagavant et al. (2003) demonstrated T-cell clusters on ovaries, but no loss of ovarian function after ZP protein immunization in macaques. Skinner et al. (1984) raised concerns about PZP effects on ovaries, based on their study in laboratory rabbits, as did Kaur and Prabha (2014), though neither paper was a study of PZP effects in equids.

Effects on Existing Pregnancies, Foals, and Birth Phenology

If a mare is already pregnant, the PZP vaccine has not been shown to affect normal development of the fetus or foal, or the hormonal health of the mare with relation to pregnancy (Kirkpatrick and Turner 2003). It is possible that there may be transitory effects on foals born to mares or jennies treated with PZP. In mice, Sacco et al. (1981) found that antibodies specific to PZP can pass from mother mouse to pup via the placenta or colostrum, but that did not apparently cause any innate immune response in the offspring: the level of those antibodies were undetectable by 116 days after birth. There was no indication in that study that the fertility or ovarian function of those mouse pups was compromised, nor is BLM aware of any such results in horses or burros. Unsubstantiated speculative connections between PZP treatment and foal stealing has not been published in a peer-reviewed study and thus cannot be verified. Similarly, although Nettles (1997) noted reported stillbirths after PZP treatments in cynomolgus monkeys, those results have not been observed in equids despite extensive use.

On-range observations from 20 years of application to wild horses indicate that PZP vaccine use in wild mares does not generally cause mares to give birth to foals out of season or late in the year (Kirkpatrick and Turner 2003). Nuñez's (2010) research showed that a small number of mares that had previously been treated with PZP foaled later than untreated mares and expressed the concern that this late foaling "may" impact foal survivorship and decrease band stability, or that higher levels of attention from stallions on PZP-treated mares might harm those mares. However, that paper provided no evidence that such impacts on foal survival or mare well-being actually occurred. Rubenstein (1981) called attention to a number of unique ecological features of horse herds on Atlantic barrier islands, which calls into question whether inferences drawn from island herds can be applied to western wild horse herds. Ransom et al. (2013), though, identified a potential shift in reproductive timing as a possible drawback to prolonged treatment with PZP, stating that treated mares foaled on average 31 days later than non-treated mares. Results from Ransom et al. (2013), however, showed that over 81percent of the documented births in this study were between March 1 and June 21, i.e., within the normal, peak, spring foaling season. Ransom et al. (2013) pointedly advised that managers should consider carefully before using PZP in small refugia or rare species. Wild horses and burros managed by BLM do not generally occur in isolated refugia, nor are they rare species. Moreover, an effect of shifting birth phenology was not observed uniformly: in two of three PZP-treated wild horse populations studied by Ransom et al. (2013), foaling season of treated mares extended three weeks and 3.5 months, respectively, beyond that of untreated mares. In the other population, the treated mares foaled within the same time period as the untreated mares. Furthermore, Ransom et al. (2013) found no negative impacts on foal survival even with an extended birthing season. If there are shifts in birth phenology, though, it is reasonable to assume that some negative effects on foal survival might result from particularly severe weather events (Nuñez et al. 2018).

Effects of Marking and Injection
Standard practices for PZP treatment require that immunocontraceptive-treated animals be readily identifiable, either via brand marks or unique coloration (BLM 2010). BLM has instituted guidelines to reduce the sources of handling stress in captured animals (BLM 2015). Some level of transient stress is likely to result in newly captured mares that do not have markings associated with previous fertility control treatments. It is difficult to compare that level of temporary stress with long-term stress that can result from food and water limitation on the range (e.g., Creel et al. 2013). Handling may include freezemarking, for the purpose of identifying that mare and identifying her PZP vaccine treatment history. Under past management practices, captured mares experienced increased stress levels from handling (Ashley and Holcombe 2001). Markings may also be used into the future to determine the approximate fraction of mares in a herd that have been previously treated, and could provide additional insight regarding gather efficiency.

Most mares recover from the stress of capture and handling quickly once released back to the HMA, and none are expected to suffer serious long term effects from the fertility control injections, other than the direct consequence of becoming temporarily infertile. Injection site reactions associated with fertility control treatments are possible in treated mares (Roelle and Ransom 2009, Bechert et al. 2013, French et al. 2017), but swelling or local reactions at the injection site are expected to be minor in nature. Roelle and Ransom (2009) found that the most time-efficient method for applying PZP is by hand-delivered injection of 2-year pellets when horses are gathered. They observed only two instances of swelling from that technique. Use of remotely delivered, 1-year PZP is generally limited to populations where individual animals can be accurately identified and repeatedly approached. The dart-delivered formulation produced injection-site reactions of varying intensity, though none of the observed reactions appeared debilitating to the animals (Roelle and Ransom 2009). Joonè et al. (2017a) found that injection site reactions had healed in most mares within 3 months after the booster dose, and that they did not affect movement or cause fever. The longer term nodules observed did not appear to change any animal's range of movement or locomotor patterns and in most cases did not appear to differ in magnitude from naturally occurring injuries or scars.

Indirect Effects
One expected long-term, indirect effect on wild horses treated with fertility control would be an improvement in their overall health (Turner and Kirkpatrick 2002). Many treated mares would not experience the biological stress of reproduction, foaling and lactation as frequently as untreated mares. The observable measure of improved health is higher body condition scores (Nuñez et al. 2010). After a treated mare returns to fertility, her future foals would be expected to be healthier overall, and would benefit from improved nutritional quality in the mare's milk. This is particularly to be expected if there is an improvement in rangeland forage quality at the same time, due to reduced wild horse population size. Past application of fertility control has shown that mares' overall health and body condition remains improved even after fertility resumes. PZP treatment may increase mare survival rates, leading to longer potential lifespan (Turner and Kirkpatrick 2002, Ransom et al. 2014a). To the extent that this happens, changes in lifespan and decreased foaling rates could combine to cause changes in overall age structure in a treated herd (i.e., Turner and Kirkpatrick 2002, Roelle et al. 2010), with a greater prevalence of older mares in the herd (Gross 2000). Observations of mares treated in past gathers showed that many of the treated mares were larger than, maintained higher body condition than, and had larger healthy foals than untreated mares.

Following resumption of fertility, the proportion of mares that conceive and foal could be increased due to their increased fitness; this has been called a 'rebound effect.' Elevated fertility rates have been observed after horse gathers and removals (Kirkpatrick and Turner 1991). More research is needed to document and quantify these hypothesized effects in PZP-treated herds. If repeated contraceptive treatment leads to a prolonged contraceptive effect, then that may minimize or delay the hypothesized rebound effect. Selectively applying contraception to older animals and returning them to the HMA could reduce long-term holding costs for such horses, which are difficult to adopt, and may reduce the compensatory reproduction that often follows removals (Kirkpatrick and Turner 1991).

Because successful fertility control would reduce foaling rates and population growth rates, another indirect effect should be to reduce the number of wild horses that have to be removed over time to achieve and maintain the established AML. Contraception would be expected to lead to a relative increase in the fraction of older animals in the herd. Reducing the numbers of wild horses that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild horses, and thereby could eliminate the need to send additional excess horses from this area to off-range holding corrals or pastures for long-term holding. Among mares in the herd that remain fertile, a high level of physical health and future reproductive success would be expected because reduced population sizes should lead to more availability of water and forage resources per capita.

Reduced population growth rates and smaller population sizes could also allow for continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse habitat quality. As the population nears or is maintained at the level necessary to achieve a thriving natural ecological balance, vegetation resources would be expected to recover, improving the forage available to wild horses and wildlife throughout the HMA. With rangeland conditions more closely approaching a thriving natural ecological balance, and with a less concentrated distribution of wild horses across the HMA, there should also be less trailing and concentrated use of water sources. Lower population density would be expected to lead to reduced competition among wild horses using the water sources, and less fighting among horses accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild horses. Wild horses would also have to travel less distance back and forth between water and desirable foraging areas. Should PZP booster treatment continue into the future, there may be fewer instances ofoverpopulation and large gathers and removals, but instead a consistent cycle of balance and stability would ensue, resulting in continued improvement of overall habitat conditions and animal health. While it is conceivable that widespread and continued treatment with PZP could reduce the birth rates of the population to such a point that birth is consistently below mortality, that outcome is not likely unless a very high fraction of the mares present are all treated in almost every year.

Behavioral Effects
The NRC report (2013) noted that all fertility suppression has effects on mare behavior, mostly as a result of the lack of pregnancy and foaling, and concluded that PZP was a good choice for use in the program. The result that PZP-treated mares may continue estrus cycles throughout the breeding season can lead to behavioral differences (as discussed below), when compared to mares that are fertile. Such behavioral differences should be considered as potential consequences of successful contraception.

Ransom and Cade (2009) delineate behaviors that can be used to test for quantitative differences due to treatments. Ransom et al. (2010) found no differences in how PZP-treated and untreated mares allocated their time between feeding, resting, travel, maintenance, and most social behaviors in three populations of wild horses, which is consistent with Powell's (1999) findings in another population. Likewise, body condition of PZP-treated and control mares did not differ between treatment groups in Ransom et al.'s (2010) study. Nuñez (2010) found that PZP-treated mares had higher body condition than control mares in another population, presumably because energy expenditure was reduced by the absence of pregnancy and lactation. Knight (2014) found that PZP-treated mares had better body condition, lived longer and switched harems more frequently, while mares that foaled spent more time concentrating on grazing and lactation and had lower overall body condition. Studies on Assateague Island (Kirkpatrick and Turner 2002) showed that once fillies (female foals) that were born to mares treated with PZP during pregnancy eventually breed, they produce healthy, viable foals.

In two studies involving a total of four wild horse populations, both Nuñez et al. (2009) and Ransom et al. (2010) found that PZP-treated mares were involved in reproductive interactions with stallions more often than control mares, which is not surprising given the evidence that PZP-treated females of other mammal species can regularly demonstrate estrus behavior while contracepted (Shumake and Killian 1997, Heilmann et al. 1998, Curtis et al. 2001, Duncan et al. 2017). There was no evidence, though, that mare welfare was affected by the increased level of herding by stallions noted in Ransom et al. (2010). Nuñez's later analysis (2017) noted no difference in mare reproductive behavior as a function of contraception history.

