Appendix A

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BLM

Spay Feasibility and On-Range Behavioral Outcomes Assessment and Warm Springs HMA Population Management Plan

Environmental Assessment
DOI-BLM-ORWA-B050-2018-0016-EA

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Environmental Assessment

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I. INTRODUCTION

This environmental assessment (EA) has been prepared to disclose and analyze the environmental consequences of the Spay Feasibility and On-Range Behavioral Outcomes Assessment and Warm Springs Herd Management Area (HMA) Population Management Plan. The research project is proposed by the United States Geological Survey (USGS) in cooperation with the Burns District Bureau of Land Management (BLM). The Burns District BLM proposes to evaluate the safety, complication rate, and feasibility of ovariectomy via colpotomy (spay) on wild horse mares and to allow the USGS to evaluate the impacts of spaying on mare and band behavior once returned to the range as compared with an untreated herd.

In conjunction with the BLM spay feasibility study and the USGS on-range behavioral outcomes study, Burns District BLM also proposes a 10-year population management plan for Warm Springs HMA. The plan includes BLM gathering the HMA and applying spaying as a population growth suppression tool, then the USGS on-range behavioral study, followed by a gather to low appropriate management level (AML) at the completion of the study, and additional gathers and removals of excess wild horses and burros. Wild horse mares returned to the range following gathers would receive population growth suppression treatments. The USGS on-range behavioral assessment is being initiated to document the BLM experience with this method for managing the population growth of wild horse herds on public lands; no burros would be spayed or be involved in the study. The population management plan is being proposed to achieve and maintain a thriving natural ecological balance and manage the wild horse and burro populations within AML over a 10-year timeframe.

A. Background

The BLM would assess the feasibility of spaying wild horse mares as a population management action and USGS would assess the on-range behavioral outcomes of ovariectomizing (i.e. spaying) wild horse mares and returning them to the range. BLM monitoring of the feasibility of the "spay" method includes, but is not limited to, quantifying the safety of the procedure for both the mare and veterinarian performing the surgery, quantifying post-surgical complication rates, quantifying costs associated with the surgical method, and surgery time. USGS's on-range behavior assessments would include, but are not limited to, band fidelity of treated/untreated mares, attention and breeding attempts by stallions toward treated/untreated mares, interactions among stallions and treated/untreated mares, and differences in habitat selection and home range size of treated/untreated mares. The study would use horses from and take place at Warm Springs HMA, with surgeries and radio collaring/tagging taking place at the Oregon Wild Horse Corral Facility in Hines.

Various methods of gathering and population control are analyzed in the document. Gathering methods of wild horses and burros include helicopter-drive trapping, bait/water trapping, and horseback-drive trapping. Two methods of wild horse mare fertility control, porcine zona pellucida (PZP) fertility control vaccine and ovariectomy via colpotomy, are analyzed in the document as potential methods of fertility treatment for the remainder of the 10-year timeframe following the completion of the spay feasibility and behavior outcomes assessment.

Warm Springs HMA is located in Harney County, Oregon, approximately 25 air miles southwest of Burns, Oregon (Appendix A, Warm Springs HMA Vicinity Map). The HMA contains approximately 474,547 acres of BLM-managed land. Topography consists of gently rolling, sagebrush covered hills and rimrock with small lake basins between. Elevations range from 4,250 feet at Iron Mountain Flat to 5,584 feet at Jackass Butte. Annual precipitation ranges from 10 to 12 inches, mostly occurring in the form of snow during the months of December through February, with spring rains common. Temperatures range from -30°F in the winter to 100°F in the summer.

The Three Rivers Resource Area Resource Management Plan (RMP) and Record of Decision (ROD) (1992) affirmed an AML range of 96 to 178 wild horses and 15 to 24 burros within the HMA; total AML would be 111 to 202 animals. The upper limit of an AML will be the maximum number of wild horses and burros (WHB) that results in a thriving natural ecological balance and avoids a deterioration of the range (BLM Wild Horses and Burros Management Handbook, H-4700-1). The AML lower limit will normally be established at a number that allows the population to grow (at the annual population growth rate) to the upper limit over a 4- to 5-year period, without any interim gathers to remove excess wild horses (H-4700-1). The population growth rate in many HMAs approaches 20 percent or even higher (National Research Council (NRC) Review 2013). Therefore, with a 20 percent population growth rate, the low level of AML would achieve or exceed the high end of AML within 4 to 5 years.

Since 1972, the Warm Springs HMA has been surveyed 19 times and gathered 16 times (partial and full gathers) to maintain the population within AML. A September 27, 2016, simultaneous double-observer aerial survey led to an estimated population size of 586 horses (513 adult horses and 73 foals; Lubow 2016). Also, a June 18–19, 2018, simultaneous double-observer aerial survey led to an estimated population size of 852 horses (694 adults and 158 foals) (USGS unpublished data, 2018). Many burro characteristics make them difficult to detect in aerial surveys; they are relatively small, cryptic-colored, can be hidden by trees and tall shrubs, occur in small groups, and may stand still during surveys (Griffin 2015). Despite this difficulty, two ground counts and the June 2018 aerial survey provided an estimated burro population of 68 adults plus 6 foals. Assuming a 19 percent population growth rate (Ransom et al. 2016), the estimated burro population by fall 2028 would be 387 adults and 73 foals.

Within the Great Basin, drought conditions are common, and water is the main limiting factor within Warm Springs HMA. During the Severe Drought (designated by the National Oceanic and Atmospheric Administration (NOAA)) in 2014, wild horses and burros were forced to congregate closer to the few remaining water sources in the HMA. Livestock permittees (who were authorized less than 50 percent active use that year) had been ordered to remove all remaining livestock from the impacted area, and cooperative agreements were being exercised to operate wells to provide water to horses in the absence of livestock. In an effort to avoid the need for emergency removals or large scale mortality, Burns District began hauling water to an existing waterhole and temporary troughs where approximately 80 wild horses were congregating. At the time, the potential for wild horse mortality was high. NOAA recently released its U.S. Seasonal Drought Outlook for the period of April 19 through July 31, 2018, which shows eastern Oregon with persistent drought and explains that "[b]elow-normal precipitation and above-normal temperatures promoted drought persistence across central and eastern Oregon…monthly and seasonal outlooks both depict enhanced changes for below-normal precipitation and above-normal temperatures, which favors persistence through the end of August" (NOAA 2018). Water availability is presently inadequate to support a subset of the wild horse population in the western half of the HMA, and BLM has begun hauling water to sustain a population of approximately 236 animals in this area. With an estimated 694 adults horses and 158 foals by fall 2018 (USGS unpublished data, 2018), severe drought in coming years would likely result in loss of life especially as compared to 2014 when the estimated wild horse population was only 253 adults and 44 foals and loss was expected without water hauling. Because water resources are limited in this HMA, especially during drought years wild horse observations show high congregation areas are occurring within 4 miles of all pending Greater Sage-Grouse (GRSG) leks (range of 15–120 horses per lek; average 49 horses per lek). Continuous yearlong impacts from horses to GRSG are a serious concern. Wild horse competition with native wildlife species for water sources is concerning especially in relation to recent GRSG lek trends in the HMA (drastic decline or loss) versus leks outside the HMA (stable). Herbaceous cover and height provide horizontal screening at GRSG nest sites, which obscures the nest from predators. Recent upland forage utilization monitoring documents moderate to high utilization levels in portions of the HMA experiencing concentrated wild horse and livestock use. In 2017 and 2018, moderate to heavy use was indicated in several areas of the HMA where lower levels of livestock use occurred.

The AML for wild horses and burros across the west is 26,715. The current estimated on-range wild horse and burro adult population is 81,814 (as of March 1, 2018; BLM). There are currently 45,402 wild horses and burros in BLM Off-Range Facilities (as of April 2018; BLM). Nationally, there is limited available funding and space to care for additional animals in BLM short- and long-term holding facilities. Unrestricted population growth of wild horses and burros eventually leads to overpopulation of herds and consequent detriment to the animals, health of the range, other species, and other users of the range. The BLM has been using a limited number of methods to address high population growth of wild horses and burros. Currently available options include periodic removals and the application of temporary fertility control vaccines. The current criteria for prioritizing gathers are as follows: court orders, public health and safety, sagebrush focal area GRSG habitat gathers, implementation of research, private land encroachment, and emergency removal of imperiled animals. The NRC found in a 2013 review that there were no highly effective, long lasting, easily delivered, and affordable fertility control methods available at the time. Therefore, the BLM aims to develop and apply a variety of population management tools to reduce the number of animals that must be removed from the range as well as the number of animals that must be cared for in off-range facilities. One objective of the Oregon GRSG Approved Resource Management Plan Amendment (ARMPA) (2015) is to "[c]oordinate with professionals from other Federal and State agencies, researchers at universities, and others to utilize and evaluate new management tools (e.g. population growth suppression, inventory techniques, and telemetry) for implementing the WHB program" (MD WHB 9). Based on a summary of surgical mare sterilization techniques (Bowen 2015), BLM preliminarily identified ovariectomy via colpotomy as the most likely mare surgical sterilization method that could be successfully used as a management tool for long-term management of the Warm Springs HMA. Prior successful application of that spaying method had already been demonstrated at the Sheldon National Wildlife Refuge (NWR) (Collins and Kasbohm 2016) and in privately-owned wild mares that had recently been removed from BLM lands in Oregon (Pielstick, personal communication). In general terms, results from prior spay via colpotomy studies have already found limited surgical and behavioral outcomes for on-range horse management, but BLM identified the desire to quantify outcomes in a more detailed fashion as part of herd management in the Warm Springs HMA. In the interest of learning as much as possible from the application of this previously-proven surgical spay method, BLM sought a research partner that could document and quantify surgical and behavioral outcomes. The BLM has an existing interagency agreement with the USGS, the Department of the Interior's research agency, to provide research related to wild horse and burro management. The BLM sent a Statement of Research Objectives (included in Appendix B) to USGS in February 2018, which identified that two main goals of the research sought would be to quantify surgical and behavioral outcomes of the application of spaying via colpotomy. In response, BLM received a study plan for proposed USGS research, and (in June 2018) BLM approved funding to proceed with the proposed research described in and attached to this analysis. USGS had originally partnered with Colorado State University (CSU) to study and oversee the surgical portion of their proposal to BLM. Up until August 8, 2018, CSU was a willing partner in collecting further detail on the effects of the ovariectomy via colpotomy procedure on wild horse mares and had provided an Institutional Animal Care and Use Committee (IACUC) approval of the procedure and on-range behavior study. On August 8, 2018, CSU publicly announced its withdrawal from Oregon's surgical spaying of mares project. The BLM respects that decision by CSU, however conditions (population level, water availability, rapid population growth) remain the same on the Warm Springs HMA and similarly across many HMAs in the western states. The BLM must continue to pursue management actions to move toward achieving and maintaining the established AML and reduce the wild horse population growth rate in order to restore and maintain a thriving natural ecological balance and multiple-use relationship on public lands. USGS has resubmitted its proposal (Appendix C, USGS Research Proposal, August 2018) to include only the behavioral research portion of the original proposal. Its study would take place on mares spayed by BLM as a management action. The BLM would contract with veterinarians experienced in ovariectomy via colpotomy and standing sedation on wild horse mares to use the same surgical protocol for ovariectomy via colpotomy originally approved by the CSU IACUC. The BLM and contracted veterinarians would monitor the mares during and after surgery to provide data for the three specific aims related to the surgical portion of the project (described in the proposed action).

In addition to wild horse management in the Warm Springs HMA, various management activities are ongoing in the area including, but not limited to, livestock grazing management, noxious weed treatments, road maintenance, and wildlife habitat improvement projects. Warm Springs HMA lies within the Dry Valley/Jack Mountain GRSG Priority Area of Conservation (PAC); is home to locally important big game species such as elk, mule deer, and pronghorn antelope; and encompasses two separate livestock grazing allotments with seven individual livestock grazing permits. Portions are also designated as the Foster Flat Research Natural Area (RNA) and South Narrows Area of Critical Environmental Concern (ACEC).

B. Purpose and Need for Action

This action includes two primary purposes. The first purpose is to remove excess wild horses from within and outside the HMA, to manage wild horses in a way that would allow BLM to move toward achieving and maintaining the established AML over a 10-year timeframe, and to reduce the wild horse population growth rate in order to restore and maintain a thriving natural ecological balance and multiple-use relationship on the public lands consistent with the provisions of Section 1333(a) of the *Wild Free-Roaming Horses and Burros Act of 1971 (as amended)* (WHB Act).