Ransom et al. (2010) found that control mares were herded by stallions more frequently than PZP-treated mares, and Nuñez et al. (2009, 2014, 2017, 2018) found that PZP-treated mares exhibited higher infidelity to their band stallion during the non-breeding season than control mares. Madosky et al. (2010) and

Knight (2014) found this infidelity was also evident during the breeding season in the same population that Nuñez et al. (2009, 2010, 2014, 2017, 2018) studied. Nuñez et al. (2014, 2017, 2018) concluded that PZP-treated mares changing bands more frequently than control mares could lead to band instability. Nuñez et al. (2009), though, cautioned against generalizing from that island population to other herds. Nuñez et al. (2014) found elevated levels of fecal cortisol, a marker of physiological stress, in mares that changed bands. The research is inconclusive as to whether all the mares' movements between bands were related to the PZP treatments themselves or the fact that the mares were not nursing a foal, and did not demonstrate any long-term negative consequence of the transiently elevated cortisol levels. Nuñez et al. 2014 wrote that these effects "…may be of limited concern when population reduction is an urgent priority." Nuñez (2018) noted (based on unpublished results) that band stallions of mares that have received PZP treatment can exhibit changes in behavior and physiology. Nuñez (2018) cautioned that PZP use may limit the ability of mares to return to fertility, but also noted that, "such aggressive treatments may be necessary when rapid reductions in animal numbers are of paramount importance…If the primary management goal is to reduce population size, it is unlikely (and perhaps less important) that managers achieve a balance between population control and the maintenance of more typical feral horse behavior and physiology."

In contrast to transient stresses, Creel et al. (2013) highlight that variation in population density is one of the most well-established causal factors of chronic activation of the hypothalamic-pituitary-adrenal axis, which mediates stress hormones; high population densities and competition for resources can cause chronic stress. Creel et al. (2013) also state that "…there is little consistent evidence for a negative association between elevated baseline glucocorticoids and fitness." Band fidelity is not an aspect of wild horse biology that is specifically protected by the Wild Horse and Burro Act of 1971. It is also notable that Ransom et al. (2014b) found higher group fidelity after a herd had been gathered and treated with a contraceptive vaccine; in that case, the researchers postulated that higher fidelity may have been facilitated by the decreased competition for forage after excess horses were removed. At the population level, available research does not provide evidence of the loss of harem structure among any herds treated with PZP. Long-term implications of these changes in social behavior are currently unknown, but no negative impacts on the overall animals or populations overall, long-term welfare or well-being have been established in these studies.

The National Research Council (2013) found that harem changing was not likely to result in serious adverse effects for treated mares:

> "The studies on Shackleford Banks (Nuñez et al., 2009; Madosky et al., 2010) suggest that there is an interaction between pregnancy and social cohesion. The importance of harem stability to mare well-being is not clear, but considering the relatively large number of free-ranging mares that have been treated with liquid PZP in a variety of ecological settings, the likelihood of serious adverse effects seem low."

Nuñez (2010) stated that not all populations will respond similarly to PZP treatment. Differences in habitat, resource availability, and demography among conspecific populations will undoubtedly affect their physiological and behavioral responses to PZP contraception, and need to be considered. Kirkpatrick et al. (2010) concluded that: "the larger question is, even if subtle alterations in behavior may occur, this is still far better than the alternative," and that the "…other victory for horses is that every mare prevented from being removed, by virtue of contraception, is a mare that will only be delaying her reproduction rather than being eliminated permanently from the range. This preserves herd genetics, while gathers and adoption do not."

The NRC report (2013) provides a comprehensive review of the literature on the behavioral effects of contraception that puts research up to that date by Nuñez et al. (2009, 2010) into the broader context of all of the available scientific literature, and cautions, based on its extensive review of the literature that:

> ". . . in no case can the committee conclude from the published research that the behavior differences observed are due to a particular compound rather than to the fact that treated animals had no offspring during the study. That must be borne in mind particularly in interpreting long-term impacts of contraception (e.g., repeated years of reproductive "failure" due to contraception)."

Genetic Effects of PZP Vaccination

In HMAs where large numbers of wild horses have recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses, contraception is not expected to cause an unacceptable loss of genetic diversity or an unacceptable increase in the inbreeding coefficient. In any diploid population, the loss of genetic diversity through inbreeding or drift can be prevented by large effective breeding population sizes (Wright 1931) or by introducing new potential breeding animals (Mills and Allendorf 1996). The NRC report (2013) recommended that single HMAs should not be considered as isolated genetic populations. Rather, managed herds of wild horses should be considered as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements. Introducing 1-2 mares every generation (about every 10 years) is a standard management technique that can alleviate potential inbreeding concerns (BLM 2010).

In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM, such that most alleles that are present in any given mare are likely to already be well represented in her siblings, cousins, and more distant relatives. With the exception of horses in a small number of well-known HMAs that contain a relatively high fraction of alleles associated with old Spanish horse breeds (NRC 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with admixtures from domestic breeds. As a result, in most HMAs, applying fertility control to a subset of mares is not expected to cause irreparable loss of genetic diversity. Improved longevity and an aging population are expected results of contraceptive treatment that can provide for lengthening generation time; this result would be expected to slow the rate of genetic diversity loss (Hailer et al. 2006). Based on a population model, Gross (2000) found that a strategy to preferentially treat young animals with a contraceptive led to more genetic diversity being retained than either a strategy that preferentially treats older animals, or a strategy with periodic gathers and removals.

Even if it is the case that repeated treatment with PZP may lead to prolonged infertility, or even sterility in some mares, most HMAs have only a low risk of loss of genetic diversity if logistically realistic rates of contraception are applied to mares. Wild horses in most herd management areas are descendants of a diverse range of ancestors coming from many breeds of domestic horses. As such, the existing genetic diversity in the majority of HMAs does not contain unique or historically unusual genetic markers. Past interchange between HMAs, either through natural dispersal or through assisted migration (i.e., human movement of horses) means that many HMAs are effectively indistinguishable and interchangeable in terms of their genetic composition. Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity, in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Their results show that the risk of the loss of genetic heterozygosity is extremely low except in case where all of the following conditions are met: starting levels of genetic diversity are low, initial population size is 100 or less, the intrinsic population growth rate is low (5percent per year), and very large fractions of the female population are permanently sterilized.

It is worth noting that, although maintenance of genetic diversity at the scale of the overall population of wild horses is an intuitive management goal, there are no existing laws or policies that require BLM to maintain genetic diversity at the scale of the individual herd management area or complex. Also, there is no Bureau-wide policy that requires BLM to allow each female in a herd to reproduce before she is treated with contraceptives.

One concern that has been raised with regards to genetic diversity is that treatment with immunocontraceptives could possibly lead to an evolutionary increase in the frequency of individuals whose genetic composition fosters weak immune responses (Cooper and Larson 2006, Ransom et al. 2014a).Many factors influence the strength of a vaccinated individual's immune response, potentially including genetics, but also nutrition, body condition, and prior immune responses to pathogens or other antigens (Powers et al. 2013). This premise is based on an assumption that lack of response to PZP is a heritable trait, and that the frequency of that trait will increase over time in a population of PZP-treated animals. Cooper and Herbert (2001) reviewed the topic, in the context of concerns about the long-term effectiveness of immunocontraceptives as a control agent for exotic species in Australia. They argue that imunocontraception could be a strong selective pressure, and that selecting for reproduction in individuals with poor immune response could lead to a general decline in immune function in populations where such evolution takes place. Other authors have also speculated that differences in antibody titer responses could be partially due to genetic differences between animals (Curtis et al. 2001, Herbert and Trigg 2005). However, Magiafolou et al. (2013) clarify that if the variation in immune response is due to environmental factors (i.e., body condition, social rank) and not due to genetic factors, then there will be no expected effect of the immune phenotype on future generations. It is possible that general health, as measured by body condition, can have a causal role in determining immune response, with animals in poor condition demonstrating poor immune reactions (NRC 2013).

Correlations between physical factors and immune response would not preclude, though, that there could also be a heritable response to immunocontraception. In studies not directly related to immunocontraception, immune response has been shown to be heritable (Kean et al. 1994, Sarker et al. 1999). Unfortunately, predictions about the long-term, population-level evolutionary response to immunocontraceptive treatments are speculative at this point, with results likely to depend on several factors, including: the strength of the genetic predisposition to not respond to PZP; the heritability of that gene or genes; the initial prevalence of that gene or genes; the number of mares treated with a primer dose of PZP (which generally has a short-acting effect); the number of mares treated with multiple booster doses of PZP; and the actual size of the genetically-interacting metapopulation of horses within which the PZP treatment takes place.

BLM is not aware of any studies that have quantified the heritability of a lack of response to immunocontraception such as PZP vaccine or GonaCon-Equine in horses. At this point there are no studies available from which one could make conclusions about the long-term effects of sustained and widespread immunocontraception treatments on population-wide immune function. Although a few, generally isolated, feral horse populations have been treated with high fractions of mares receiving PZP immunocontraception for long-term population control (e.g., Assateague Island and Pryor Mountains), no studies have tested for changes in immune competence in those areas. Relative to the large number of free-roaming feral horses in the western United States, immunocontraception has not been used in the type of widespread or prolonged manner that might be required to cause a detectable evolutionary response.

Although this topic may merit further study, lack of clarity should not preclude the use of immunocontraceptives to help stabilize extremely rapidly growing herds.

Gonadotropin Releasing Hormone (GnRH) Vaccine (GonaCon)

This literature review is intended to summarize what is known and what is not known about potential effects of treating mares with GonaCon. As noted below, some negative consequences of vaccination are possible. Anti-GnRH vaccines can be administered to either sex, but this analysis is limited to effects on females, except where inferences can be made to females, based on studies that have used the vaccine in males.

Whether to use or not use this method to reduce population growth rates in wild horses is a decision that must be made considering those effects as well as the potential effects of inaction, such as continued overpopulation and rangeland health degradation.

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Registration and safety of GonaCon-Equine

Taking into consideration available literature on the subject, the National Research Council concluded in their 2013 report that GonaCon-B (which is produced under the trade name GonaCon-Equine for use in feral horses and burros) was one of the most preferable available methods for contraception in wild horses and burros (NRC 2013), in terms of delivery method, availability, efficacy, and side effects. GonaCon-Equine is approved for use by authorized federal, state, tribal, public and private personnel, for application to wild and feral equids in the United States (EPA 2013, 2015). Its use is appropriate for free-ranging wild horse herds. GonaCon-Equine has been used on feral horses in Theodore Roosevelt National Park and on wild horses by BLM (BLM 2015). GonaCon-Equine can be remotely administered in the field in cases where mares are relatively approachable, using a customized pneumatic dart (McCann et al. 2017). Use of remotely delivered (dart-delivered) vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached within 50 m (BLM 2010).

GonaCon is an immunocontraceptive vaccine which has been shown to provide multiple years of infertility in several wild ungulate species, including horses (Killian et al., 2008; Gray et al., 2010). GonaCon uses the gonadotropin-releasing hormone (GnRH), a small neuropeptide that performs an obligatory role in mammalian reproduction, as the vaccine antigen. When combined with an adjuvant, the GnRH vaccine stimulates a persistent immune response resulting in prolonged antibody production against GnRH, the carrier protein, and the adjuvant (Miller et al., 2008). The most direct result of successful GnRH vaccination is that it has the effect of decreasing the level of GnRH signaling in the body, as evidenced by a drop in luteinizing hormone levels, and a cessation of ovulation. The lack of estrus cycling that results from successful GonaCon vaccination has been compared to typical winter period of anoestrus in open mares. As anti-GnRH antibodies decline over time, concentrations of available endogenous GnRH increase and treated animals usually regain fertility (Power et al., 2011).

As with other contraceptives applied to wild horses, the long-term goal of GonaCon-Equine use is to reduce or eliminate the need for gathers and removals (NRC 2013). GonaCon-Equine vaccine is an EPA-approved pesticide (EPA 2009a) that is relatively inexpensive, meets BLM requirements for safety to mares and the environment, and is produced in a USDA-APHIS laboratory. The intended effect of the vaccine is as a contraceptive. GonaCon is produced as a pharmaceutical-grade vaccine, including aseptic manufacturing technique to deliver a sterile vaccine product (Miller et al. 2013). If stored at 4° C, the shelf life is 6 months (Miller et al 2013).

Miller et al. (2013) reviewed the vaccine environmental safety and toxicity. When advisories on the product label (EPA 2015) are followed, the product is safe for users and the environment (EPA 2009b).

EPA waived a number of tests prior to registering the vaccine, because GonaCon was deemed to pose low risks to the environment, so long as the product label is followed (Wang-Cahill et al., *in press*).

Under the Proposed Action, the BLM would return to the HMA as needed to re-apply GonaCon-Equine and initiate new treatments in order to maintain contraceptive effectiveness in controlling population growth rates. GonaCon-Equine can safely be reapplied as necessary to control the population growth rate; booster dose effects may lead to increased effectiveness of contraception, which is generally the intent. Even with one booster treatment of GonaCon-Equine, it is expected that most, if not all, mares would return to fertility at some point, although the average duration of effect after booster doses has not yet been quantified. Although it is unknown what would be the expected rate for the return to fertility rate in mares boosted more than once with GonaCon-Equine, a prolonged return to fertility would be consistent with the desired effect of using GonaCon (e.g., effective contraception). Once the herd size in the project area is at AML and population growth seems to be stabilized, BLM could make a determination as to the required frequency of new mare treatments and mare re-treatments with GonaCon, to maintain the number of horses within AML.

GnRH Vaccine Direct Effects

GonaCon-Equine is one of several vaccines that have been engineered to create an immune response to the gonadotropin releasing hormone peptide (GnRH). GnRH is a small peptide that plays an important role in signaling the production of other hormones involved in reproduction in both sexes. GnRH is highly conserved across mammalian taxa, so some inferences about the mechanism and effects of GonaCon-Equine in horses can be made from studies that used different anti-GnRH vaccines, in horses and other taxa. Other commercially available anti-GnRH vaccines include: Improvac (Imboden et al. 2006, Botha et al. 2008, Janett et al. 2009a, Janett et al. 2009b, Schulman et al. 2013, Dalmau et al. 2015), made in South Africa; Equity (Elhay et al. 2007), made in Australia; Improvest, for use in swine (Bohrer et al. 2014); Repro-BLOC (Boedeker et al. 2011); and Bopriva, for use in cows (Balet et al. 2014). Of these, GonaCon-Equine, Improvac, and Equity are specifically intended for horses. Other anti-GnRH vaccine formulations have also been tested, but did not become trademarked products (e.g., Goodloe 1991, Dalin et al 2002, Stout et al. 2003, Donovan et al. 2013, Schaut et al. 2018, Yao et al. 2018). The effectiveness and side-effects of these various anti-GnRH vaccines may not be the same as would be expected from GonaCon-Equine use in horses. Results could differ as a result of differences in the preparation of the GnRH antigen, and the choice of adjuvant used to stimulate the immune response. While GonaCon-Equine can be administered as a single dose, most other anti-GnRH vaccines require a primer dose and at least one booster dose to be effective.

GonaCon has been produced by USDA-APHIS (Fort Collins, Colorado) in several different formulations, the history of which is reviewed by Miller et al. (2013). In any vaccine, the antigen is the stimulant to which the body responds by making antigen-specific antibodies. Those antibodies then signal to the body that a foreign molecule is present, initiating an immune response that removes the molecule or cell. GonaCon vaccines present the recipient with hundreds of copies of GnRH as peptides on the surface of a linked protein that is naturally antigenic because it comes from invertebrate hemocyanin (Miller et al 2013). Early GonaCon formulations linked many copies of GnRH to a protein from the keyhole limpet (GonaCon-KHL), but more recently produced formulations where the GnRH antigen is linked to a protein from the blue mussel (GonaCon-B) proved less expensive and more effective (Miller et al. 2008). GonaCon-Equine is in the category of GonaCon-B vaccines.

Adjuvants are included in vaccines to elevate the level of immune response, inciting recruitment of lymphocytes and other immune cells which foster a long-lasting immune response that is specific to the antigen. For some formulations of anti-GnRH vaccines, a booster dose is required to elicit a contraceptive response, though GonaCon can cause short-term contraception in a fraction of treated animals from one dose (Powers et al. 2011, Gionfriddo et al. 2011a, Baker et al. 2013, Miller et al 2013). The adjuvant used in GonaCon, Adjuvac, generally leads to a milder reaction than Freund's Complete Adjuvant (Powers et al. 2011). Adjuvac contains a small number of killed *Mycobacterium avium* cells (Miller et al. 2008, Miller et al. 2013). The antigen and adjuvant are emulsified in mineral oil, such that they are not all presented to the immune system right after injection It is thought that the mineral oil emulsion leads to a 'depot effect' that is associated with slow or sustained release of the antigen, and a resulting longer-lasting immune response (Miller et al. 2013). Miller et al. (2008, 2013) have speculated that, in cases where memory-B leukocytes are protected in immune complexes in the lymphatic system, it can lead to years of immune response. Increased doses of vaccine may lead to stronger immune reactions, but only to a certain point; when Yoder and Miller (2010) tested varying doses of GonaCon in prairie dogs, antibody responses to the 200µg and 400µg doses were equal to each other but were both higher than in response to a 100µg dose.

The most direct result of successful GnRH vaccination is that it has the effect of decreasing the level of GnRH signaling in the body, as evidenced by a drop in luteinizing hormone levels, and a cessation of ovulation. Antibody titer measurements are proximate measures of the antibody concentration in the blood specific to a given antigen. Anti-GnRH titers generally correlate with a suppressed reproduction system (Gionfriddo et al. 2011a, Powers et al. 2011). Various studies have attempted to identify a relationship between anti-GnRH titer levels and infertility, but that relationship has not been universally predictable or consistent. The time length that titer levels stay high appears to correlate with the length of suppressed reproduction (Dalin et al. 2002, Levy et al. 2011, Donovan et al. 2013, Powers et al. 2011). For example, Goodloe (1991) noted that mares did produce elevated titers and had suppressed follicular development for 11-13 weeks after treatment, but that all treated mares ovulated after the titer levels declined. Similarly, Elhay (2007) found that high initial titers correlated with longer-lasting ovarian and behavioral anoestrus. However, Powers et al. (2011) did not identify a threshold level of titer that was consistently indicative of suppressed reproduction despite seeing a strong correlation between antibody concentration and infertility, nor did Schulman et al. (2013) find a clear relationship between titer levels and mare acyclicity.

In many cases, young animals appear to have higher immune responses, and stronger contraceptive effects of anti-GnRH vaccines than older animals (Brown et al. 1994, Curtis et al. 2001, Stout et al. 2003, Schulman et al. 2013). Vaccinating with GonaCon at too young an age, though, may prevent effectiveness; Gionfriddo et al. (2011a) observed weak effects in 3-4 month old fawns. It has not been possible to predict which individuals of a given age class will have long-lasting immune responses to the GonaCon vaccine. Gray (2010) noted that mares in poor body condition tended to have lower contraceptive efficacy in response to GonaCon-B. Miller et al. (2013) suggested that higher parasite loads might have explained a lower immune response in free-roaming horses than had been observed in a captive trial. At this time it is unclear what the most important factors affecting efficacy are.

Females that are successfully contracepted by GnRH vaccination enter a state similar to anestrus, have a lack of or incomplete follicle maturation, and no ovarian cycling (Botha et al. 2008). A leading hypothesis is that anti-GnRH antibodies bind GnRH in the hypothalamus – pituitary 'portal vessels,' preventing GnRH from binding to GnRH-specific binding sites on gonadotroph cells in the pituitary, thereby limiting the production of gonadotropin hormones, particularly luteinizing hormone (LH) and, to a lesser degree, follicle-stimulating hormone (FSH) (Powers et al. 2011, NRC 2013). This reduction in LH (and FSH), and a corresponding lack of ovulation, has been measured in response to treatment with anti-GnRH vaccines (Boedeker et al. 2011, Garza et al. 1986).

Females successfully treated with anti-GnRH vaccines have reduced progesterone levels (Garza et al. 1986, Stout et al. 2003, Imboden et al. 2006, Elhay 2007, Botha et al. 2008, Killian et al. 2008, Miller et al. 2008, Janett et al. 2009, Schulman et al. 2013, Balet et al 2014, Dalmau et al. 2015) and β-17 estradiol levels (Elhay et al. 2007), but no great decrease in estrogen levels (Balet et al. 2014). Reductions in progesterone do not occur immediately after the primer dose, but can take several weeks or months to develop (Elhay et al. 2007, Botha et al. 2008, Schulman et al. 2013, Dalmau et al. 2015). This indicates that ovulation is not occurring and corpora lutea, formed from post-ovulation follicular tissue, are not being established.

Changes in hormones associated with anti-GnRH vaccination lead to measurable changes in ovarian structure and function. The volume of ovaries reduced in response to treatment (Garza et al. 1986, Dalin et al. 2002, Imboden et al. 2006, Elhay et al. 2007, Botha et al. 2008, Gionfriddo 2011a, Dalmau et al. 2015). Treatment with an anti-GnRH vaccine changes follicle development (Garza et al. 1986, Stout et al. 2003, Imboden et al. 2006, Elhay et al. 2007, Donovan et al. 2013, Powers et al. 2011, Balet et al. 2014), with the result that ovulation does not occur. A related result is that the ovaries can exhibit less activity and cycle with less regularity or not at all in anti-GnRH vaccine treated females (Goodloe 1991, Dalin et al. 2002, Imboden et al. 2006, Elhay et al. 2007, Janett et al. 2009a, Powers et al. 2011, Donovan et al. 2013). In studies where the vaccine required a booster, hormonal and associated results were generally observed within several weeks after delivery of the booster dose.

GnRH Vaccine Contraceptive Effects
The NRC (2013) review pointed out that single doses of GonaCon-Equine do not lead to high rates of initial effectiveness, or long duration. Initial effectiveness of one dose of GonaCon-Equine vaccine appears to be lower than for a combined primer plus booster dose of the PZP vaccine Zonastat-H (Kirkpatrick et al. 2011), and the initial effect of a single GonaCon dose can be limited to as little as one breeding season. However, preliminary results on the effects of boostered doses of GonaCon-Equine indicate that it can have high efficacy and longer-lasting effects in free-roaming horses (Baker et al. 2018) than the one-year effect that is generally expected from a single booster of Zonastat-H.