There is a need to remove excess wild horses and burros from within and outside the HMA because the estimated population within Warm Springs HMA exceeds the established AML of 111–202 horses and burros. By fall 2018, there will be an estimated 694 adult horses (USGS unpublished data, 2018) plus burros, which is more than 500 animals over high AML. There is a need to protect rangeland resources from deterioration associated with animal populations that exceed AML. There is also a need to maintain the wild horse and burro population in balance with the four essential habitat components (forage, water, cover, and space), *especially water in this instance*, over the long term.

The second purpose is to study the use of ovariectomy via colpotomy as a method to maintain the wild horse population within Warm Springs HMA at AML, with spayed mares making up a portion of a self-sustaining herd, and maintaining free-roaming behavior. There is a need for more detailed quantification of surgical and behavioral effects of this method, using appropriate study design—including studying an adequate population—to effectively draw conclusions about the method's effects.

Further study of this method is needed to provide BLM more detailed quantification of the feasibility of this procedure as it relates to morbidity[1] and mortality rates. The BLM chose this method of spaying wild horse mares for reasons described in the Background

[1] Morbidity is defined as the frequency of the appearance of complications following a surgical procedure or other treatment. In contrast, mortality is defined as an outcome of death due to the procedure.

section above; BLM's need to develop and apply fertility control methods that effectively reduce the number of animals removed from the range; BLM's summary review of surgical mare sterilization techniques that preliminarily identified ovariectomy via colpotomy as the most likely mare surgical sterilization method that could be successfully used as a management tool for long-term management (Bowen 2015); and prior successful application of ovariectomy via colpotomy on feral mares at the Sheldon NWR (Collins and Kasbohm 2016). Alternate spay methods are described in the Alternatives Considered but Eliminated from Further Analysis section of this EA.

The USGS proposed a study to assess the on-range behavioral impacts of having spayed mares in a wild horse herd. The BLM is responding to this proposal by spaying wild horse mares and allowing USGS to assess on-range impacts. This study would provide BLM more detailed quantification of the reduction of the annual population growth rate of a wild horse herd and behavioral outcomes on the range when spayed mares are living with other treated and untreated animals.

These purposes are consistent with the provisions of section 1333(b) of the WHB Act, the multiple-use mandate of the Federal Land Policy and Management Act (FLPMA) of 1976, and the Three Rivers RMP/ROD (1992) that established the AML for the HMA.

C. Decision to be Made

The BLM's authorized officer will determine if excess wild horses and burros exist in Warm Springs HMA. The officer will also decide whether or not to gather and remove excess horses; to proceed with the proposed spay feasibility and on-range behavioral outcomes assessment; and to implement the 10-year population management plan including future fertility control treatments.

The decision would affect wild horses and burros within (and those that have strayed outside) the Warm Springs HMA. The BLM's authorized officer's decision would not set or adjust AML nor would it adjust livestock use, as these were set through previous decisions.

This study represents a feasibility approach, and the results are not policy setting for BLM. Any future proposal by BLM to utilize the spay method analyzed in this EA would be subject to NEPA compliance.

D. Conformance with BLM Resource Management Plan(s)

The proposed action is in conformance with the objectives, rationale, and allocation and management actions from the Three Rivers RMP/ROD (1992) and the Oregon Greater Sage-Grouse Approved Resource Management Plan Amendment (GRSG ARMPA) (2015).

Landscape-level Goals, Objectives, and Management Decisions

Oregon Greater Sage-Grouse Approved Resource Management Plan Amendment (GRSG ARMPA) (September 2015), WHB Objectives (p. 2-21)

Objective WHB 1: Manage wild horses and burros as components of BLM-administered lands in a manner that preserves and maintains a thriving natural ecological balance in a multiple-use relationship.

Objective WHB 2: Manage wild horse and burro population levels within established appropriate management levels.

MD WHB 1: Manage HMAs in GRSG habitat within established AML ranges to achieve and maintain GRSG habitat objectives.

MD WHB 3: Prioritize gathers and population growth suppression techniques in HMAs in GRSG habitat, unless removals are necessary in other areas to address higher priority environmental issues, including herd health impacts.

MD WHB 8: When conducting NEPA analysis for wild horse/burro management activities, water developments, or other rangeland improvements for wild horses, address the direct and indirect effects on GRSG populations and habitat.

MD WHB 9: Coordinate with professionals from other Federal and State agencies, researchers at universities, and others to utilize and evaluate new management tools (e.g., population growth suppression, inventory techniques, and telemetry) for implementing the WHB program.

MD WHB 10: When WHB are a factor in not meeting GRSG habitat objectives or influence declining GRSG populations in priority habitat management areas (PHMA), Oregon's gather priority for consideration by the Washington Office (WO) is as follows:

1. Response to an emergency (e.g., fire, insect infestation, disease, or other events of unanticipated nature).
2. GRSG habitat.
3. Maintain a thriving natural ecological balance.

Three Rivers RMP/ROD (1992) (p. 2-43)

WHB 1: Maintain healthy populations of wild horses within the Kiger, Palomino Buttes, Stinkingwater, and Riddle Mountain HMAs, and wild horses and burros in the Warm Springs HMA.

> WHB 1.1: Continue to allocate the following acres and animal unit months (AUM) in active HMAs: … Warm Springs HMA, 456,855 ac., 2,424 AUMs. This is equivalent to an AML of 111–202 animals, including 15–24 burros (Proposed Three Rivers RMP, September 1991, Volume 1 – Text, pp. 2-43 and 3-8).
>
> WHB 1.3: Adjust wild horse and burro population levels in accordance with the results of monitoring studies and allotment evaluations, where such adjustments are needed in order to achieve and maintain objectives for a thriving natural ecological balance and multiple-use relationships in each herd area (HA).
>
> Permanent adjustments would not be lower than the established minimum numbers in order to maintain viability. The AML would be based on the analysis

of trend in range condition, utilization, actual use and other factors which provide for the protection of the public range from deterioration.

Procedures to Implement:

1. Use currently approved methods for control of herd population levels.

WHB 2: Enhance the management and protection of HAs and herds in the following HMAs: Kiger, Stinkingwater, Riddle Mountain, Palomino Buttes, and Warm Springs.

WHB 2.3: Select for high quality horses when gathered horses are returned to the range.

WHB 2.4: Provide facilities and water sources necessary to ensure the integrity of the individual herds.

WHB 3: Enhance and perpetuate the special or rare and unique characteristics that distinguish the respective herds in the resource area (RA).

WHB 3.1: Limit any releases of wild horses or burros into an HMA to individuals which exhibit the characteristics designated for that HMA.

WHB 3.2: Manage burros for a maximum of 24 head in the west side of the Warm Springs HMA. The allocation of forage for burros is within the total allocation for the Warm Springs HMA.

E. Consistency with Laws, Regulations, and Policies

The proposed action has been designed to conform to Federal regulations, consultation requirements, and other authorities that direct and provide the framework and official guidance for management of BLM lands within the Burns District:

1. *Wild Free-Roaming Horses and Burros Act* (WHB Act) of 1971 (Pub. L. 92-195), as amended. The proposed action is consistent with the WHB Act, specifically, but not limited to the following sections:

1332. Definitions

(b) "wild free-roaming horses and burros" means all unbranded and unclaimed horses and burros on public lands of the United States;

(f) "excess animals" means wild free-roaming horses or burros

(1) which have been removed from an area by the Secretary pursuant to application law or,

(2) which must be removed from an area in order to preserve and maintain a thriving natural ecological balance and multiple-use relationship in that area.

1333. Powers and duties of the Secretary. (b) Inventory and determinations; consultation; overpopulations; research study; submittal to Congress. (1) The Secretary shall maintain a current inventory of wild free-roaming horses and burros on given areas of the public lands. The purpose of such inventory shall be to: make determinations as to whether and where an overpopulation exists and whether action should be taken to remove excess animals; determine appropriate management levels of wild free-roaming horses and burros on these areas of the public lands; and determine whether appropriate management levels should be

achieved by the removal or destruction of excess animals, or other options (such as sterilization, or natural controls on population levels). In making such determinations the Secretary shall consult with the United States Fish and Wildlife Service, wildlife agencies of the State or States wherein wild free-roaming horses and burros are located, such individuals independent of Federal and State government as have been recommended by the National Academy of Sciences, and such other individuals whom he determines have scientific expertise and special knowledge of wild horse and burro protection, wildlife management and animal husbandry as related to rangeland management.
(3) For the purpose of furthering knowledge of wild horse and burro population dynamics and their interrelationship with wildlife, forage and water resources, and assisting him in making his determination as to what constitutes excess animals, the Secretary shall contract for a research study of such animals with such individuals independent of Federal and State government as may be recommended by the National Academy of Sciences for having scientific expertise and special knowledge of wild horse and burro protection, wildlife management and animal husbandry as related to rangeland management.

2. *Wild Free-Roaming Horse and Burro Management* (43 CFR 4700).

4700.0-6(a) Wild horses and burros shall be managed as self-sustaining populations of healthy animals in balance with other uses and the productive capacity of their habitat....(c) Management activities affecting wild horses and burros shall be undertaken with the goal of maintaining free-roaming behavior.
4710.4 Constraints on management: Management shall be at the minimum level necessary to attain the objectives identified in approved land use plans and herd management area plans.
4720.1 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....
4740.1(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.

3. *BLM Wild Horses and Burros Management Handbook*, H-4700-1 (June 2010).

2.1.3 Herd Management Areas: "LUPs [Land Use Plans] should also identify: The HMAs to be managed for non-reproducing wild horses to aid in controlling on the range population numbers and the criteria for their selection....Examples of criteria that could be used to select HMAs for management of non-reproducing wild horses include: no special or unique herd characteristics, low ecological condition, limited public land water, and reliance on private water."

4.1.1 Self-Sustaining: "[WHB] shall be managed as self-sustaining populations of healthy animals in balance with other uses and the productive capacity of their habitat." Self-sustaining is defined as the ability of reproducing herds of wild horses and burros to maintain themselves in a healthy condition and to produce healthy foals (H-4700-1).
4.1.2 Free-Roaming Behavior: "In accordance with 43 CFR 4700.0-6(c), management activities affecting [WHB] shall be undertaken with the goal of maintaining free-roaming behavior." Free-roaming is defined as WHB that are able to move without restriction by fences or other barriers within an HMA (H-4700-1).
4.5.3 Reduce Population Growth Rates: "Additional management alternatives (tools) may be considered in the future, pending further research (see Chapter 8)."
4.5.4 Manage Selected HMAs for Non-Reproducing Wild Horses: "… some selected HMAs may be managed for non-reproducing wild horses to aid in controlling on the range population numbers." Non-reproducing wild horses are defined as "An HMA composed, in whole or in part, of sterilized wild horses (either stallions or mares) to aid in controlling on the range population numbers" (H-4700-1).
4.5.4.1. "LUPs *should* identify the HMAs to be managed for non-reproducing wild horses and the criteria for their selection. Completion of additional site-specific environmental analysis, issuance of a decision, and providing opportunity for administrative review under 43 CFR Part 4.21 *may* also be necessary." (emphasis added).
8.1 Strategic Research Plan: "Research results will be used to improve management practices within the [WHB] program."
8.3.2 Other Possible Fertility Control Tools: "Other possible fertility control tools that could potentially be considered in the future include: spaying mares…."
8.3.2.1 Spaying (Mares): "Spaying mares involves major abdominal surgery, is risky, and requires good post-operative care. Spaying mares could be considered in the future if safe, effective and humane surgical methods and post-operative care procedures can be perfected for use on wild horses."

4. *Monitoring responses of wild horse behavior and demography to BLM management treatment*, (Appendix C, USGS Research Proposal, August 2018).

5. *Warm Springs Equine Herd Management Area Plan* (1979).

This was the first management plan written following the signing of the WHB Act in 1971. It outlined the acreages and pasture of the HMA; the inventory records for burros, horses, and Shetlands; gathering records; vegetative and soil resource data; livestock and wildlife allocations; wild horse and burro populations and characteristics; and range improvement projects and established objectives:

- Remove all Shetlands, all crossbreeds involving horses, burros and Shetlands, and all branded animals from the herd area.