GonaCon and other anti-GnRH vaccines can be injected while a female is pregnant (Miller et al. 2000, Powers et al. 2011, Baker et al. 2013) – in such a case, a successfully contracepted mare will be expected to give birth during the following foaling season, but to be infertile during the same year's breeding season. Thus, a mare injected in November of 2018 would not show the contraceptive effect (i.e., no new foal) until spring of 2020.

Too few studies have reported on the various formulations of anti-GnRH vaccines to make generalizations about differences between products, but GonaCon formulations were consistently good at causing loss of fertility in a statistically significant fraction of treated mares for at least one year (Killian et al. 2009, Gray et al. 2010, Baker et al. 2013, 2017). With few exceptions (e.g., Goodloe 1991), anti-GnRH treated mares gave birth to fewer foals in the first season when there would be an expected contraceptive effect (Botha et al. 2008, Killian et al. 2009, Gray et al. 2010, Baker et al. 2013). Goodloe (1991) used an anti-GnRH-KHL vaccine with a triple adjuvant, in some cases attempting to deliver the vaccine to horses with a hollow-tipped 'biobullet,'but concluded that the vaccine was not an effective immunocontraceptive in that study.

Not all mares should be expected to respond to the GonaCon-equine vaccine; some number should be expected to continue to become pregnant and give birth to foals. In studies where mares were exposed to stallions, the fraction of treated mares that are effectively contracepted in the year after anti-GnRH vaccination varied from study to study, ranging from ~50 percent (Baker et al. 2017), to 61 percent (Gray et al. 2010), to ~90 percent (Killian et al. 2006, 2008, 2009). Miller et al. (2013) noted lower effectiveness in free-ranging mares (Gray et al. 2010) than captive mares (Killian et al. 2009). Some of these rates are lower than the high rate of effectiveness typically reported for the first year after PZP vaccine treatment

(Kirkpatrick et al. 2011). In the one study that tested for a difference, darts and hand-injected GonaCon doses were equally effective in terms of fertility outcome (McCann et al. 2017).

In studies where mares were not exposed to stallions, the duration of effectiveness also varied. A primer and booster dose of Equity led to anoestrus for at least 3 months (Elhay et al. 2007). A primer and booster dose of Improvac also led to loss of ovarian cycling for all mares in the short term (Imboden et al. 2006). It is worth repeating that those vaccines do not have the same formulation as GonaCon.

Results from horses (Baker et al. 2017) and other species (Curtis et al. 2001) suggest that providing a booster dose of GonaCon-Equine will increase the fraction of temporarily infertile animals to higher levels than would a single vaccine dose alone.

Longer-term infertility has been observed in some mares treated with anti-GnRH vaccines, including GonaCon-Equine. In a single-dose mare captive trial with an initial year effectiveness of 94 percent, Killian et al. (2008) noted infertility rates of 64 percent, 57 percent, and 43 percent in treated mares during the following three years, while control mares in those years had infertility rates of 25 percent, 12 percent, and 0 percent in those years. GonaCon effectiveness in free-roaming populations was lower, with infertility rates consistently near 60 percent for three years after a single dose in one study (Gray et al. 2010) and annual infertility rates decreasing over time from 55 percent to 30 percent to 0 percent in another study with one dose (Baker et al. 2017). Similarly, gradually increasing fertility rates were observed after single dose treatment with GonaCon in elk (Powers et al. 2011) and deer (Gionfriddo et al. 2011a).

Baker et al. (2017) observed a return to fertility over 4 years in mares treated once with GonaCon, but then noted extremely low fertility rates of 0 percent and 16 percent in the two years after the same mares were given a booster dose four years after the primer dose. These are extremely promising preliminary results from that study in free-roaming horses; a third year of post-booster monitoring is ongoing in summer 2017, and researchers on that project are currently determining whether the same high-effectiveness, long-term response is observed after boosting with GonaCon after 6 months, 1 year, 2 years, or 4 years after the primer dose. Four of nine mares treated with primer and booster doses of Improvac did not return to ovulation within 2 years of the primer dose (Imboden et al. 2006), though one should probably not make conclusions about the long-term effects of GonaCon-Equine based on results from Improvac.

It is difficult to predict which females will exhibit strong or long-term immune responses to anti-GnRH vaccines (Killian et al. 2006, Miller et al. 2008, Levy et al. 2011). A number of factors may influence responses to vaccination, including age, body condition, nutrition, prior immune responses, and genetics (Cooper and Herbert 2001, Curtis et al. 2001, Powers et al. 2011). One apparent trend is that animals that are treated at a younger age, especially before puberty, may have stronger and longer-lasting responses (Brown et al. 1994, Curtis et al. 2001, Stout et al. 2003, Schulman et al. 2013). It is plausible that giving ConaGon-Equine to prepubertal mares will lead to long-lasting infertility, but that has not yet been tested.

To date, short term evaluation of anti-GnRH vaccines, show contraception appears to be temporary and reversible. Killian et al. noted long-term effects of GonaCon in some captive mares (2009). However, Baker et al. (2017) observed horses treated with GonaCon-B return to fertility after they were treated with a single primer dose; after four years, the fertility rate was indistinguishable between treated and control mares. It appears that a single dose of GonaCon results in reversible infertility. Although it is unknown whether long-term treatment would result in permanent infertility, such permanent infertility fertility would be consistent with the desired effect of using GonaCon (e.g., effective contraception).

Other anti-GnRH vaccines also have had reversible effects in mares. Elhay (2007) noted a return to ovary functioning over the course of 34 weeks for 10 of 16 mares treated with Equity. That study ended at 34 weeks, so it is not clear when the other six mares would have returned to fertility. Donovan et al. (2013) found that half of mares treated with an anti-GnRH vaccine intended for dogs had returned to fertility after 40 weeks, at which point the study ended. In a study of mares treated with a primer and booster dose of Improvac, 47 of 51 treated mares had returned to ovarian cyclicity within 2 years; younger mares appeared to have longer-lasting effects than older mares (Schulman et al. 2013). Joonè et al. (2017c) analyzed samples from the Schulman et al. (2013) study, and found no significant decrease in anti-Mullerian hormone (AMH) levels in mares treated with GnRH vaccine. AMH levels are thought to be an indicator of ovarian function, so results from Joonè et al. (2017c) support the general view that the anoestrus resulting from GnRH vaccination is physiologically similar to typical winter anoestrus. In a small study with a non-commercial anti-GnRH vaccine (Stout et al. 2003), three of seven treated mares had returned to cyclicity within 8 weeks after delivery of the primer dose, while four others were still suppressed for 12 or more weeks. In elk, Powers et al. (2011) noted that contraception after one dose of GonaCon was reversible. In white-tailed deer, single doses of GonaCon appeared to confer two years of contraception (Miller et al. 2000). Ten of 30 domestic cows treated became pregnant within 30 weeks after the first dose of Bopriva (Balet et al. 2014).

Permanent sterility as a result of single-dose or boostered GonaCon-Equine vaccine, or other anti-GnRH vaccines, has not been recorded, but that may be because no long-term studies have tested for that effect. It is conceivable that some fraction of mares could become sterile after receiving one or more booster doses of GonaCon-Equine, but the rate at which that could be expected to occur is currently unknown. If some fraction of mares treated with GonaCon-Equine were to become sterile, though, that result would be consistent with text of the Wild Horse and Burro Act of 1971, as amended, which allows for sterilization to achieve population goals.

In summary, based on the above results related to fertility effects of GonaCon and other anti-GnRH vaccines, application of a single dose of GonaCon-Equine to gathered or remotely-darted wild horses could be expected to prevent pregnancy in perhaps 30percent-60percent of mares for one year. Some smaller number of wild mares should be expected to have persistent contraception for a second year, and less still for a third year. Applying one booster dose of GonaCon to previously-treated mares should lead to two or more years with relatively high rates (80+percent) of additional infertility expected, with the potential that some as-yet-unknown fraction of boostered mares may be infertile for several to many years. There is no data to support speculation regarding efficacy of multiple boosters of GonaCon-Equine; however, given it is formulated as a highly immunogenic long-lasting vaccine, it is reasonable to hypothesize that additional boosters would increase the effectiveness and duration of the vaccine.

GonaCon-Equine only affects the fertility of treated animals; untreated animals will still be expected to give birth. Even under favorable circumstances for population growth suppression, gather efficiency might not exceed 85percent via helicopter, and may be less with bait and water trapping. Similarly, not all animals may be approachable for darting. The uncaptured or undarted portion of the female population would still be expected to have normally high fertility rates in any given year, though those rates could go up slightly if contraception in other mares increases forage and water availability.

GnRH Vaccine Effects on Other Organ Systems

BLM requires individually identifiable marks for immunocontraceptive treatment; this may require handling and marking. Mares that receive any vaccine as part of a gather operation would experience slightly increased stress levels associated with handling while being vaccinated and freezemarked, and potentially microchipped. Newly captured mares that do not have markings associated with previous fertility control treatments would be marked with a new freezemark for the purpose of identifying that mare, and identifying her vaccine treatment history. This information would also be used to determine the number of mares captured that were not previously treated, and could provide additional insight regarding gather efficiency, and the timing of treatments required into the future. Most mares recover from the stress of capture and handling quickly once released back to the HMA, and none are expected to suffer serious long term effects from the fertility control injections, other than the direct consequence of becoming temporarily infertile.

Injection site reactions associated with immunocontraceptive treatments are possible in treated mares (Roelle and Ransom 2009). Whether injection is by hand or via darting, GonaCon-Equine is associated with some degree of inflammation, swelling, and the potential for abscesses at the injection site (Baker et al. 2013). Swelling or local reactions at the injection site are generally expected to be minor in nature, but some may develop into draining abscesses. When PZP vaccine was delivered via dart it led to more severe swelling and injection site reactions (Roelle and Ransom 2009), but that was not observed with dart-delivered GonaCon (McCann et al. 2017). Mares treated with one formulation of GnRH-KHL vaccine developed pyogenic abscesses (Goodloe 1991). Miller et al. (2008) noted that the water and oil emulsion in GonaCon will often cause cysts, granulomas, or sterile abscesses at injection sites; in some cases, a sterile abscess may develop into a draining abscess. In elk treated with GonaCon, Powers et al. (2011) noted up to 35 percent of treated elk had an abscess form, despite the injection sites first being clipped and swabbed with alcohol. Even in studies where swelling and visible abscesses followed GonaCon immunization, the longer term nodules observed did not appear to change any animal’s range of movement or locomotor patterns (Powers et al. 2013, Baker et al. 2017).