- Maintain a viable herd of 55 to 101 horses in the East Unit and a herd of 56 to 102 horses and 15 to 35 burros in the West Unit. (This is a management decision and may be modified after the Malheur Framework Plan is updated.)
- Provide adequate forage to meet the following (not all included):
    - Provide yearlong water sources so all species will have adequate and reliable water.

6. *Warm Springs Wild Horse Herd Management Area Plan* – Update (December 1987).

This plan was written to update the 1979 HMA Plan following the Drewsey, Andrews, and Riley Management Framework Plan Amendment that resulted in a decision affecting management numbers of wild horses in seven herd areas. The plan updated management numbers (AML) and acreage for the HMA as well as set wild horse objectives.

- Maintain a viable herd of 111–202 wild horses. The east unit will be managed at 50–100 horses and the west unit at 61–102 horses. Burros are still found in the west unit but no management objectives nor plans have been identified.
- Provide adequate forage to meet the following:

Maximum herd of wild horses	2,424 AUMs
Adjudicated demand for livestock	19,392 AUMs
Wildlife forage demand	204 AUMs

7. *Warm Springs Herd Management Area Plan Update* (June 2010).

This plan outlined the boundaries of the HMA, described other uses and resources within the boundaries, recommended an appropriate management level, and established wild horse and burro objectives. Some of the objectives set forth in this plan include, but are not limited to:

- Maintain the previously established AML range of 111 to 202 horses and burros (15–35 of the total) within the Warm Springs HMA boundary during a 4-year removal cycle.
- Maintain the relative frequency of occurrence and ground cover of key forage plant species (bluebunch wheatgrass, Thurber's needlegrass, and Idaho fescue) at key areas within known wild horse and burro concentration areas in the Warm Springs HMA over the next 10 years. Upland trend data at these key areas… shall provide the baseline data for determining the achievement of this objective.
- Maintain the healthy, free-roaming nature of wild horses and burros within the Warm Springs HMA emphasizing Appaloosa color phase, saddle type horses, 14 to 16 hands high and 950 to 1,300 pounds across all age classes.

8. *Livestock Grazing Allotment Objectives.*

As compared to the Warm Springs HMA Plans that describe general habitat objectives and wild horse population characteristics, the allotment management plans (AMP) for West Warm Springs (1980) and East Warm Springs (1993) allotments establish more specific habitat objectives.

9. *Instruction Memorandum (IM) No. 2009-062*, Wild Horse and Burro Genetic Baseline Sampling.

10. *IM No. 2009-090*, Population-Level Fertility Control Field Trials: Herd Management Area Selection, Vaccine Application, Monitoring and Reporting Requirements.

11. *IM No. 2010-057*, Wild Horse and Burro Population Inventory and Estimation.

12. *IM No. 2013-058*, Wild Horse and Burro Gathers: Public and Media Management.

13. *IM No. 2013-060*, Wild Horse and Burro Gathers Management by Incident Command System.

14. *IM No. 2013-146*, Exception to Policy in BLM Handbook H-4700-1 and Manual 4720.41: Helicopter Gather of Wild Horses and Burros Between March 1 and June 30 Due to Emergency Conditions and Escalating Problems.

15. *IM No. 2018-066*, Guidance for the Sale of Excess Wild Horses and Burros.

16. *IM No. 2015-070*, Animal Health, Maintenance, Evaluation and Response.

17. *IM No. 2015-151*, Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers.

18. *Burns District BLM IM-ORB-000-2018-004*, Oregon Wild Horse and Burro Corral Facility Access for Visitors.

19. *The Federal Land Policy and Management Act* (FLPMA) of 1976, as amended.

20. *National Environmental Policy Act* (NEPA) (42 U.S.C. 4321–4347, 1970).

21. *BLM NEPA Handbook*, H-1790-1 (January 2008), FLPMA (43 U.S.C. 1701, 1976), Section 302(b) of FLPMA states, "all public lands are to be managed so as to prevent unnecessary or undue degradation of the lands."

22. *Public Rangelands Improvement Act* (43 U.S.C. 1901, 1978).

23. *Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands Administered by the BLM in the States of Oregon and Washington* (1997).

24. *Vegetation Treatment Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Final Environmental Impact Statement* (FEIS) (2010) and ROD (2010).

25. *Integrated Invasive Plant Management for the Burns District Revised EA* (DOI-BLM-OR-B000-2011-0041-EA) Decision Record (DR) (2015).

26. *BLM Manual 6310*, Conducting Wilderness Characteristics Inventory on BLM Lands (March 2012), Section 201 of FLPMA requires that BLM maintain on a continuing basis an inventory of all public lands and their resources and other values, which includes wilderness characteristics. It also provides that the preparation and maintenance of the inventory shall not, of itself, change or prevent change of the management or use of public lands.

27. *BLM Manual 6320*, Considering Lands with Wilderness Characteristics in the BLM Land Use Planning Process. Section .04 Responsibilities, "C. District Managers and Field Managers shall: 1. Update and maintain the wilderness inventory for lands within the planning area consistent with BLM wilderness characteristics inventory guidance. 2. Ensure that wilderness characteristics inventories are considered and that, as warranted, lands with wilderness characteristics are protected in a manner consistent with this manual in BLM planning processes."

F. Scoping and Identification of Issues

On May 21, 2018, the BLM Burns District mailed a scoping letter to 127 interested individuals, groups, and agencies regarding the proposed spay feasibility and on-range behavioral outcomes assessment and the proposed population management plan for Warm Springs HMA. The scoping letter was also posted to BLM's ePlanning website. Letters mailed to the Burns District BLM and emails sent to blm_or_spaystudy_warmsprhma@blm.gov were received from 2,044 individuals, groups, and agencies during the scoping period. Comments received following the May 21, 2018, scoping period were incorporated into a draft EA which was released for a 30-day public comment period on June 29, 2018. The announcement of the availability of the EA for public comment was also emailed to 49 interested parties. In addition, the EA and unsigned FONSI were posted to BLM's ePlanning website, and a notice was posted in the Burns Times-Herald newspaper for one week, beginning on July 4, 2018. A total of 8,326 comment emails, letters, and faxes were received during the 30-day public comment period. The comments and issues identified during the public comment period have been incorporated into this EA or addressed in documents that would be in an administrative record. Permanent sterilization of wild mares, especially ovariectomy, and the possibility of BLM conducting this type of research is not a new topic. At least six years ago the National Wild Horse and Burro Advisory Board (Advisory Board) began discussing the possibility of mare sterilization during their meetings. These meetings are open to the public, with public comment periods provided. The agenda and minutes from these meetings are posted online[2] and are, therefore, available for public review. In October 2012, the Advisory Board recommended that, "BLM add ovariectomy as one additional tool for population growth suppression," and drafted a seven-page description of their interpretation of this specific recommendation (BLM 2012). The 2013 NRC Review of the BLM Wild Horse and Burro Program evaluated ovariectomy of mares, and explained that ovariectomy via colpotomy was an alternative vaginal approach to ovariectomy, as it avoids an external incision and reduces the chances of complication and infection (NRC Review 2013). The NRC Review (2013) noted that this surgery is not without risk, but also noted that all fertility control measures have some effects on physiology or behavior.

In September 2013, the Advisory Board provided discussion and recommendations to BLM addressing the key findings in the NRC Review (2013). In response finding number seven, the Advisory Board recommended that "no options for reproductive control be eliminated from consideration due to the conflicting data on immune-contraceptives such as intrauterine devices (IUD), ovariectomy, and tubal ligation" (BLM 2013).

The issues identified in the letters and emails from the public during the public scoping period and the Draft EA comment period held from June 29 to July 30, 2018 along with issues identified during Burns District BLM interdisciplinary team (IDT) meetings and through contact with other agencies, are listed below. Comments and the following issues were used to guide the effects analysis in chapter III.

1. Issues for Analysis

Wild Horses and Burros

- *What would be the direct effects of gathering on wild horses and burros?*
- *What are the anticipated complications and rate of complications associated with the ovariectomy via colpotomy procedure (procedure)?*
- *If the mare is pregnant, would the procedure affect the development of the foal?*
- *Would the mare continue to have an estrous cycle following this procedure?*
- *What would be the anticipated long-term effects of the surgical procedure on mares?*

[2] The minutes can be found at: https://www.blm.gov/programs/wild-horse-and-burro/get-involved/advisory-board.

- *What are anticipated on-range effects following the release of spayed mares, including free-roaming behavior?*
- *How would the alternatives affect genetic diversity, health, and the self-sustaining nature of Warm Springs HMA wild horses?*
- *What are the potential risks of radio collaring wild horses and how would BLM ensure the animals would not be injured?*
- *What are the effects of PZP on a mare and the herd?*
- *What are the effects of ovariectomy via colpotomy on the population of wild horses in the Warm Springs HMA?*
- *What are the effects of PZP on the population of wild horses in the Warm Springs HMA?*
- *How would the alternatives affect wild horse and burro habitat?*

Cultural Resources

- *What would be the effect of the wild horse and burro population management plan alternatives on cultural resources?*

Riparian Zones, Wetlands, and Water Quality

- *What would be the effects of the alternatives on water quality and riparian conditions within the HMA?*

Livestock Grazing Management

- *What would be the effects of the alternatives on livestock grazing management and associated ranch operations?*

Wildlife and Wildlife Habitat, Including Special Status Species

- *What would be the effects of the alternatives on GRSG habitat?*
- *What would be the effects of the alternatives on pygmy rabbit habitat?*
- *What would be the effects of the alternatives on large ungulate habitat in the HMA?*

Noxious Weeds

- *How would the 10-year population management plan affect the spread and introduction of noxious weeds?*

Economic Values

- *What are the anticipated costs associated with gathering wild horses and burros?*
- *What is the estimated cost per mare to conduct ovariectomy via colpotomy?*
- *What is the estimated cost per mare if PZP were used in the future?*
- *What are the anticipated costs associated with the study?*
- *What are the economic effects to other range users and local economy?*

Soils and Biological Crusts

- *What would be the effects of the alternatives on soils and biological crusts?*

Upland Vegetation

- *What would be the effects of the alternatives on upland vegetation health?*

Lands with Wilderness Characteristics

- *What would be the effects of the alternatives on lands with wilderness characteristics?*

2. Issues Considered but Eliminated from Detailed Analysis

Wild Horses

- *Sterilizing wild horse mares is an action that is contrary to the Wild Free-roaming Horse and Burro Act (1971).*
  This issue was eliminated from detailed analysis because the 1971 WHB Act specifically states that "The Secretary shall maintain a current inventory of wild free-roaming horses and burros.... The purpose of such inventory shall be to...determine whether appropriate management levels should be achieved by the removal or destruction of excess animals, or other options (such as sterilization, or natural controls on population levels)."
- *The availability and success of using PZP fertility control to manage wild horse populations is well documented in the scientific literature; why doesn't BLM just continue using PZP?*
  The use of PZP for fertility control is well documented; however, longer lasting formulations have not proven effective at population growth suppression on a majority of HMAs. Using the two-injection liquid PZP inoculation, BLM would need to gather the horses and treat the mares during the appropriate time period (late winter to early spring) then release those mares back to the HMA. For PZP to remain effective, mares would either need to be gathered or bait/water trapped every year and retreated with PZP, or mares would need to be located, identified, and successfully darted every year with a booster dose of liquid PZP. Locating, identifying, and successfully darting all individual mares during later winter or early spring annually is logistically infeasible across the vast expanse of most HMAs. When identifying the most promising fertility control methods, the NRC Review (2013) concluded there are HMAs in which remote delivery (i.e., darting) is possible, but these seem to be exceptions where horses are easily approached and individually identifiable. Given the current fertility control options, remote delivery (darting) appears not to be a practical characteristic of an effective population management tool, but it could be useful in some scenarios (NRC Review 2013, p. 147). Access to animals for timely inoculation and other management constraints may affect the utility of PZP as a management tool for western feral horse populations

(Ransom et al. 2011). Warm Springs HMA is a large HMA and mares there are not easily approachable. The BLM must explore the use of different methods and techniques for long-term population growth suppression, such as surgical sterilization, which could be applied to horses in HMAs with limited access and other constraints.

- *The Wild Free-Roaming Horse and Burro Act (1971) states that all management activities shall be at the minimal feasible level; is surgical sterilization the most [minimal] feasible level of management that would achieve population growth suppression?*
  The results of the study in this EA would provide BLM with more details on the safety and feasibility of this one-time population growth suppression tool to curb wild horse population growth. Application of this method on the Warm Springs HMA would come at a time when on-range population levels are 3 times the appropriate management level. The BLM has only applied a population growth suppression tool that is effective for one year or less per vaccine injection. Gathering every mare on all rangelands managed by BLM (currently approximately 40,000+ mares) annually to apply a fertility control vaccine (a cost each year of over $2,000 per mare gathered, plus $30 per vaccine dose) is less feasible than handling and permanently sterilizing a mare with a 15-minute surgical procedure, at a cost of $250–$300 plus the cost of being gathered only once. Incessant temporary fertility control vaccine use requires much more handling than spaying does, therefore it is not the most "minimal" level of management that achieves a thriving natural ecological balance. The most minimal feasible level of fertility control management is a safe, long-term efficacy, one-time treatment (e.g. spay) with no follow-up treatment required in the mare's lifetime as compared to multiple handlings and temporary treatments over her reproductive lifetime to apply an annual fertility control vaccine.

- *The BLM claims an overpopulation of wild horses on the range; however, it has no evidence of excess wild horses and burros because the BLM has failed to use scientifically sound methods to estimate the populations.*
  As discussed on page 2, the AML for Warm Springs HMA is 111 to 202 wild horses and burros (15–24 animals included in the total AML). Page 2 (above) also explains that a June 2018 simultaneous double-observer aerial survey led to an estimated population size of 852(694 adult horses and 158 foals) (USGS unpublished data) with an estimated 68 adult burros and 6 foals based on recent air and ground surveys. In addition to Warm Springs HMA having a wild horse and burro population well over the high end of AML, the total AML for public lands across the western USA is 26,715 wild horses and burros while the current estimated on-range population is 81,814 (as of March 1, 2018). In 2013, the NRC reviewed how BLM estimates population size and growth rates (NRC Review 2013, pp. 37–72). The NRC Review (2013) explains that although animals can be missed or double-counted during the same survey, a large body of

scientific literature on techniques for inventorying large mammals has demonstrated that failure to detect animals is overwhelmingly more common. The NRC Review (2013) also explains that the animal counts (the total number of animals tallied in a given survey) derived from BLM's typical inventory procedures prior to 2013 did not reflect the true number of animals in an HMA but instead generally led to an estimate of population size that was far lower than the true number present. The raw counts themselves represent the minimum number of animals occupying the HMA (p. 39). The report goes on to state "it is the committee's judgment that the reported annual population statistics are probably substantial underestimates of the actual number of horses occupying the public lands inasmuch as most of the individual HMA population estimates are based on the assumption that all animals are detected and counted in population surveys – that is, perfect detection" (p. 55). The committee went on to explain (p. 66) their conclusions that there are substantially more horses on public rangelands than reported and that horse populations generally are experiencing high population growth rates, which have important consequences for management. Since 2013, BLM has been using the statistically validated simultaneous double-observer method (Lubow and Ransom 2016) for collecting data, which allows for statistical analysis of observations and a better estimate of actual population size from survey data, as recommended in the NRC Review (2013).

II. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

This section of the EA describes the no action alternative and the proposed action alternative. This section also identifies alternatives that were considered but eliminated from detailed analysis.

- Alternative A – No Action – No Spay Assessment, Gather, or Removal
- Alternative B – Proposed Action – Spay Feasibility and On-Range Behavioral Outcomes Assessment and 10-year Population Management Plan.

The proposed action was developed, in response to the research proposal submitted by USGS, to respond to identified resource issues and the purpose and need for action. Alternative A, No Action, would not achieve the identified purpose and need, however it is analyzed in this EA to provide a basis for comparison with the action alternative and to assess the effects of not conducting research for a potential population management tool and not conducting population management on Warm Springs HMA. Alternative A, the no action alternative, does not conform to the WHB Act (1971) that requires BLM to immediately remove excess wild horses and burros.

A. Alternative A – No Action

The no action alternative would reject the spay feasibility and on-range behavioral outcomes assessment proposal. It would not be possible to conduct the research specified in the USGS financial assistance agreement. The BLM funding for this specific research project would be de-obligated.

Also under the no action alternative, a population management plan for the Warm Springs HMA would not be prepared. No gathers would occur and no additional management actions would be taken to regulate population size, sex ratio, or characteristics of the wild horses and burros at this time. Using a 20 percent population growth rate, within one normal gather cycle (5 years) wild horse numbers would increase from the fall 2018 estimate of 694 adults and 158 foals (USGS unpublished data, 2018) to approximately 1,726 adult horses and 345 foals by fall 2023. By fall 2028, the end of the 10-year timeframe of this EA, the wild horse population could be as large as 4,297 adult horses plus 859 foals. Using an estimated 19 percent population growth rate, the burro population would increase from the fall 2018 estimate of 68 adults to 387 adults plus foals by fall 2028. Wild horses and burros ranging outside the HMA boundaries would remain in areas not designated for their management, including private lands.

Although the no action alternative does not propose any gathers during the 10-year timeframe, there could be incidents where emergency gathers and removals are required. Emergencies generally are unexpected events that threaten the health and welfare of a WHB population and/or their habitat and immediate action is normally required (e.g. fire, insect infestation, disease, or other events of a catastrophic and unanticipated nature) (BLM, H-4700-1, 2010). In the event of an emergency gather, the effects to horses and burros from gathering, transport, and adoption/sales preparation would be equivalent to those described in Chapter III – Wild Horses and Burros section, Proposed Action.

B. Alternative B – Proposed Action

In order to clearly define the phases involved in this project, the proposed action is described in two separate sections:

1. Spay Feasibility and On-Range Behavioral Outcomes Assessment (2018–2022), and
2. 10-year Population Management Plan (2018–2028).

Implementation of the proposed action would begin in the fall of 2018. Only horses would be involved in the spay procedures and on-range behavioral outcomes study. Burro population management is incorporated in the 10-year population management plan. This population management plan describes proposed actions to manage wild horses and burros within AML and existing HMA objectives.

Common to all portions of the proposed action, low stress handling techniques, as described in the BLM's Comprehensive Animal Welfare Program (Appendix D, IM

2015-151) or updated policy, would be utilized to ensure the safety of the animals and minimize stress to the extent possible during the gather, transport, processing, treatments, collaring, and return of animals to the range. In addition to BLM's IM 2012-151, animal handling would follow USGS's approved animal care and use protocol for testing of radio telemetry collars and radio tags on free-roaming wild horses and burros (FORT-IACUC 2015-10) (Appendix C, USGS Research Proposal, August 2018).

1. Spay Feasibility and On-Range Behavioral Outcomes Assessment

In this portion of the proposed action, BLM is responsible for the gathering of animals, contracting to conduct ovariectomy via colpotomy, and monitoring the mortality and morbidity rates of mares treated. USGS is responsible for radio collaring/tagging horses, studying herd genetics (beyond BLM's WO IM 2009-062, Wild Horse and Burro Genetic Baseline Sampling), and on-range behavioral observations.

As described in the earlier version of this EA circulated in June of 2018, this study was originally intended to be overseen by an experienced team made up in part by personnel affiliated with CSU. Because of CSU's withdrawal from the study, some of those personnel—specifically, a professor of equine surgery, an animal welfare specialist, and a research scientist—will no longer be involved in the spay portion of the study. Despite CSU's withdrawal, the spay procedures and after care would remain the same under BLM oversight and be conducted by a contracted veterinary team with experience in performing ovariectomy via colpotomy and standing sedation on wild horse mares. In the original CSU proposal, they had planned to contract with a veterinarian, not affiliated with CSU, to actually perform the procedures because they did not have the experience in both ovariectomy via colpotomy and standing sedation of wild horses. The change in veterinarians overseeing the procedures and monitoring does not change the potential effects of the procedure described in chapter III of this EA. The collaring/radio tagging and on-range behavioral observations would be overseen by a USGS ecologist specializing in ungulate population dynamics.

The Warm Springs HMA was chosen for this USGS on-range behavioral outcomes study because of the way the HMA is divided into two large pastures with one main fence down the middle, with comparable topographical, vegetative, and watering features on either side. This study design was chosen to prevent the need to gather twice (a similar USGS/CSU study on the effect of gelding a portion of stallions in an on-range herd required a first gather to collar/mark horses, then conducted behavioral observations for one year prior to a second gather to treat horses then return them to the range for behavioral observations post treatment (BLM Utah 2016)). For this proposed study, one side of the HMA would be the control segment (no treated (spayed) mares) and the other would be the treatment segment (treated mares present). There would be 100 horses on the control side and 100 horses on treatment side (200 horses involved in this project total). The terrain consists of rolling hills and valleys, which is acceptable for radio telemetry tracking. For the duration of the study, the gates in the fence line separating the two herd segments would remain closed. Once the study is complete, the gates would remain open along this fence line when livestock are not present.

The first portion of the proposed action would be to gather by helicopter up to 100 percent of the total wild horse population, and remove excess horses down to 200, which is the sample size needed for the on-range behavior study. If this gather takes place in the fall of 2018 as proposed, approximately 694 adult horses plus 158 foals could be gathered with approximately 652 excess animals removed from the range. A high percentage of the herd would be gathered in order to select horses to return to the HMA by their location on the HMA prior to the gather, their physical characteristics, age, and sex. All horses, along with any burros captured, would be transported to the Oregon Wild Horse Corral Facility in Hines. All animals would be freeze marked and aged. Only those horses not selected for the study would be dewormed, vaccinated, and prepped for the adoption program.

The horses gathered from either side of the HMA and selected for the study would be kept separate throughout the gather process and while at the Oregon Corral Facility so they can be returned to their original home ranges on the HMA in order to discourage movement from one side to the other during the study.

The BLM would select a candidate pool of horses that can be returned to the range, then randomly select horses for the on-range behavioral outcomes study based on age (to include all age classes), sex (50:50 sex ratio), and treatment status (spayed or control). No horses would be selected that have cryptorchidism, inguinal hernia, club feet, or any other congenital or heritable defects, as per BLM policy. All horses returned to the range would receive an individual freeze mark on their neck with a unique BLM identifier using the International Alpha Angle System. In addition to the neck freeze mark, all animals returned to the range would receive a microchip implanted in a ligament in their neck for improved individual identification purposes and would receive a freeze mark on their left hip with the last four numbers of their BLM identifier. This would aid in identification during the field observations portion of the study.

The BLM acknowledges that not all animals would be collected during the gather. This would not limit the validity of the study design for two reasons. First, researchers would be focusing on the marked subset of the population. Second, researchers would be able to document any unmarked horses in the population once field crews are on the ground monitoring the population.

a. Specific Aims of the Study

- Determine the approximate stage of gestation of the mares presented for surgery. Because a majority of mares are pregnant when gathered after July 1 of any year, it would be of interest to study how gestational stage affects the surgical procedure and how the surgical procedure affects maintenance of pregnancy. (BLM)[3]

- Determine the feasibility of performing ovariectomies via colpotomy in free-roaming wild horses. (BLM)
- Evaluate the immediate and short-term effects of the surgical procedure on free-roaming wild mares. (BLM)
- Measure rates of social and reproductive behavior and group cohesion in free-roaming male and female wild horses, evaluating individuals within and between treatment and control HMA segments and comparing their behavior. (USGS)
- Record body condition and mortality of females and their foals in both treatment and control herd segments to determine if these factors are affected by spay treatment. (USGS)
- Test for an effect of spay treatment on spatial ecology of free-roaming horses by monitoring the Global Positioning System (GPS) locations of individuals (22 treatment herd females, 22 control herd females, and 12 stallions from each herd segment) within treatment and control herd segments of the population throughout the year. (USGS)
- Measure demographic characteristics in both treated and untreated herd segments by monitoring foaling rates and natural mortality and by conducting aerial surveys once or twice annually to test for treatment effects on herd segment annual growth rates. (USGS)

b. Ovariectomy via Colpotomy Procedure

The BLM would use the same surgical protocol originally approved by the CSU IACUC. BLM-contracted veterinarians would be required to have experience performing ovariectomy via colpotomy and standing sedation on at least 100 ungentled, wild horse mares. The BLM and contracted veterinarians would monitor the mares during and after surgery to provide data for the three specific aims related to the surgical portion of the project (described above). Because the procedure would still be carried out by experienced contract veterinarians, and the surgical protocol is unchanged, the departure of CSU's team does not affect the procedure's anticipated outcomes.