The result that other formulations of anti-GnRH vaccine may be associated with less notable injection site reactions in horses may indicate that the adjuvant formulation in GonaCon leads a single dose to cause a stronger immune reaction than the adjuvants used in other anti-GnRH vaccines. Despite that, a booster dose of GonaCon-Equine appears to be more effective than a primer dose alone (Baker et al. 2017). Horses injected in the hip with Improvac showed only transient reactions that disappeared within 6 days in one study (Botha et al. 2008), but stiffness and swelling that lasted 5 days were noted in another study where horses received Improvac in the neck (Imboden et al. 2006). Equity led to transient reactions that resolved within a week in some treated animals (Elhay et al. 2007). Donovan et al. noted no reactions to the canine anti-GnRH vaccine (2013). In cows treated with Bopriva there was a mildly elevated body temperature and mild swelling at injection sites that subsided within 2 weeks (Balet et al. 2014).

Several studies have monitored animal health after immunization against GnRH. GonaCon treated mares did not have any measurable difference in uterine edema (Killian 2006, 2008). Powers et al. (2011, 2013) noted no differences in blood chemistry except a mildly elevated fibrinogen level in some GonaCon treated elk. In that study, one sham-treated elk and one GonaCon treated elk each developed leukocytosis, suggesting that there may have been a causal link between the adjuvant and the effect. Curtis et al. (2008) found persistent granulomas at GonaCon-KHL injection sites three years after injection, and reduced ovary weights in treated females. Yoder and Miller (2010) found no difference in blood chemistry between GonaCon treated and control prairie dogs. One of 15 GonaCon treated cats died without explanation, and with no determination about cause of death possible based on necropsy or histology (Levy et al. 2011). Other anti-GnRH vaccine formulations have led to no detectable adverse effects (in elephants; Boedeker et al. 2011), though Imboden et al. (2006) speculated that young treated animals might conceivably have impaired hypothalamic or pituitary function.

Kirkpatrick et al. (2011) raised concerns that anti-GnRH vaccines could lead to adverse effects in other organ systems outside the reproductive system. GnRH receptors have been identified in tissues outside of the pituitary system, including in the testes and placenta (Khodr and Siler-Khodr 1980), ovary (Hsueh and Erickson 1979), bladder (Coit et al. 2009), heart (Dong et al. 2011), and central nervous system, so it is plausible that reductions in circulating GnRH levels could inhibit physiological processes in those organ systems. Kirkpatrick et al. (2011) noted elevated cardiological risks to human patients taking GnRH agonists (such as leuprolide), but the National Academy of Sciences (2013) concluded that the mechanism and results of GnRH agonists would be expected to be different from that of anti-GnRH antibodies; the former flood GnRH receptors, while the latter deprive receptors of GnRH.

GnRH Vaccine Effects on Fetus and Foal

Although fetuses are not explicitly protected under the Wild Horse and Burro Act of 1971, as amended, it is prudent to analyze the potential effects of GonaCon-Equine or other anti-GnRH vaccines on developing fetuses and foals. GonaCon had no apparent effect on pregnancies in progress, foaling success, or the health of offspring, in horses that were immunized in October (Baker et al. 2013), elk immunized 80-100 days into gestation (Powers et al. 2011, 2013), or deer immunized in February (Miller et al. 2000). Kirkpatrick et al. (2011) noted that anti-GnRH immunization is not expected to cause hormonal changes that would lead to abortion in the horse, but this may not be true for the first 6 weeks of pregnancy (NRC 2013). Curtis et al. (2011) noted that GonaCon-KHL treated white tailed deer had lower twinning rates than controls, but speculated that the difference could be due to poorer sperm quality late in the breeding season, when the treated does did become pregnant. Goodloe (1991) found no difference in foal production between treated and control animals.

Offspring of anti-GnRH vaccine treated mothers could exhibit an immune response to GnRH (Khodr and Siler-Khodr 1980), as antibodies from the mother could pass to the offspring through the placenta or colostrum. In the most extensive study of long-term effects of GonaCon immunization on offspring, Powers et al. (2012) monitored 15 elk fawns born to GonaCon treated cows. Of those, 5 had low titers at birth and 10 had high titer levels at birth. All 15 were of normal weight at birth, and developed normal endocrine profiles, hypothalamic GnRH content, pituitary gonadotropin content, gonad structure, and gametogenesis. All the females became pregnant in their second reproductive season, as is typical. All males showed normal development of secondary sexual characteristics. Powers et al. (2012) concluded that suppressing GnRH in the neonatal period did not alter long-term reproductive function in either male or female offspring. Miller et al. (2013) report elevated anti-GnRH antibody titers in fawns born to treated white tailed deer, but those dropped to normal levels in 11 of 12 of those fawns, which came into breeding condition; the remaining fawn was infertile for three years.

Direct effects on foal survival are equivocal in the literature. Goodloe (1991), reported lower foal survival for a small sample of foals born to anti-GnRH treated mares, but she did not assess other possible explanatory factors such as mare social status, age, body condition, or habitat in her analysis (NRC 2013). Gray et al. (2010) found no difference in foal survival in foals born to free-roaming mares treated with GonaCon.

There is little empirical information available to evaluate the effects of GnRH vaccination on foaling phenology. It is possible that immunocontracepted mares returning to fertility late in the breeding season could give birth to foals at a time that is out of the normal range (Nuñez et al. 2010, Ransom et al 2013). Curtis et al. (2001) did observe a slightly later fawning date for GonaCon treated deer in the second year after treatment, when some does regained fertility late in the breeding season. In anti-GnRH vaccine trials in free-roaming horses, there were no published differences in mean date of foal production (Goodloe 1991, Gray et al. 2010). Unpublished results from an ongoing study of GonaCon treated free-roaming mares indicate that some degree of aseasonal foaling is possible (D. Baker, Colorado State University, personal communication to Paul Griffin, BLM WH&B Research Coordinator). Because of the concern that contraception could lead to shifts in the timing of parturitions for some treated animals, Ransom et al. (2013) advised that managers should consider carefully before using PZP immunocontraception in small refugia or rare species; the same considerations could be advised for use of GonaCon, but wild horses and burros in most areas do not generally occur in isolated refugia, they are not a rare species at the regional, national, or international level, and genetically they represent descendants of domestic livestock with most populations containing few if any unique alleles (NRC 2013). Moreover, in PZP-treated horses that did have some degree of parturition date shift, Ransom et al. (2013) found no negative impacts on foal survival even with an extended birthing season; however, this may be more related to stochastic, inclement weather events than extended foaling seasons. If there were to be a shift in foaling date for some treated mares, the effect on foal survival may depend on weather severity and local conditions; for example, Ransom et al. (2013) did not find consistent effects across study sites.

Indirect Effects of GnRH Vaccination
One expected long-term, indirect effect on wild horses treated with fertility control would be an improvement in their overall health. Many treated mares would not experience the biological stress of reproduction, foaling and lactation as frequently as untreated mares, and their better health is expected to be reflected in higher body condition scores. After a treated mare returns to fertility, her future foals would be expected to be healthier overall, and would benefit from improved nutritional quality in the mares' milk. This is particularly to be expected if there is an improvement in rangeland forage quality at the same time, due to reduced wild horse population size. Past application of fertility control has shown that mares' overall health and body condition can remain improved even after fertility resumes. Anecdotal, subjective observations of mares treated with a different immunocontraceptive, PZP, in past gathers showed that many of the treated mares were larger, maintained better body condition, and had larger healthy foals than untreated mares.

Body condition of anti-GnRH-treated females was equal to or better than that of control females in published studies. Ransom et al. (2014b) observed no difference in mean body condition between GonaCon-B treated mares and controls. Goodloe (1991) found that GnRH-KHL treated mares had higher survival rates than untreated controls. In other species, treated deer had better body condition than controls (Gionfriddo et al. 2011b), treated cats gained more weight than controls (Levy et al. 2011), as did treated young female pigs (Bohrer et al. 2014).

Following resumption of fertility, the proportion of mares that conceive and foal could be increased due to their increased fitness; this has been called by some a 'rebound effect.' Elevated fertility rates have been observed after horse gathers and removals (Kirkpatrick and Turner 1991). More research is needed to document and quantify these hypothesized effects. If repeated contraceptive treatment leads to a prolonged contraceptive effect, then that may minimize or delay the hypothesized rebound effect. Selectively applying contraception to older animals and returning them to the HMA could reduce long-term holding costs for such horses, which are difficult to adopt, and could negate the compensatory reproduction that can follow removals (Kirkpatrick and Turner 1991).

Because successful fertility control would reduce foaling rates and population growth rates, another indirect effect would be to reduce the number of wild horses that have to be removed over time to achieve and maintain the established AML. Contraception would be expected to lead to a relative increase in the fraction of older animals in the herd. Reducing the numbers of wild horses that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild horses, and thereby could eliminate the need to send additional excess horses from this area to off-range holding corrals or pastures for long-term holding. Among mares in the herd that remain fertile, a high level of physical health and future reproductive success would be expected because reduced population sizes should lead to more availability of water and forage resources per capita.

Reduced population growth rates and smaller population sizes could also allow for continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse habitat quality. As the local horse abundance nears or is maintained at the level necessary to achieve a thriving natural ecological balance, vegetation resources would be expected to recover, improving the forage available to wild horses and wildlife throughout the HMA or HMAs. With rangeland conditions more closely approaching a thriving natural ecological balance, and with a less concentrated distribution of wild horses across the HMA, there should also be less trailing and concentrated use of water sources. Lower population density would be expected to lead to reduced competition among wild horses using the water sources, and less fighting among horses accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild horses. Wild horses would also have to travel less distance back and forth between water and desirable foraging areas. Should GonaCon-Equine treatment, including booster doses, continue into the future, with treatments given on a schedule to maintain a lowered level of fertility in the herd, there may be less frequent need for large gathers and removals, but instead a consistent abundance of wild horses could be maintained, resulting in continued improvement of overall habitat conditions and animal health. While it is conceivable that widespread and continued treatment with GonaCon-Equine could reduce the birth rates of the population to such a point that birth is consistently below mortality, that outcome is not likely unless a very high fraction of the mares present are all treated with primer and booster doses, and perhaps repeated booster doses.

Behavioral Effects of GnRH Vaccination
Behavioral differences should be considered as potential consequences of contraception with GonaCon. The NRC (2013) noted that all successful fertility suppression has effects on mare behavior, mostly as a result of the lack of pregnancy and foaling, and concluded that GonaCon was a good choice for use in the program. The result that GonaCon treated mares may have suppressed estrous cycles throughout the breeding season can lead treated mares to behave in ways that are functionally similar to pregnant mares or mares in seasonal anoestrus.