Approximately 28–34 mares would receive ovariectomy treatment and, after recovery (approximately 7 days), would be returned to the HMA for the behavioral and spatial ecology portion of the study. In addition to the mares that would return to the HMA, approximately 70 more mares would receive ovariectomy treatment in order to improve the quantification of the complication rate of the surgical procedure. The mares in the second group

[3] Parenthesis after each specific aim indicate who would be responsible for each, BLM or USGS.

of spayed animals would be observed and evaluated for 7 days for any complications from the treatment, but would not be returned to the HMA. They would receive veterinary care if needed. These additional mares would remain at the Oregon Wild Horse Corral Facility and enter the adoption program.

Mares receiving treatment would be adult females, 3 years of age and older. Taking into account both the mares that would be returned to the range and those that would not, in total approximately 100 mares could receive ovariectomy treatment. Those would include mares 3 years of age and older, and spread evenly across three gestational stages: open (not pregnant), <120 days, and 120–250 days. The BLM would aim to evenly distribute these three gestational stages as long as they are available in the animals gathered at the time of surgery. This design would allow adequate quantification of the complication rate of the surgical procedure as it relates to the gestational stages treated. The overall sample size of about 100 is needed to provide adequate statistical power to estimate the complication rate with reliable accuracy and precision. The sample size would allow for the ability to obtain accurate estimates of the complication rate typical for the procedure in each of three gestational stages, without being unduly influenced by one or two unusual outcomes. It would also allow for the ability to obtain precise estimates of overall mortality rate (or morbidity rate), with a 95 percent confidence interval between 0 and 10 percent if the estimated overall rate is 3 percent or lower.

While in the squeeze chute, mares that would be candidates for being returned to the range would have rectal palpation and/or transrectal ultrasound performed to determine if the mare is pregnant and to stage the pregnancy if indicated. Mares from the treatment group that are open (not pregnant), early-term (<120 days), or mid-term (120–250 days) would be considered candidates for surgery. Sixty to seventy-five percent of adult mares (≥3 years old) from the treatment herd segment would be spayed. This means that about 30 mares would be treated and returned to the range, depending on the age structure of the herd, leaving about 8 unsterilized adult mares plus juveniles and foals untreated in the treatment segment. The study blocks mares and pairs treated and control mares by age, body condition, and pregnancy status. Mares with (Henneke et al. 1983) body condition scores of ≤3 or any mares in their third trimester of pregnancy (>250 days), as determined by palpation and ultrasound, would not be spayed. Otherwise females would be randomly selected within blocks for treatment. Both treatment and control mares would undergo the same handling through the chute and determination of gestational stage, but only treatment mares would undergo the surgery.

Treatments would be conducted around November to maximize the sample size of mares in their first and second trimesters of pregnancy.

Individuals selected for inclusion in the ovariectomy procedure would be held without feed for 24–36 hours prior to surgery to minimize the risks associated with distended intestines near the surgical region. Water will not be withheld.

The patient would be restrained in a fully-padded chute which allows for access to the horse's neck for injections and to the tail and perineal area to allow for performance of the surgery. Each mare would be intravenously administered a mixture of detomidine hydrochloride (10–20 ug/kg; 5–10 mg), butorphanol tartrate (0.02–0.04 mg/kg; 5–15 mg), and Xylazine hydrochloride (0.2–0.5 mg/kg; 100–300 mg) to sedate and provide analgesia (to minimize discomfort) for surgery (exact dosages may be adjusted as determined by the veterinarian). If further sedation is required the mare would bc administered further detomidine, Xylazine, or 100 mg of ketamine hydrochloride. Anti-inflammatory/analgcsic (pain) treatment would include flunixin meglumine (Banamine) at 1.1 mg/kg (10 ml of 50 mg/ml). Tetanus toxoid would be given to any unvaccinated individuals. Each mare would also be administered a long-duration antibiotic (Excede – ceftiofur crystalline free acid, Zoetis, Florham Park, New Jersey). Excede is effective for 4 days.

Following sedation, a rectal examination would be performed to evacuate the rectum and double check pregnancy status and gestational stage. The tail would be wrapped and tied straight up. A padded bumper would be placed above the rump of the mare to keep her from jumping up. While the surgical field may not be entirely sterile, all reasonable steps would be taken to ensure that it is disinfected. The perineal region would be cleansed, and the vagina would be aseptically prepared for surgery using povidone iodine solution prior to insertion of the surgeon's sterile gloved arm into the vaginal vault. The surgical procedure would involve making an incision, approximately 1–3 centimeters long, in the anterior-dorsal-lateral vagina. Both ovaries are accessed through this one incision. The incision would be enlarged with blunt dissection to perforate the peritoneum and allow the surgeon's hand to enter the abdomen. This method separates rather than transects the muscle fibers so the incision decreases in length when the tissues contract after the tranquilization wanes post-surgery. The ovary and associated mesovarium are isolated by direct manual palpation and local anesthesia (5 ml 5% bupivacaine and 5 ml 2% lidocaine) is injected into each ovarian pedicle. This combination was selected to provide rapid onset (lidocaine) and extended duration (bupivacaine) of effect, reducing pain associated with removal of the ovaries. The surgeon would add epinephrine to the lidocaine/bupivacaine anesthesia of the ovarian pedicle to constrict blood vessels. This may reduce the risk of hemorrhage at the surgical site, and by reducing blood flow at the site of injection the local anesthesia should stay longer at the surgical site. The rate would be 1 ml/100ml of the anesthetic mixture (epinephrine for injection 1:1000). The ovarian pedicle would be transected with a chain ecraseur, seen in the hands of the veterinarian in Figure II-1. If the internal structure of a mare appears or feels abnormal, the surgery would not be completed, and the mare would not be included in the study. Removing such contraindicated mares would prevent complications to the mares and ensure the procedure is only conducted on a uniform group of structurally correct mares. Instruments would be cleaned and soaked in Chlorhexidine between procedures, then rinsed with sterile saline. Duration of surgery for each individual would be recorded, but is expected to take approximately 15 minutes. The veterinarian would conduct no more than 25 surgeries per day to avoid surgeon fatigue.

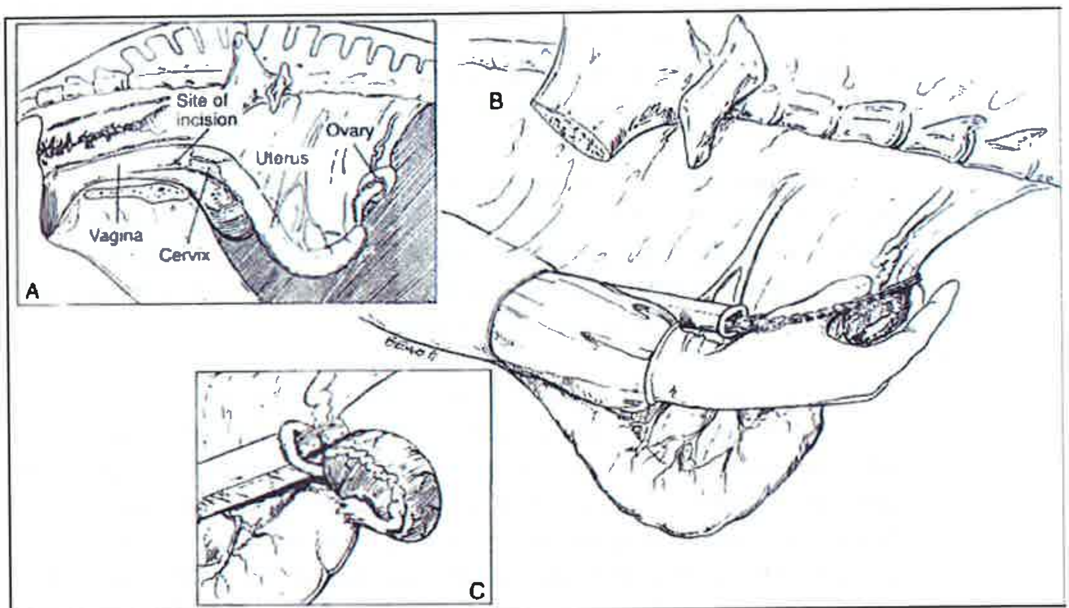


Figure II-1: (A) The site for the vaginal incision is located ventrolateral and caudal to the cervix. (B) The chain loop of the ecraseur is positioned over the hand so that the ovary can be grasped and drawn inside the loop. (C) After ensuring that only the ovarian pedicle is within the loop, the pedicle is slowly crushed and transected. (From Kobluk et al. 1995).

Horses that have received surgery would be turned into an approximately half-acre pen for recovery from sedation. Mares may be held in this pen with other mares that are in the initial hours of post-surgery recovery. Being held with other mares while recovering from sedation would reduce the signs of stress commonly observed when wild horses are held in isolation. Mares would be monitored for any signs of discomfort and for the beginning of fecal production. As soon as mares have become fully alert, they can be moved back into a larger pen with other mares and dependent foals. They will remain in this pen until they are returned to the range or made available for adoption.

Mares would be assessed from a distance three times a day for a week by the veterinarians involved in the study. It is expected that any complications would present within the first several days. Indicators to be measured would be: attitude, respiratory rate, fecal production (if possible), signs of abdominal distress (colic), ambulation, and appetite. Any horses that show signs of abdominal distress, lack of appetite, or rapid respiratory rate would be more closely evaluated and further analgesia (Flunixin meglumine 1.1 mg/kg IV) may be given at the veterinarian's discretion. No postoperative antibiotics would be given.

If within the first 24 hours after surgery animals are refusing food and not moving, they would be checked by a veterinarian and given analgesia (Flunixin meglumine 1.1 mg/kg IV or similar) as necessary. The attending veterinarian or BLM staff would decide if euthanasia is necessary and, if so, would follow BLM IM 2015-070, Animal Health, Maintenance, Evaluation and Response, or updated policy. Once released to the range no further veterinary interventions would be possible.

Approximately 30 days post surgery and 60 days post surgery, the 70 mares treated but not returned to the range would be monitored by ultrasound to evaluate pregnancy status. This data would aid in quantification of pregnancy loss related to performing this procedure on mares in early to mid-gestational stages.

CSU had originally proposed to study what were termed "Post-surgery Welfare Observations" in the June 29, 2018, draft EA. The purpose of those observations in the originally proposed action would have been to attempt to quantify, using a pain scoring system developed for domestic horses, a measure of apparent discomfort in mares after surgery, as compared to untreated control mares who would not receive surgery. This monitoring was to have been conducted by a CSU animal welfare specialist experienced in observing, recording, and scoring based on a composite measure pain scale. In its revised proposal, USGS is not proposing to conduct any observations on the immediate outcomes of surgery, so this portion of the originally proposed action is no longer included in the currently proposed action.

The specific pain scoring measures that had been in the original USGS and CSU proposal are not necessary for quantifying the immediate outcomes of the spay surgery. In the currently proposed spay procedure, the immediate health outcomes of surgery would still be monitored, with veterinarians contracted by BLM conducting observations three times per day for the first week of post-surgery monitoring (described 3–4 paragraphs above). Based on those observations, the contracted veterinarians would perform any veterinary care or interventions, as they would find appropriate. The proposed action has not changed in that observations and examinations by veterinarians were to have been the determinant for any follow-up analgesic or other veterinary treatment, if needed. The originally proposed "Post-surgery Welfare Observation" section did not have any identified design elements that would have based veterinary treatment on pain measure scores of treated mares. As a result, there would be effectively no changes in the post-surgical care for treated mares and, hence, there would be no added impacts to the treated mares due to the removal of those pain scoring observations from the proposed action. The currently proposed veterinary observations would provide the information needed to address the third specific aim discussed in the proposed action, which remains unchanged from the June 29, 2018, draft EA: "Evaluate the immediate and short-term effects of the surgical procedure on free-roaming wild mares." In the currently proposed action, those short-term effects will continue to be evaluated in objective measures of morbidity and mortality by licensed veterinarians.

c. Opportunity for Public Observation

Public observation during helicopter gather operations would be provided for in accordance with WO IM 2013-058, Wild Horse and Burro Gathers: Public and Media Management, or updated policy. Once horses are gathered, they would be transported to the Oregon Wild Horse Corral Facility in Hines, Oregon. Visitors would be allowed access to view animals within the facility via the existing self-guided auto tour. This observation would be provided during normal working hours (8:00 am–3:00 pm). All other observation at the Oregon Corral Facility would be in accordance with IM ORB-000-2018-004, Oregon Wild Horse and Burro Corral Facility Access for Visitors (Appendix E).

Public viewing of collaring/tagging and surgery would be permitted and managed by BLM. The public may observe the collaring/tagging and ovariectomy via colpotomy procedures by complying with the following protocol and procedures:

(1) A doorway to an office space (historically not accessed by the public) adjacent to the working chute would be converted into a window to allow for public observation. The doorway is within 15 feet of the working chute. Photographs of the working chute as seen from the existing doorway where public can safely observe are shown below. Observers can also photograph/film from this location.

Figure II-2: View from observation area.

(2) A maximum of five people at a time would be allowed to observe due to the limited space available to safely observe.
(3) If more than five observers are interested in viewing per day, viewing could occur in shifts with observers rotating through every 2–4 hours.
(4) BLM staff would escort these public observers at all times (refer to BLM Burns District IM ORB-000-2018-004, Oregon Wild Horse and Burro Corral Facility Access for Visitors (Appendix E).
(5) Observers will not be allowed within the working area during this phase of the project.
(6) Any viewers who verbally or physically interfere with or disrupt the work being performed will be removed and not allowed to return.
(7) Those interested in observing must contact the Burns District BLM Public Affairs Specialist at 541-573-4400, two weeks prior to the start of the surgeries to have their name added to the viewing list. Observation would be offered to those on the viewing list in order based on the date in which interest was expressed in attending. The earlier you express interest, the higher in the observation order your name would appear. On observation days, you must check in, in person and individually,

with the BLM official at the meeting site (Burns District BLM Office, 28910 Highway 20 West, Hines, Oregon). If a public observer does not arrive at the specified time, the next observer on the list would be contacted about observing the procedure.

Following the collaring, tagging, and spay procedures, horses would be placed in pens outside the working barn. As outlined in IM ORB-000-2018-004, Oregon Wild Horse and Burro Corral Facility Access for Visitors (Appendix E), the public would be allowed to observe these horses from the self-guided auto tour.

d. Radio Collaring/Tagging

USGS would be responsible for this portion of the proposed action. GPS collars/tags and very high frequency (VHF) tags would be used to record the spatial ecology of horses and locate animals to record behaviors, births, deaths, body conditions, and group composition.

At the Oregon Corral Facility, a sample of up to 84 horses would be fit with GPS radio collars or GPS/VHF radio tags (FORT-Institutional Animal Care and Use Committee Approval 2015-10, in USGS Research Proposal, August 2018 (Appendix C)). GPS radio collars would be placed on up to 30 females per herd segment (up to 60 total), and up to 20 stallions per herd segment (up to 40 total) would be fitted with tail tags (GPS or VHF).

Females ≥3 years old would receive radio collars while stallions would be tracked with radio tags braided into their manes and tails and secured to the hair with cable ties and a low temperature curing epoxy resin. Females receiving collars would have a Henneke body condition score of 4 or greater (i.e. "moderately thin" and fatter; Henneke et al. 1983), and stratified by adult age class (3–5, 6–10, 11–15, >16 years old). This is considered a normal level of body condition for horses that are at athletic fitness or living in wild conditions. Animals that are "thin" (Henneke score of ≤3), deformed, or who have any apparent neck problems would not be fitted with a collar. As tags are small (<70g) and are not worn around the neck, they are considered insignificant or minimal burden to the animal and, therefore, could potentially be worn by animals in lower body condition. However, such animals would likely not be selected by BLM as candidates for return to the range. The forty stallions (20 per segment) to be fitted with tail tags would be selected randomly but stratified by age.

Only biologists experienced with fitting radio collars and tags on wild horses would be permitted to place them on animals. Researchers would be following an unpublished protocol titled *The Use of Radio Collars on*

Wild Horse Mares and Burro Jennies (in Appendix C, USGS Research Proposal, August 2018) for the placement of collars.

To monitor horse welfare effects after they are returned to the range, all animals wearing a collar would be visually observed at least once a month during winter (October to March), and twice a month during spring/summer (April to September). This welfare monitoring is to assure collars remain in proper positioning on the animals' necks and do not cause any unforeseen problems for mares. In addition to having a drop-off mechanism with a release date scheduled to coincide with the end of the study (about October 2021), each radio collar would be equipped with a remotely-triggerable emergency release mechanism in case the collar needs to be removed. If this mechanism fails and the collar must be removed, the horse would be captured for collar removal via helicopter-drive trapping, bait or water trapping, or darting, depending on the best option for the specific situation.

e. Herd Genetics

USGS would be responsible for this portion of the proposed action. While horses are at the BLM facility, hair follicles would be collected from all individuals that would be returned to the range. Also, fecal samples from new foals (and from any individuals that were not captured during the gather) would be collected throughout the study. DNA from these samples would be analyzed to form a pedigree of both herd segments, enabling researchers to assess paternity of foals born during the study and to understand kinship between mares. Should ovariectomy lead to lower group fidelity of mares these genetic data would allow researchers to test whether or not mares move with more closely related individuals, and whether or not having spayed individuals within the population influences foal paternity by non-harem stallions. It would also allow for quantification of the "sneak" mating rate of non-harem holding stallions, and determine age of first reproduction for mares. These parameters could be used in future modelling of population growth.

f. On-Range Behavioral Observations

The BLM would return the control and treatment herd segments (100 each) to their respective sides of the HMA as soon as possible following the 7-day post-surgery monitoring.

USGS would then begin the on-range behavioral observations, which would be conducted during the breeding season (March to September) each year, beginning the March after animals are returned to the range. This allows time for social groups to re-establish over the winter after gather and release are completed. Individual horses would be referred to by the last four digits of their unique BLM numeric identifier or collar/tag frequency (not named). Behavioral observations would be conducted on focal[4] animals and their social groups, using focal animals to determine groups observed rather than selecting focal groups, as horses are likely to change groups during the study. In the treatment segment there would be 8 treatment and 8 control focal collared mares, and in the control segment there would be 16 control collared mares. There would be 4 focal tagged stallions in each segment. As average band size is often approximately 4 adults (Linklater 2000), the outcome is that although the number of focal animals would be relatively small, data would be gathered on a larger number of individuals overall, including a greater number of males than the focal individuals as they are generally associated with females. Focal females would be distributed across adult age classes, and focal males would include stallions that are bachelors and harem stallions at the start of behavioral observations (i.e. March). Focal animals would determine which bands are observed, but otherwise behavior of all animals within a social group would be recorded. It is possible that more than one focal animal may be in a social group; this would not lead to pseudo-replication, but instead would result in more data gathered per individual in that group. If a focal animal changes groups then all members of the new group would be recorded. The same focal individuals would be followed throughout the study, so researchers would be able to compare treated animals with un-treated controls in the same population. Observers would remain blind to treatment and control animals to the extent possible.

Due to the logistics of travel around the HMA, groups would be stratified into regional areas for observations with focal animals then selected for observation at random within a region. This would ensure that all focal animals are observed evenly but randomly. Horses spend over 50 percent of their time feeding and 20 percent of their time resting (Duncan 1980), with social interactions being rare. Therefore many hours of observation are required to provide enough data for meaningful statistical analyses. With a crew of four field technicians, the aim is to gather 1,600 to 1,800 hours of observations per field season, which would be sufficient for statistical analyses. Examining 20 horses and their social associates represents coverage of the majority of the horses within each segment of the HMA. Sample sizes are comparable to other equid studies; up to 19 radio collars were used to examine the ecology of wild equids (Kaczensky et al. 2011), although not all simultaneously, with most studies only having collars on 4 to 10 individuals (Goodloe et al. 2000, Fischhoff et al. 2007, Girard et al. 2013, Owen-Smith and Goodall 2014). While some

[4] A focal animal is one that is randomly selected (but blocked by age class, and treatment status or stallion status where applicable) to be a 'target' for behavioral observations. Behavioral observations would be conducted on this animal and whoever else it is with, or just on that animal if it is alone. Having a focal animal is a way to ensure behavioral data is representative of the population, without a bias towards groups or individuals that are simply close to camp or easy to find. By also recording behavior of the social associates of that animal at the time of the behavioral observation, the researchers get behavioral data on a larger number of individuals than just the focal animal.

equid studies have conducted population-wide observations, such as those at the Pryor Mountains, Wyoming (Roelle et al. 2010) and the Granite Range, Nevada (Berger 1986), the number of focal animals proposed is comparable to most fine behavior studies (ranging from Bourjade et al. (2009) n=9, to Krueger et al. (2014) n=55).

Every 10 minutes during a 1-hour observation session the basic state of each individual (e.g., feeding, standing, moving, lying down) within a social group and the identity of their nearest neighbor would be recorded. These data would allow researchers to test whether treatment affects time budget and associations between individuals. All-occurrence sampling (Altmann 1974) would be used to record individuals involved in incidents of social behaviors such as agonistic behavior (e.g., bites, kicks) and affiliative behavior (e.g., mutual grooming, touch), and reproductive behavior (e.g., estrus behavior, mating and mating attempts, and scent marking behavior), as well as other behaviors such as nursing and vocalizations; detailed data would be taken at each event. These data would allow researchers to test whether spaying affects social behavior of treated mares and the animals they associate with.

g. Population Level Effects

Aerial surveys for population estimation would take place in both herd segments before the initial gather and then once or twice annually for the remainder of the study. Population estimation would follow set BLM guidelines for counting wild horses (BLM IM 2010-057, or update) using published population estimation techniques, primarily simultaneous double-observer surveys with sightability covariates (Lubow and Ransom 2016, Schoenecker and Lubow 2016). Foaling rates in both herd segments would be determined by visually observing mares wearing collars approximately twice a month between March and September. Foal survival would be determined by monitoring these same animals monthly during the rest of the year.

h. Schedule

Year 1 (September 2018–September 2019)

(1) Fall 2018 conduct a gather of Warm Springs HMA. Keep herd segments separate. Flip coin to randomly select herd segment for treatment. Identify over 200 horses, allowing for release of up to 200 (with release of up to 100 into each of 2 herd segments), and remove remaining animals for adoption/sale program.

(2) Assess age and pregnancy status of all females that are potentially to be returned to the range. Place radio tags on 40 adult males and radio collars on 22 females in treatment herd segment and the same

number in control herd segment. Collect tail hair follicle samples from every individual (200 total) for genetic analysis.

(3) Conduct ovariectomy surgery in 60–75 percent of adult females from the treatment herd segment. Conduct ovariectomy surgery on additional 70 mares that would not be returned to the range.
(4) Conduct post-surgery recovery assessments.
(5) Return animals to the HMA, and initiate field study. Begin testing radio collars, locating radioed individuals 1–2x/month to check collars or tags, body condition, and presence of foals. Throughout winter 2018/2019, assess body condition and record social associations of radio-marked horses.
(6) The BLM will conduct data analyses and write up results for effects of surgery study.
(7) Winter 2018/2019, fly aerial surveys in both treatment and control segments of the HMA.
(8) March to September 2019, collect data on social behavior, reproductive behavior, and band membership and fidelity using radio collars/tags to locate focal individuals for observation.

Year 2 (October 2019–September 2020)

(1) Winter 2019/2020, fly aerial surveys in both treatment and control segments of the HMA.
(2) Continue the field study; locate radio-collared individuals 1–2x/month to check collars, body condition, and survival, and record presence of foals.
(3) March to September 2020, collect data on social behavior, reproductive behavior, and band membership and fidelity using radio marks to locate focal individuals for observation.

Year 3 (October 2020–September 2021)

(1) Winter 2020/2021, fly aerial surveys in both treatment and control segments of the HMA.
(2) Continue the field study; locate radio-collared individuals 1–2x/month to check collars, body condition, and survival, and record presence of foals.
(3) March to September 2021, collect data on social behavior, reproductive behavior, and band membership and fidelity using radio marks to locate focal individuals for observation.
(4) Upon completion of the field observation portion of the study (i.e., October), BLM will open the gates in the fence that separates the two segments of the HMA.

Year 4 (October 2021–August 2022)

(1) USGS will conduct data analyses and publish papers on the on-range behavioral outcomes assessment.

i. Statistical Methods

A description of the statistical methods used to analyze each portion of this study is found in Appendix C, USGS Research Proposal (August 2018).