While successful in mares, GonaCon and other anti-GnRH vaccines are expected to induce fewer estrous cycles when compared to non-pregnant control mares. This has been observed in many studies (Garza et al. 1986, Curtis et al. 2001, Dalin et al. 2002, Killian et al. 2006, Dalmau et al. 2015). In contrast, PZP vaccine is generally expected to lead mares to have more estrous cycles per breeding season, as they continue to be receptive to mating while not pregnant. Females treated with GonaCon had fewer estrous cycles than control or PZP-treated mares (Killian et al. 2006) or deer (Curtis et al. 2001). Thus, concerns about PZP treated mares receiving more courting and breeding behaviors from stallions (Nuñez et al. 2009, Ransom et al. 2010) are not generally expected to be a concern for mares treated with anti-GnRH vaccines (Botha et al. 2008).

Ransom et al. (2014b) found that GonaCon treated mares had similar rates of reproductive behaviors that were similar to those of pregnant mares. Among other potential causes, the reduction in progesterone levels in treated females may lead to a reduction in behaviors associated with reproduction. Despite this, some females treated with GonaCon or other anti-GnRH vaccines did continue to exhibit reproductive behaviors, albeit at irregular intervals and durations (Dalin et al. 2002, Stout et al. 2003, Imboden et al. 2006), which is a result that is similar to spayed (ovariectomized) mares (Asa et al. 1980). Gray et al. (2009) found no difference in sexual behaviors in mares treated with GonaCon and untreated mares. When progesterone levels are low, small changes in estradiol concentration can foster reproductive estrous behaviors (Imboden et al. 2006). Owners of anti-GnRH vaccine treated mares reported a reduced number of estrous-related behaviors under saddle (Donovan et al. 2013). Treated mares may refrain from reproductive behavior even after ovaries return to cyclicity (Elhay et al. 2007). Studies in elk found that GonaCon treated cows had equal levels of precopulatory behaviors as controls (Powers et al. 2011), though bull elk paid more attention to treated cows late in the breeding season, after control cows were already pregnant (Powers et al. 2011).

Stallion herding of mares, and harem switching by mares are two behaviors related to reproduction that might change as a result of contraception. Ransom et al. (2014b) observed a 50 percent decrease in herding behavior by stallions after the free-roaming horse population at Theodore Roosevelt National Park was reduced via a gather, and mares there were treated with GonaCon-B. The increased harem tending behaviors by stallions were directed to both treated and control mores. It is difficult to separate any effect of GonaCon in this study from changes in horse density and forage following horse removals.

Mares in untreated free-roaming populations change bands; some have raised concerns over effects of PZP vaccination on band structure (Nuñez et al. 2009), with rates of band fidelity being suggested as a measure of social stability. With respect to treatment with GonaCon or other anti-GnRH vaccines, it is probably less likely that treated mares will switch harems at higher rates than untreated animals, because treated mares are similar to pregnant mares in their behaviors (Ransom et al. 2014b). Indeed, Gray et al. (2009) found no difference in band fidelity in a free-roaming population of horses with GonaCon treated mares, despite differences in foal production between treated and untreated mares. Ransom et al. (2014b) actually found increased levels of band fidelity after treatment, though this may have been partially a result of changes in overall horse density and forage availability.

Even in cases where there may be changes in band fidelity, the National Research Council (2013) found that harem changing was not likely to result in serious adverse effects for treated mares:

> “The studies on Shackleford Banks (Nuñez et al., 2009; Madosky et al., 2010) suggest that there is an interaction between pregnancy and social cohesion. The importance of harem stability to mare well-being is not clear, but considering the relatively large number of free-ranging mares that have been treated with liquid PZP in a variety of ecological settings, the likelihood of serious adverse effects seem low.”

Kirkpatrick et al. (2010) concluded that “the larger question is, even if subtle alterations in behavior may occur, this is still far better than the alternative.”

The NRC (2013) provides a comprehensive review of the literature on the behavioral effects of contraception that puts Nuñez’s (2009, 2010) research into the broader context of all of the available scientific literature, and cautions, based on its extensive review of the literature that:

> “. . . in no case can the committee conclude from the published research that the behavior differences observed are due to a particular compound rather than to the fact that treated animals had no offspring during the study. That must be borne in mind particularly in interpreting long-term impacts of contraception (e.g., repeated years of reproductive “failure” due to contraception).”

Gray et al. (2009) and Ransom et al. (2014b) monitored non-reproductive behaviors in GonaCon treated populations of free-roaming horses. Gray et al. (2009) found no difference between treated and untreated mares in terms of activity budget, sexual behavior, proximity of mares to stallions, or aggression. Ransom et al. (2014b) found only minimal differences between treated and untreated mare time budgets, but those differences were consistent with differences in the metabolic demands of pregnancy and lactation in untreated mares, as opposed to non-pregnant treated mares.

Genetic Effects of GnRH Vaccination
In HMAs where large numbers of wild horses have recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses, contraception is not expected to cause an unacceptable loss of genetic diversity or an unacceptable increase in the inbreeding coefficient. In any diploid population, the loss of genetic diversity through inbreeding or drift can be prevented by large effective breeding

population sizes (Wright 1931) or by introducing new potential breeding animals (Mills and Allendorf 1996). The NRC (2013) recommended that managed herds of wild horses would be better viewed as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements. In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM, such that most alleles that are present in any given mare are likely to already be well represented in her siblings, cousins, and more distant relatives. With the exception of horses in a small number of well-known HMAs that contain a relatively high fraction of alleles associated with old Spanish horse breeds (NRC 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with admixtures from domestic breeds. As a result, in most HMAs, applying fertility control to a subset of mares is not expected to cause irreparable loss of genetic diversity. Improved longevity and an aging population are expected results of contraceptive treatment that can provide for lengthening generation time; this result which would be expected to slow the rate of genetic diversity loss (Hailer et al., 2006). Based on a population model, Gross (2000) found that an effective way to retain genetic diversity in a population treated with fertility control is to preferentially treat young animals, such that the older animals (which contain all the existing genetic diversity available) continue to have offspring. Conversely, Gross (2000) found that preferentially treating older animals (preferentially allowing young animals to breed) leads to a more rapid expected loss of genetic diversity over time.

Even if it is the case that booster treatment with GonaCon may lead to prolonged infertility, or even sterility in some mares, most HMAs have only a low risk of loss of genetic diversity if logistically realistic rates of contraception are applied to mares. Wild horses in most herd management areas are descendants of a diverse range of ancestors coming from many breeds of domestic horses. As such, the existing genetic diversity in the majority of HMAs does not contain genetic markers that have been identified as unique or historically unusual (NRC 2013). Past interchange between HMAs, either through natural dispersal or through assisted migration (i.e. human movement of horses) means that many HMAs are effectively indistinguishable and interchangeable in terms of their genetic composition. Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity, in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Their results show that the risk of the loss of genetic heterozygosity is extremely low except in cases where all four of the following conditions are met: starting levels of genetic diversity are low, initial population size is 100 or less, intrinsic population growth rate is low (5percent per year), and very large fractions of the female population are permanently sterilized.

Many factors influence the strength of a vaccinated individual's immune response, potentially including genetics, but also nutrition, body condition, and prior immune responses to pathogens or other antigens (Powers et al 2013). One concern that has been raised with regards to genetic diversity is that treatment with immunocontraceptives could possibly lead to an evolutionary increase in the frequency of individuals whose genetic composition fosters weak immune responses (Cooper and Larson 2006, Ransom et al. 2014a). This premise is based on a hypothesis that lack of response to immunocontraceptives could be a heritable trait, and that the frequency of that trait will increase over time in a population of treated animals. Cooper and Herbert (2001) reviewed the topic, in the context of concerns about the long-term effectiveness of immunocontraceptives as a control agent for exotic species in Australia. They argue that immunocontraception could be a strong selective pressure, and that selecting for reproduction in individuals with poor immune response could lead to a general decline in immune function in populations where such evolution takes place. Other authors have also speculated that differences in antibody titer responses could be partially due to genetic differences between animals (Curtis et al. 2001, Herbert and Trigg 2005).

BLM is not aware of any studies that have quantified the heritability of a lack of response to immunocontraception such as PZP vaccine or GonaCon-Equine in horses. At this point there are no studies available from which one could make conclusions about the long-term effects of sustained and widespread immunocontraception treatments on population-wide immune function. Although a few, generally isolated, feral horse populations have been treated with high fractions of mares receiving PZP immunocontraception for long-term population control (e.g., Assateague Island and Pryor Mountains), no studies have tested for changes in immune competence in those areas. Relative to the large number of free-roaming feral horses in the western United States, immunocontraception has not been used in the type of widespread or prolonged manner that might be required to cause a detectable evolutionary response at a large scale.

Magiafolou et al. (2013) clarify that if the variation in immune response is due to environmental factors (i.e., body condition, social rank) and not due to genetic factors, then there will be no expected effect of the immune phenotype on future generations. Correlations between immune response and physical factors such as age and body condition have been documented; it remains untested whether or not those factors play a larger role in determining immune response to immunocontraceptives than heritable traits. Several studies discussed above noted a relationship between the strength of individuals' immune responses after treatment with GonaCon or other anti-GnRH vaccines, and factors related to body condition. For example, age at immunization was a primary factor associated with different measures of immune response, with young animals tending to have stronger and longer-lasting responses (Stout et al. 2003, Schulman et al. 2013). It is also possible that general health, as measured by body condition, can have a causal role in determining immune response, with animals in poor condition demonstrating poor immune reactions (Gray 2009, NRC 2013). Miller et al. (2013) speculated that animals with high parasite loads also may have weaker immune reactions to GonaCon.

Correlations between such physical factors and immune response would not preclude, though, that there could also be a heritable response to immunocontraception. In studies not directly related to immunocontraception, immune response has been shown to be heritable (Kean et al. 1994, Sarker et al. 1999). Unfortunately, predictions about the long-term, population-level evolutionary response to immunocontraceptive treatments would be speculative at this point, with results likely to depend on several factors, including: the strength of the genetic predisposition to not respond to GonaCon-Equine; the heritability of that gene or genes; the initial prevalence of that gene or genes; the number of mares treated with a primer dose of GonaCon-Equine (which generally has a short-acting effect, if any); the number of mares treated with a booster dose of GonaCon-Equine (which appears to cause a longer-lasting effect); and the actual size of the genetically-interacting metapopulation of horses within which the GonaCon treatment takes place.

<u>Effects of Neutering or Gelding</u>

Castration (the surgical removal of the testicles, also called gelding or neutering) is a surgical procedure for the horse sterilization that has been used for millennia. The procedure is fairly straight forward, and has a relatively low complication rate. As noted in the review of scientific literature that follows, the expected effects of gelding are well understood overall, even though there is some degree of uncertainty about the exact quantitative outcomes for any given individual (as is true for any natural system).