2. 10-Year Population Management Plan

Following the completion of the research study and during the remainder of the 10-year timeframe of this plan, BLM would conduct additional helicopter gathers of wild horses each time the high end of AML is exceeded. Smaller wild horse bait/water/horseback drive trapping gathers would occur as needed between normal helicopter-drive gather cycles as a tool to remove excess animals in areas where concentrations are detrimental to habitat conditions or other resources within the HMA, to remove animals from private lands or public lands outside the HMA boundary, to selectively remove a portion of excess horses for placement into the adoption program, or to capture, treat, and release horses for application of fertility treatment. Burros would be gathered via bait/water/horseback drive trapping. Gathers would be conducted following future population surveys and a determination that excess animals exist within the HMA. All other project design features would be the same irrespective of the number of animals gathered and removed. The first gather to low AML (111 horses and burros) following the completion of the USGS study would be scheduled for 2022. The number of horses and burros gathered and excess removed would be adjusted based upon the estimated herd size and the number of excess animals determined at the time of the gather.

In the absence of an initial gather for the study or consecutive years, the proposed action includes gathering to low AML regardless of population size. For example, if the first gather happened in 2028, up to 5,300 horses and burros could be removed (see description of the no action alternative in chapter II). All other project design features related to gathers would be the same irrespective of the number of animals gathered and removed.

In order to maintain a reduced population growth rate following the study and during the 10-year timeframe, adaptive management would be incorporated to use the most promising methods of fertility control that maintain a self-sustaining herd within AML, and that maintain the free-roaming behavior of the animals. After the gather to low AML following the completion of the study, potential population growth suppression actions that would be applied include spaying additional mares (assuming results of the spay procedure confirm previously published work that demonstrated that spaying is a feasible management tool) or PZP (if the results of the spay procedure indicate that spaying is *not* a feasible management tool for this HMA).

Many factors play into determining the number of horses that would be required to gather to reach low AML and to treat (with any treatment type) depending on, but not limited to, climatic conditions leading up to the gather, gather efficiency, condition of animals at time of gather, and age structure of animals captured. This is why ranges for animals treated during the remainder of the 10-year timeframe following the study are provided below.

After the 2022 gather to re-establish low AML, and if spaying were the management tool chosen for this HMA, up to 25–37 mares ages 2–5 years and older would be spayed and returned to the range (if there is a 100 percent capture rate during the gather). After this treatment, it is anticipated that AML would be exceeded in 2028 and require one additional gather in order to maintain AML. By treating and returning this range of mares at each gather, only 0–76 horses are anticipated to be removed from the range between 2022 and 2028 in order to maintain AML. (See Chapter III, Wild Horses and Burros section discussion on WinEquus Population Modelling). If after the study PZP is the management tool chosen for this HMA, up to 37 mares would be treated and returned to the range in 2022 (if there is a 100 percent capture rate during the gather). It is anticipated that with this treatment regime AML would be exceeded in 2027, and a gather would be required to maintain AML. By following this treatment regimen after both gathers, approximately 110 animals would be removed from the range between 2022 and 2027. (See Chapter III, Wild Horses and Burros section discussion on WinEquus Population Modelling). PZP treatment would follow BLM's protocol in IM 2009-090 (Appendix F), or updated policy.

No fertility control treatments are proposed for burros. Unless immediate removal is required (e.g. private land, public safety, emergency situation), a notice to the public would be sent out 30 days prior to any future gather.

Following the completion of the on-range study, BLM would assess whether analysis in this EA adequately supports future population growth suppression actions (spay or PZP treatment) outlined in this plan, or if BLM needs to prepare new or supplemental analysis. This assessment would also be made for any new fertility control method that may become available during the 10-year time frame of this plan.

In addition to AML helicopter gathers, smaller bait/water, horseback-drive, or helicopter-drive trapping operations would be conducted as needed between normal helicopter-drive gather cycles. These trapping methods would be used as tools to remove excess animals in areas where concentrations are detrimental to habitat conditions or other resources within the HMA, to remove animals from private lands or public lands outside the HMA boundary, to selectively remove a portion of excess horses for placement into the adoption program, or to capture, treat, and release horses for application of fertility treatment. Bait/water, horseback-drive, and helicopter-drive trapping operations could take anywhere from one week to several months depending on the amount of animals to trap, weather conditions, or other considerations. Operations would be conducted either by contract or by BLM personnel. Refer to table II-1 for a summary of the proposed methods of capture of wild horses and burros for removal, relocation, and/or application of fertility treatment.

Table II-1: Proposed Action Methods for Capturing Horses and Burros for Removal, Relocation, and/or Application of Fertility Treatment.

Method	Reason	When
Helicopter Gather (AML Gather)	To remove excess horses and burros to maintain AML.	Fall 2018 and following the research study once population exceeds AML.
Helicopter-drive Trapping	To remove or relocate horses and burros when concentrations are causing detriment to habitat conditions or other resources within the HMA	As needed between Helicopter Gather Cycles (AML Gathers).
Bait/Water Trapping	To selectively remove a portion of excess horses and burros for placement in the adoption program.	
Horseback-drive Trapping	To capture, treat, and release horses for application of fertility treatment.	

Site-specific removal criteria were never set for Warm Springs HMA; therefore, animals removed from the HMA during helicopter/AML gathers would be chosen based on a selective removal strategy set forth in BLM Manual Section 4720.33, or updated policy. Currently there is no removal criterion set for burros, however BLM Manual Section 4720.33 states, "When gathers are conducted, emphasis will be placed on the removal of younger, more adoptable animals."

BLM Manual Section 4720.33 further specifies some animals that should be removed irrespective of their age class. These animals include, but are not limited to, nuisance animals and animals residing outside the HMA or in an area of an inactive HA.

Following a helicopter/AML gather, captured wild horses would be released back into the HMA under the following criteria:

- Released horses would be selected to maintain a diverse age structure, at the low AML level, and with a 50/50 sex ratio.
- Horses to be released would be selected to maintain a height of 14 to 16 hands and a weight of 950 to 1,300 pounds. Any color would be selected to return but with an emphasis on Appaloosa.
- Horses selected to return to the HMA may be returned directly from the short-term holding facility constructed during the gather operation. However, it is likely most horses would be transported to the Oregon Wild

Horse Corral Facility in Hines for processing (aging, freeze marking, worming, vaccinating) and/or application of fertility treatment.

- Spay treatments would follow the protocol outlined in this analysis, or updated policy, if chosen as a management tool following the study.
- If there is a need to utilize PZP for fertility control, it would be administered following IM No. 2009-090, Population-Level Fertility Control Field Trails: Herd Management Area Selection, Vaccine Application, Monitoring and Reporting Requirements (Appendix F) or updated policy. This would be done at the Oregon Wild Horse Corral Facility as it is a two dose treatment with a two-week period in between the primer and booster. If mares would be treated only with the liquid form of PZP vaccine, they would receive the first liquid dose within several days of arriving at the facility. They would be held on hay and water for at least 2 weeks until given the second liquid PZP injection. Following the second dose, mares would be returned to the HMA. If mares would be treated with the PZP-22 vaccine pellet treatment, they would receive a liquid primer dose at the same time as also receiving a dose of the time-release pellets. If these mares are captured in subsequent gathers, they would receive a booster dose of liquid, native PZP or of PZP-22 vaccine pellets and be immediately returned to the range unless population and characteristics objectives could not be achieved without removal of a previously treated mare.

a. Project Design Features

(1) Implementation of management actions would begin in fall of 2018 and would continue over the next 10 years unless environmental conditions change enough to require analysis of additional management actions.

(2) The BLM would plan each gather as soon as holding space and funding became available and BLM's Washington D.C. Office provides authorization.

(3) All gathers would be initiated following public notice on the BLM Press Releases webpage or its future equivalent webpage.

(4) No horses found outside of the HMA would be returned to the range.

(5) Depending on the number of animals that must be captured, helicopter/AML gather operations would take approximately 7–14 days to complete. Several factors such as animal populations, animal condition, herd health, weather conditions, or other considerations could result in adjustments in the schedule.

(6) Helicopter gather operations would be scheduled any time from July 1 through February 28 in any year. Bait trapping operations may be scheduled at any time during the year.

(7) Trap sites would be approximately 0.5 acre in size.
(8) Trap sites would be selected in areas where horses are located to the greatest extent possible.
(9) Trap sites and temporary holding facilities would be located in previously used sites or other disturbed areas whenever possible. These areas would be seeded with a seed mix appropriate to the specific site if bare soil exceeds more than 10 square yards per location. The seed applied would be a mix of native and desirable non-native species.
(10) Undisturbed areas identified as trap sites or holding facilities would be inventoried, prior to being used, for cultural and botanical resources. If cultural or botanical resources were encountered, these locations would not be utilized unless they could be modified to avoid detrimental effects to the resources.
(11) Trap sites and temporary holding facilities would be surveyed for noxious weeds prior to gather activities. Any weeds found would be treated using the most appropriate methods. All gather activity sites would be monitored for at least 2 years post gather. Any weeds found would be treated using the most appropriate methods, as outlined in the decision record for the Integrated Invasive Plant Management for the Burns District Revised EA (DOI-BLM-OR-B000-2011-0041-EA) (July 2015).
(12) All vehicles and equipment used during gather operations would be cleaned before and following implementation to guard against spreading noxious weeds.
(13) Efforts would be made to keep trap and holding locations away from areas with noxious weed infestations.
(14) Gather sites would be noted and reported to range and weed personnel for monitoring and/or treatment of new and existing infestations.
(15) Maintenance may be conducted along roads accessing trap sites and holding facilities prior to the start of gather operations to ensure safe passage for vehicles hauling equipment and animals to and from these sites. Any gravel required for road maintenance is to be certified weed-free gravel and obtained by purchase (if from a private mineral material source). Road maintenance would be done in accordance with Appendix I of the Three Rivers RMP, Best Management Practices, and BLM Manual 9113, Roads, and would be in compliance with the Oregon GRSG ARMPA (2015). Maintenance may be conducted along any existing road within the Warm Springs HMA or accessing the Warm Springs wild horses or burros outside the HMA (Appendix A, Warm Springs HMA Vicinity Map).

(16) Gather and trapping operations would be conducted in compliance with the Oregon GRSG ARMPA (2015), specifically:

- MD SSS-11: No helicopter trapping would occur between March 1 and June 30. Bait trapping and/or moving horses between pastures via helicopter could occur during this time period but would be in compliance with lek hourly restrictions.
- MD SSS-13: All authorized actions in GRSG habitat would be in compliance with the required design features (RDF) and best management practices (BMP) outlined in appendix C of the GRSG ARMPA (2015).

(17) Gather and trapping operations would be conducted in accordance with the standard operating procedures (SOP) described in the Comprehensive Animal Welfare Program (CAWP) for Wild Horse and Burro Gathers (IM No. 2015-151), which defines standards, training, and monitoring for conducting safe, efficient, and successful wild horse and burro gather operations while ensuring humane care and treatment of all animals gathered (Appendix D). In addition, all personnel involved in handling animals at the Oregon Corral Facility would have previously completed the BLM's CAWP training.

(18) An Animal and Plant Health Inspection Service (APHIS) veterinarian would be onsite during helicopter gathers, as needed, to examine animals and make recommendations to BLM for care and treatment of the wild horses and burros.

(19) Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy (Appendix G, IM 2015-070).

(20) On all horses gathered (removed and returned), data including sex and age distribution would be recorded. Additional information such as color, condition class information (Henneke et al. 1983), size, disposition of the animal, and other information may also be recorded.

(21) Excess animals would be transported to the Oregon Wild Horse Corral Facility via truck and trailer where they would be prepared (freeze marked, vaccinated, and dewormed) for adoption.

(22) Hair samples would be collected to assess genetic variability of the herd, as outlined in WO IM 2009-062, Wild Horse and Burro Genetic Baseline Sampling, or updated policy. Hair samples would be collected from a minimum of 25 percent of the post-gather population. Gathering allows BLM to collect DNA samples, closely

monitor the genetic variability of the herd, and make appropriate changes (i.e. translocation from other HMAs) when testing deems them necessary.

(23) Public and media management during gather operations would be conducted in accordance with WO IM 2013-058, Wild Horse and Burro Gathers: Public and Media Management, or updated policy. This IM establishes BLM policy and procedures for safe and transparent visitation by the public and media at wild horse and burro gather operations while ensuring the humane treatment of wild horses and burros.

(24) Emergency gathers: BLM Manual 4720.22 defines an emergency situation as an unexpected event that threatens the health and welfare of a wild horse or burro population, its habitat, wildlife habitat, or rangeland resources and health. Emergency gathers may be necessary during this 10-year timeframe for reasons including disease, fire, insect infestation, or other events of catastrophic nature and/or unanticipated natural events that affect forage and water availability for wild horses and burros. Emergency gather operations would follow the project design features described in this section and BLM IM 2009-085, Managing Gathers Resulting from Escalating Problems and Emergency Situations, or updated policy.