Including a portion of geldings in a herd can lead to a reduced population-level per-capita growth rate, by virtue of having fertile mares comprise a lower fraction of the herd. By having a skewed sex ratio with less females than males (stallions and geldings), the result will be that there will be a lower number of breeding females in the population. Including geldings in herd management is not new for BLM and federal land management. Geldings have been released on BLM lands as a part of herd management in the Barren Valley complex in Oregon (BLM 2011), the Challis HMA in Idaho (BLM 2012), and the

Conger HMA in Utah (BLM 2016). Geldings were also included in US Fish and Wildlife Service management plans for the Sheldon National Wildlife Refuge that relied on sterilization and removals (Collins and Kasbohm 2016).

The more commonly applied methods for managing population growth of free-roaming wild horses focus largely on suppressing female fertility through contraceptive vaccines (e.g., Ballou et al. 2008, Killian et al. 2008, Turner et al. 2008, Gray et al. 2010, Ransom et al. 2011). Fewer studies have been conducted on techniques for reducing male fertility. Nelson (1980) and Garrott and Siniff (1992) modeled potential efficacy of male-oriented contraception as a population management tool, and both studies agreed that while slowing growth, sterilizing only dominant males (i.e., harem-holding stallions) would result in only marginal reduction in female fertility rates. Eagle et al. (1993) and Asa (1999) tested this hypothesis on herd management areas (HMAs) where dominant males were vasectomized. Their findings agreed with modeling results from previous studies, and they also concluded that sterilizing only dominant males would not provide the desired reduction in female fertility and overall population growth rate, assuming that the numbers of fertile females is not changed. While bands with vasectomized harem stallions tended to have fewer foals, breeding by bachelors and subordinate stallions meant that population growth still occurred – female fertility was not dramatically reduced. Garrott and Siniff (1992) concluded from their modeling that male sterilization would effectively cause there to be zero population growth (the point where births roughly equal deaths) only if a large proportion of males (i.e., >85%) could be sterilized. In cases where the goal of harem stallion sterilization is to reduce population growth rates, success appears to be dependent on a stable group structure, as strong bonds between a stallion and mares reduce the probability of a mare mating an extra-group stallion (Nelson 1980, Garrott and Siniff 1992, Eagle et al. 1993, Asa 1999). Collins and Kasbohm (2016) demonstrated that there was a reduced fertility rate in a feral horse herd with both spayed and vasectomized horses – some geldings were also present in that herd.

Despite these studies, geldings can be used to reduce overall growth rates in a management strategy that does not rely on any expectation that geldings will retain harems or lead to a reduction in per-female fertility rates. In alternatives being considered in this environmental analysis, the primary goal of including geldings in the herd is not necessarily to reduce female fertility. Rather, by including some geldings in a herd that also has fertile mares and stallions, the geldings would take some of the spaces toward AML that would otherwise be taken by fertile females. If the total number of horses is constant but geldings are included in the herd, this can reduce the number of fertile mares, therefore reducing the absolute number of foals produced. Put another way, if geldings occupy spaces toward AML that would otherwise be filled by fertile mares, that will reduce growth rates merely by the fact of causing there to be a lower starting number of fertile mares.

Surgical sterilization techniques, while not reversible, may control horse reproduction without the kind of additional handling or darting that can be needed to administer contraceptive vaccines. In this sense, sterilization surgeries can be used to achieve herd management objectives with a relative minimum level of animal handling and management over the long term. The Wild Horse and Burro Act (as amended) indicates that management should be at the minimum level necessary to achieve management objectives (CFR 4710.4), and if gelding some fraction of a managed population can reduce population growth rates by replacing breeding mares, it then follows that gelding some individuals can lead to a reduced number of handling occasions and removals of excess horses from the range, which is consistent with legal guidelines. Other fertility control options that may be temporarily effective on male horses, such as the injection of GonaCon-Equine immunocontraceptive vaccine, apparently require multiple handling occasions to achieve longer-term male infertility. Similarly, PZP immunocontraception that is currently available for use in wild mares requires handling or darting every year. By some measures, any management activities that require multiple capture operations to treat a given individual would be more intrusive for wild horses and potentially less sustainable than an activity that requires only one handling occasion.

Effects of handling and marking

It is prudent for gelded animals to be readily identifiable, either via freeze brand marks or unique coloration, so that their treatment history is easily recognized (e.g., BLM 2010). Markings may also be useful into the future to determine the approximate fraction of geldings in a herd, and could provide additional insight regarding gather efficiency. BLM has instituted guidelines to reduce the sources of handling stress in captured animals (BLM 2015). Handling may include freezemarking, for the purpose of identifying an individual. Some level of transient stress is likely to result in newly captured horses that are not previously marked. Under past management practices, captured horses experienced increased, transient stress levels from handling (Ashley and Holcombe 2001). It is difficult to compare that level of temporary stress with long-term stress that can result from food and water limitation on the range (e.g., Creel et al. 2013), which could occur in the absence of herd management.

Most horses recover from the stress of capture and handling quickly once released back to the HMA, and none are expected to suffer serious long term effects from gelding, other than the direct consequence of becoming infertile.

Selected stallions would be shipped to the facility, gelded, and returned to the range within 30 days. Gelded animals could be monitored periodically for complications for approximately 7-10 days following release. In the proposed alternatives, gelding is not part of any research study, but additional monitoring on the range could be completed either through aerial recon, if available, or field observations from major roads and trails. It is not anticipated that all the geldings would be observed but if the goal is to detect complications on the range, then this level of casual observation may help BLM determine if they are occurring. Observations of the long term outcomes of gelding could be recorded during routine resource monitoring work. Such observations could include but not be limited to band size, social interactions with other geldings and harem bands, distribution within their habitat, forage utilization and activities around key water sources. Periodic population inventories and future gather statistics could provide additional anecdotal information about how logistically effective it is to manage a portion of the herd as non-breeding animals.

Indirect Effects of Gelding

Castration is not expected to reduce geldings' survival rates. Castration is thought to increase survival as males are released from the cost of reproduction (Jewell 1997). In Soay sheep castrates survived longer than rams in the same cohort (Jewell 1997), and Misaki horse geldings lived longer than intact males (Kaseda et al. 1997, Khalil and Murakami 1999). Moreover, it is unlikely that a reduced testosterone level will compromise gelding survival in the wild, considering that wild mares survive with low levels of testosterone. Consistent with geldings not expending as much energy toward in attempts to obtain or defend a harem, it is expected that wild geldings may have a better body condition that wild, fertile stallions.

Under the proposed action, reproductive stallions would still be a component of the population's age and sex structure. The question of whether or not a given gelding would or would not attempt to maintain a harem is not germane to population-level management. Gelding a subset of stallions in the proposed action would not prevent other stallions and mares from continuing with the typical range of social behaviors for sexually active adults. For fertility control strategies where gelding is intended to reduce growth rates by virtue of sterile males defending harems, the National Academies of Sciences (NRC 2013) suggested that the effectiveness of gelding on overall reproductive rates may depend on the pre-castration social roles of those animals. However, in this decision the alternatives being considered that include gelding would reduce population growth rates by a different means: including geldings as a component of the total horses counted toward AML would effectively reduce the relative number of fertile mares in the herd. Having a post-gather herd with some geldings and a lower fraction of fertile mares necessarily reduces the absolute number of foals born per year, compared to a herd that includes more fertile mares. An additional benefit is that geldings that would otherwise be permanently removed from the range (for adoption, sale or other disposition) may be released back onto the range where they can engage in free-roaming behaviors.

BLM would expect that wild horse family structures will continue to exist under the proposed action within wild horse population, because fertile mares, stallions, and their foals will continue to be a component of the herd. Because the fraction of males gelded is not expected to come anywhere close to the ~85% threshold suggested by Garrott and Siniff (1992) as being necessary to substantially reduce population growth rates, is not expected that gelding a subset of stallions will significantly change the social structure or herd demographics (age and sex ratios) of fertile wild horses. It is worth noting, though, that the BLM is not required to manage populations of wild horses in a manner that ensures that any given individual maintains its social standing within any given harem or band.

Behavioral Effects of Gelding
Gelding adult male horses is expected to result in reduced testosterone production, which is expected to directly influence reproductive behaviors (NRC 2013). However, testosterone levels alone are not a predictor of masculine behavior (Line et al. 1985, Schumacher 2006). In domestic geldings, 20-30% continued to show stallion-like behavior, whether castrated pre- or post-puberty (Line et al. 1985). Gelding of domestic horses most commonly takes place before or shortly after sexual maturity, and age-at-gelding can affect the degree to which stallion-like behavior is expressed later in life. In intact stallions, testosterone levels peak increase up to an age of ~4-6 years, and can be higher in harem stallions than bachelors (Khalil et al 1998). It is assumed that free roaming wild horse geldings would generally exhibit reduced aggression toward other horses, and reduced reproductive behaviors (NRC 2013). The behavior of wild horse geldings in the presence of intact stallions has not been well documented, but the literature review below can be used to make reasonable inferences about their likely behaviors.

Despite livestock being managed by castrating males for millenia, there is relatively little published research on castrates' behaviors (Hart and Jones 1975). Stallion behaviors in wild or pasture settings are better documented than gelding behaviors, but it inferences about how the behaviors of geldings will change, how quickly any change will occur after surgery, or what effect gelding an adult stallion and releasing him back in to a wild horse population will have on his behavior and that of the wider population must be surmised from the existing literature. There is an ongoing BLM study in Utah focused on the individual and population-level effects of including some geldings in a free-roaming horse population (BLM 2016), but results from that study are not yet available. However, inferences about likely behavioral outcomes of gelding can be made based on available literature.

Feral horses typically form bands composed of an adult male with 1 to 3 adult females and their immature offspring (Feist and McCullough 1976, Berger 1986, Roelle et al. 2010). In many populations subordinate 'satellite' stallions have been observed associating with the band, although the function of these males continues to be debated (see Feh 1999, and Linklater and Cameron 2000). Juvenile offspring of both sexes leave the band at sexual maturity (normally around two or three years of age (Berger 1986), but adult females may remain with the same band over a span of years. Group stability and cohesion is maintained through positive social interactions and agonistic behaviors among all members, and herding and reproductive behaviors from the stallion (Ransom and Cade 2009). Group movements and consortship of a stallion with mares is advertised to other males through the group stallion marking dung piles as they are encountered, and over-marking mare eliminations as they occur (King and Gurnell 2006).

In horses, males play a variety of roles during their lives (Deniston 1979): after dispersal from their natal band they generally live as bachelors with other young males, before associating with mares and developing their own breeding group as a harem stallion or satellite stallion. In any population of horses not all males will achieve harem stallion status, so all males do not have an equal chance of breeding (Asa 1999). Stallion behavior is thought to be related to androgen levels, with breeding stallions having higher androgen concentrations than bachelors (Angle et al. 1979, Chaudhuri and Ginsberg 1990, Khalil et al. 1998). A bachelor with low libido had lower levels of androgens, and two year old bachelors had higher testosterone levels than two year olds with undescended testicles who remained with their natal band (Angle et al. 1979).

The effect of castration on aggression in horses has not often been quantified. One report has noted that high levels of aggression continued to be observed in domestic horse geldings who also exhibited sexual behaviors (Rios and Houpt 1995). Stallion-like behavior in domestic horse geldings is relatively common (Smith 1974, Schumacher 1996), being shown in 20-33% of cases whether the horse was castrated pre- or post-puberty (Line et al. 1985, Rios and Houpt 1995, Schumacher 2006). While some of these cases may be due to cryptorchidism or incomplete surgery, it appears that horses are less dependent on hormones than other mechanisms for the maintenance of sexual behaviors (Smith 1974). Domestic geldings exhibiting masculine behavior had no difference in testosterone concentrations than other geldings (Line et al. 1985, Schumacher 2006), and in some instances the behavior appeared context dependent (Borsberry 1980, Pearce 1980).

Dogs and cats are commonly neutered, and it is also common for them to continue to exhibit reproductive behaviors several years after castration (Dunbar 1975). Dogs, ferrets, hamsters, and marmosets continued to show sexually motivated behaviors after castration, regardless of whether they had previous experience or not, although in beagles and ferrets there was a reduction in motivation post-operatively (Hart 1968, Dunbar 1975, Dixson 1993, Costantini et al. 2007, Vinke et al. 2008). Ungulates continued to show reproductive behaviors after castration, with goats and llamas continuing to respond to females even a year later in the case of goats, although mating time and the ejaculatory response was reduced (Hart and Jones 1975, Nickolmann et al. 2008).

The likely effects of castration on geldings' social interactions and group membership can be inferred from available literature, even though wild horses are rarely gelded and released back into the wild, resulting in few studies that have investigated their behavior in free-roaming populations. In the western US – where ranges are much larger, intact stallions are present year-round, and population density varies – free-roaming gelding behaviors may differ somewhat from those noted below. In a pasture study of domestic horses, Van Dierendonk et al. (1995) found that social rank among geldings was directly correlated to the age at which the horse was castrated, suggesting that social experiences prior to sterilization may influence behavior afterward. Of the two geldings present in a study of semi-feral horses in England, one was dominant over the mares whereas a younger gelding was subordinate to older mares; stallions were only present in this population during a short breeding season (Tyler 1972). A study of domestic geldings in Iceland held in a large pasture with mares and sub-adults of both sexes, but no mature stallions, found that geldings and sub-adults formed associations amongst each other that included interactions such as allo-grooming and play, and were defined by close proximity (Sigurjónsdóttir et al. 2003). These geldings and sub-adults tended to remain in a separate group from mares with foals, similar to castrated Soay sheep rams (Ovis aries) behaving like bachelors and grouping together, or remaining in their mother's group (Jewell 1997). In Japan, Kaseda et al. (1997) reported that young males dispersing from their natal harem and geldings moved to a different area than stallions and mares during the non-breeding season. Although the situation in Japan may be the equivalent of a bachelor group in natural populations, in Iceland this division between mares and the rest of the horses in the herd contradicts the dynamics typically observed in a population containing mature stallions. Sigurjónsdóttir et al. (2003) also noted that in the absence of a stallion, allo-grooming between adult females increased drastically. Other findings included increased social interaction among yearlings, display of stallion-like behaviors such as mounting by the adult females, and decreased association between females and their yearling offspring (Sigurjónsdóttir et al. 2003). In the same population in Iceland Van Dierendonck et al. (2004) concluded that the presence of geldings did not appear to affect the social behavior of mares or negatively influence parturition, mare-foal bonding, or subsequent maternal activities. Additionally, the welfare of broodmares and their foals was not affected by the presence of geldings in the herd (Van Dierendonck et al. 2004). These findings are important because treated geldings will be returned to the range in the presence of pregnant mares and mares with foals of the year.

The likely effects of castration on geldings' home range and habitat use can also be surmised from available literature. Bands of horses tend to have distinct home ranges, varying in size depending on the habitat and varying by season, but always including a water source, forage, and places where horses can shelter from inclement weather or insects (King and Gurnell 2005). By comparison, bachelor groups tend to be more transient, and can potentially use areas of good forage further from water sources, as they are not constrained by the needs of lactating mares in a group. The number of observations of gelded wild stallion behavior are still too few to make general predictions about whether a particular gelded stallion individuals will behave like a harem stallion, a bachelor, or form a group with geldings that may forage and water differently from fertile wild horses.

Gelding wild horses does not change their status as wild horses under the Wild Horse and Burro Act (as amended). In terms of whether geldings will continue to exhibit the free-roaming behavior that defines wild horses, BLM does expect that geldings would continue to roam unhindered in the Twin Peaks HMA where this action would take place. Wild horse movements may be motivated by a number of biological impulses, including the search for forage, water, and social companionship that is not of a sexual nature. As such, a gelded animal would still be expected to have a number of internal reasons for moving across a landscape and, therefore, exhibiting 'free-roaming' behavior. Despite marginal uncertainty about subtle aspects of potential changes in habitat preference, there is no expectation that gelding wild horses will cause them to lose their free-roaming nature. It is worth noting that individual choices in wild horse group membership, home range, and habitat use are not protected under the Wild Horse and Burro Act. BLM acknowledges that geldings may exhibit some behavioral differences after surgery, compared to intact stallions, but those differences are not be expected to remove the geldings' rebellious and feisty nature, or their defiance of man. While it may be that a gelded horse could have a different set of behavioral priorities than an intact stallion, the expectation is that geldings will choose to act upon their behavioral priorities in an unhindered way, just as is the case for an intact stallion. In this sense, a gelded male would be just as much 'wild' as defined by the Wild Horse and Burro Act as any intact stallion, even if his patterns of movement differ from those of an intact stallion. Congress specified that sterilization is an acceptable management action (16 USC §1333.b.1). Sterilization is not one of the clearly defined events that cause an animal to lose its status as a wild free-roaming horse (16 USC §1333.2.C.d). Several academics have offered their opinions about whether gelding a given stallion would lead to that individual effectively losing its status as a wild horse (Rutberg 2011, Kirkpatrick 2012, Nock 2017). Those opinions are based on a semantic and subjective definition of 'wild,' while BLM must adhere to the legal definition of what constitutes a wild horse, based on the Wild Horse and Burro Act (as amended). Those individuals have not conducted any studies that would test the speculative opinion that gelding wild stallions will cause them to become docile. BLM is not obliged to base management decisions on such opinions, which do not meet the BLM's principle and practice to "Use the best available scientific knowledge relevant to the problem or decision being addressed, relying on peer reviewed literature when it exists" (Kitchell et al. 2015).

Genetic Effects of Gelding

It is true that geldings are unable to contribute to the genetic diversity of the herd, but that does not lead to an expectation that the Twin Peaks HMA would necessarily experience high levels of inbreeding, because there would be a core breeding population of stallions consistent with low end AML. Existing levels of genetic diversity were high in this area when last measured, and expectations are that heterozygosity levels are even higher now, because the population has continued to grow exponentially in the recent past. In addition, many of the stallions that would be gelded would have already had a chance to breed, passing on genetic material to their offspring. BLM is not obligated to ensure that any given individual in a herd has the chance to sire a foal and pass on genetic material. The herd in which the proposed action is to take place are not at immediate or future risk of catastrophic loss of genetic diversity, nor does the genetic diversity in this herd represent unique genetic information. This action does not prevent BLM from augmenting genetic diversity in the treated herd in the future, if future genetic monitoring indicates that would be necessary.

It is not expected that genetic health would be affected by the Proposed Action. Available indications are that these populations contain high levels of genetic diversity at this time. The AML range of 448-758 wild horses and 72-116 burros Twin Peaks HMA should provide for acceptable genetic diversity. If at any time in the future the genetic diversity in either HMA is determined to be relatively low, then a large number of other HMAs could be used as sources for fertile wild horses that could be translocated into the HMA of concern (BLM 2010).

The Twin Peaks HMA is located such that a small number of horses could enter the population from adjacent HMAs (Coppersmith, Buckhorn, and Buffalo Hills HMAs). As such, there is the potential for some additional genetic information to continually enter this population. The BLM allows for the possibility that, if future genetic testing indicates that there is a critically low genetic diversity in the Twin Peaks HMA herd and other herds that interact with it genetically, future management of the Twin Peaks HMA herd could include genetic augmentation, by bringing in additional stallions, mares, or both. The NRC report (2013) recommended that managed herds of wild horses would be better viewed as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements. Introducing 1-2 mares every generation (about every 10 years) is a standard management technique that can alleviated potential inbreeding concerns (BLM 2010).

Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity, in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Although those results are specific to mares, some inferences about potential effects of stallion sterilization may be made from their results. Roelle and Oyler-McCance (2015) showed that the risk of the loss of genetic heterozygosity is extremely low except in cases where all of the following conditions are met: starting levels of genetic diversity are low, initial population size is 100 or less, the intrinsic population growth rate is low (5% per year), and very large fractions of the population are permanently sterilized.

BLM acknowledges that if the management goal was to sterilize >85% of males in a population, that could lead to genetic consequences of reduced heterozygosity and increased inbreeding coefficients, as it would potentially allow a very small group of males to dominate the breeding (e.g., Saltz et al. 2000). Such genetic consequences could be mitigated by natural movements or human-facilitated translocations (BLM 2010). However, the question of how >85% gelded males in a population would interact with intact stallions and mares and with their habitat is not relevant to this decision because that level of castration is not being considered as an alternative in this decision. Garrott and Siniff’s (1992) model predicts that gelding 50-80% of mature males in the population would result in reduced, but not halted, mare fertility rates. However, within a few years after any male sterilization treatment, a number of fertile male colts would become sexually mature stallions who could contribute genetically to the herd.

Appendix Q. Required Design Features (RDF)

The following RDFs would be applied to be consistent with the BLM Nevada and Northeastern California's Approved Resource Plan Amendment (as amended, 2019):

1. RDF Gen 12: Control the spread and effects of nonnative, invasive plant species (e.g. by washing vehicles and equipment, minimize unnecessary surface disturbance). All projects would be required to have a noxious weed management plan in place prior to construction and operations.
2. RDF Gen 13: Implement project site-cleaning practices to preclude the accumulative of debris, solid waste, putrescible wastes, and other potential anthropogenic subsidies for predators of GRSG.
3. RDF Gen 17: Restore disturbed areas at final reclamation to the pre-disturbance landforms and desired plant community.
4. RDF Gen 19: Instruct all construction employees to avoid harassment and disturbance of wildlife, especially during the GRSG breeding (e.g. courtship and nesting) season. In addition, pets shall not be permitted on site during construction.
5. RDF Gen 21: Outfit all reservoirs, pits, tanks, troughs or similar features with appropriate type and number of wildlife escape ramps.
6. RDF Gen 22: Load and unload all equipment on existing roads, pull outs, or disturbed areas to minimize disturbance to vegetation and soil.