(25) Trapping activities would be scheduled in coordination with the rangeland management specialist to avoid conflict with authorized grazing rotations.

b. Monitoring

(1) The BLM contracting officer's representative (COR) and project inspectors (PI) assigned to the gather would be responsible for ensuring contract personnel abide by the contract specifications in the Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers (Appendix D, IM No. 2015-151).

(2) Ongoing monitoring of forage condition and utilization, water availability, and animal health, as well as aerial population surveys, would continue on the Warm Springs HMA. Aerial inventories are conducted every 2 to 3 years for each HMA on Burns District. Population estimates for Warm Springs HMA would be updated as inventories are conducted in the future.

(3) Genetic monitoring (as outlined in IM 2009-062 or updated policy) would also continue following gathers and/or trapping. If genetic monitoring indicates a loss of genetic

diversity, the BLM would consider introduction of horses from HMAs in similar environments to maintain the projected genetic diversity.

(4) Fertility control monitoring would be conducted in accordance with the population-level fertility control treatment SOPs in IM 2009-090, Population Level Fertility Control Field Trials: Herd Management Area Selection, Vaccine Application, Monitoring and Reporting Requirements (Appendix F), or updated policy.

C. Alternatives Considered but Eliminated from Further Analysis

1. Closure of HMA to Livestock Use

This alternative was not brought forward for detailed analysis because such an action would not be in conformance with the multiple-use mandate of FLPMA (1976) and the existing LUP, Three Rivers RMP/ROD/Rangeland Program Summary (RPS) (1992), which authorizes AUMs for wild horses and burros and for livestock grazing in the allotments within the Warm Springs HMA (Appendix 9, pp. Appendices 116–118). Livestock grazing is identified as a major use of the public land and is to be conducted in a manner that will meet multiple-use and sustained yield objectives (Three Rivers RMP/ROD 1992, p. 2-33). Livestock grazing management is designed to achieve standards for rangeland health and conform to guidelines for livestock grazing management (S&G). For both West and East Warm Springs Allotments, indicators for rangeland health and riparian monitoring data through 2015 indicate standards for rangeland health are either not present, achieved, or if not achieved, livestock are not a causal factor. The closure of the HMA to livestock grazing without maintaining wild horse and burro populations within AML would be inconsistent with the WHB Act (1971) which directs the Secretary to immediately remove excess animals. Livestock grazing is reduced or eliminated following the process outlined in the regulations found at 43 CFR Part 4100. This alternative would not achieve the purpose and need.

2. Complete Removal of Wild Horses and Burros from the HMA

Complete removal of wild horses and burros from Warm Springs HMA was eliminated from detailed analysis because it would not be in conformance with the WHB Act (1971) nor the multiple-use mandate of FLPMA (1976); this alternative would therefore not achieve the purpose and need of this document. The Three Rivers RMP/ROD (1992) specifically authorizes AUMs and reestablished AML for wild horse and burro use in Warm Springs HMA on page 2-43. This LUP provides a management objective to "Maintain healthy populations of wild horses within the Kiger, Palomino Buttes, Stinkingwater, and Riddle Mountain Herd Management Areas, and wild horses and burros in Warm Springs HMA" (p. 2-43). That LUP does not include management direction to eliminate AML for wild horses and burros. Elimination of wild horses and burros and closure of HMAs can only be conducted during the land use planning process or within an RMP revision or amendment; this project is neither.

3. Spaying via Flank Laparoscopy

This alternative proposes using flank laparoscopy as the method for ovariectomizing (spaying) mares instead of ovariectomy via colpotomy. Flank laparoscopy is now commonly used in domestic mares due to its minimal invasiveness and full observation of the operative field (Lee and Hendrickson 2008). Although ovariectomy via flank laparoscopy was seen as the lowest risk method in terms of mortality and morbidity (Bowen 2015), it is a method that would not appear to be logistically applicable for wild horses. Flank laparoscopy requires a far longer surgical duration than ovariectomy via colpotomy and requires that the patient remain standing still for the duration of the surgery, which may be over 45 minutes (Bowen 2015). During that time, the horse must be maintained in an anesthetic plane that prevents it from sudden movements. If the mare is not still during surgery, there is a risk that the instruments placed inside the body cavity may damage internal organs or that the instruments may become malfunctional. The long duration and requirement that mares stand peacefully reduce the likelihood that this surgical method would be feasible for most wild horses. While ovariectomy via colpotomy has been proven to be applicable and effective in another herd of federally managed feral horses (Collins and Kasbohm 2016), no studies document the use of ovariectomy via flank laparoscopy in recently caught wild mares.

This surgical approach entails three small incisions on the animal's flank, through which three cannulae (tubes) allow entry of narrow devices to the body cavity: these are the insufflator, endoscope, and surgical instrument. The surgical procedure involves the use of narrow instruments introduced into the abdomen via cannulas for the purpose of transecting the ovarian pedicle, but the insufflation should allow the veterinarian to navigate inside the abdomen without damaging other internal organs. The insufflator blows air into the cavity to increase the operating space between organs, and the endoscope provides a video feed to visualize the operation of the surgical instrument. This procedure can require a relatively long duration of surgery but tends to lead to the lowest post-operative rates of complications in domestic horses. Flank laparoscopy may leave three small (<5 cm) visible scars on one side of the horse's flank, but even in performance horses these scars are considered minimal. Because of the three external wounds, mares recovering from surgery are typically confined alone in small pens after surgery for several days. Experience handling wild animals in relatively confined areas shows that wild horses, as compared to domestic horses, cannot and should not be restrained for long periods of time or confined in individual pens to prevent rolling or interaction with other horses. Restraint for long periods of time (days) would induce additional stress on a wild animal as well as added risk from fighting restraint. "Animals may become overstimulated with an epinephrine rush during restraint procedures. They may be inclined to and capable of, feats of athleticism beyond imagination" (Fowler 2008), which can cause unnecessary injury. Yet, rolling on the ground is not conducive to wound healing. If the patient does not roll and remove bandages to expose the wound from flank laparoscopy, it is expected that the tissues and musculature under the skin at the site of the incisions in the flank will heal quickly, leaving no long-lasting effects on horse health.

The above discussions indicate to BLM that until there is more indication that this method can be successfully demonstrated in similar conditions, spaying via flank laparoscopy is technically infeasible for application on wild horse mares due to the higher risk of infection at external incision sites, the time required to perform each surgery, and the post-surgical care requirements for flank laparoscopy. This method also would not respond to the purpose and need for action described above.

4. Sterilization via Tubal Ligation or Laser Ablation of the Oviduct Papilla

The BLM is aware of only one published study that tested tubal ligation in domestic mares (McCue et al. 2000) and no studies of laser ablation in mares. The safety and effectiveness of these procedures is largely unknown for domestic or wild horses. In 2016, BLM considered conducting research at the Oregon Wild Horse and Burro Corral Facility that would have included novel studies of mare sterilization via tubal ligation and via laser ablation of the oviduct papilla (BLM 2016). The EA that analyzed that research made clear that the purpose and need of that study was to "...conduct research on three methods of permanent mare sterilization...." Tubal ligation and laser ablation were promising in principle, but had not been tested. Neither method has been proven elsewhere to be effective in wild or feral mares. Partners withdrew from the BLM-funded study that would have examined the safety and efficacy of those procedures, and the study did not take place. Because this study did not take place and the techniques have not been tested on wild horse mares, they are remote or speculative. These methods would not respond to the purpose and need for action described above. In contrast, ovariectomy via colpotomy is a well-established veterinary method that has been in practice for over a century, including in feral mares (Collins and Kasbohm 2016).

5. Intensive Fertility Control Using PZP Vaccine via Remote Darting

This alternative would encompass a 10-year timeframe with an initial helicopter gather to bring the population down to the low end of AML. Mares returned to the HMA to re-establish low AML would be treated with a liquid primer dose of PZP vaccine (or other available and effective fertility control vaccine) followed by a liquid PZP booster vaccination or PZP-22 vaccine pellets two weeks later. Treated mares would be age 2 and older as outlined in IM 2009-090. In order to maintain a reduced population growth rate on the range, annual remote darting of these treated wild horse mares would be required. The on-range program would be designed to treat mares ages 2 through 4 and ages 11 through 20. Following the initial primer and booster doses at the time of the gather, all mares ages 5–10 would not be re-treated on the range until age 11. The intent of such an alternative would be to reduce the population growth rate each year with annual PZP application, thereby eliminating or reducing the need to remove horses through future bait or helicopter gathers.

A majority of the horses in Warm Springs HMA are not approachable by humans within 0.5 mile of them for identification and darting of the fertility control vaccine. The size of the HMA (nearly 500,000 acres) and the limited access during late winter or early spring for annual darting make this alternative technically infeasible for this HMA. As a result, administering annual PZP treatments to mares from the Warm Springs HMA would require first capturing them with either helicopter-drive trapping or bait-water trapping. When identifying the most promising fertility control methods, the NRC Review (2013) concluded there are HMAs in which remote delivery (i.e. darting) is possible, but these seem to be exceptions. Access to animals for timely inoculation and other management constraints may affect the utility of PZP as a management tool for western feral horse populations (Ransom et al. 2011). Given the currently available fertility control options, remote delivery appears not to be a practical characteristic of an effective population management tool, but it could be useful in some scenarios (NRC Review 2013). In addition, annual gathering of the entire herd is economically infeasible due to the associated gather costs. (Refer to the Economic Values section of this EA for costs of gathering wild horses.)

Longer lasting formulations of PZP have not proven effective at population growth suppression on a majority of HMAs where they have been applied (see analysis of PZP literature in Chapter III – Wild Horse and Burro section, below). The BLM must explore the use of other methods and techniques for long-term population growth suppression not currently in widespread use, such as surgical sterilization of females, which could ultimately be applied to horses in HMAs with limited access and other constraints. Intensive fertility control using PZP to remotely dart horses would be ineffective and technically infeasible for population control in this HMA and would not respond to the purpose and need for action described above.

6. Bait and Water Trapping Only

An alternative considered but eliminated from detailed analysis was the use of bait and/or water trapping as the primary or sole gathering method. The use of only bait and water trapping, although effective in other HMAs with varying circumstances, would not be cost effective or practical as the primary gather method for this HMA. However, water or bait trapping may be used as a supplementary approach to help achieve the desired goals of the proposed action following the research study if a helicopter gather cannot be scheduled. Water and bait trapping is an effective tool for specific management purposes such as removing groups of horses from an accessible concentration area. The use of only bait and water trapping was dismissed from detailed analysis because much of this HMA has limited road access capable of handling pickups and livestock trailers. The lack of adequate road access would make it technically infeasible to construct traps and safely transport captured wild horses and burros from these areas of the HMA. Appendix I, June 2018 Warm Springs HMA Survey Map depicts animal distribution and locations in relation to the few major roads within the HMA. Also, the logistics of bait or water trapping 800+ horses over approximately 500,000 acres of land in a relatively short amount of time render that option infeasible.

7. Manage the Warm Springs HMA Wild Horse and Burro Population by Natural Predation

Cougars are the only large predator in the area that may prey on wild horses or burros, mainly foals. The estimated maximum cougar population in the Southeast Oregon Zone F is 985 (including all age classes) with an estimated 2015 population of 946 (ODFW 2017a). Even with high and growing cougar populations across Oregon and in the Southeast Oregon Cougar Management Zone F, there is no evidence to suggest cougars have an effect on wild horse recruitment in this area. Canadian biologists (Knopff et al. 2010) confirmed that wild horses were killed by cougars, but all kills were of animals less than 2 years of age, "Although our seasonal result is novel, that cougar predation on large ungulate species tends to focus on animals <1 year old has been well-documented (Hornocker 1970, Turner et al. 1992, Ross and Jalkotzy 1996, Murphy 1998, Husseman et al. 2003)." They also found 0.5 percent of an adult female's diet made up of feral horse in the summer. Thirteen percent of adult males' summer diet was feral horse while 10 percent of their winter diet was feral horse. Subadult cougars did not prey on feral horses. There was no discussion on how this amount of predation would affect wild horse population growth. The NRC Review (2013) confirms foals are usually the prey of cougars and goes on to explain population size is not affected as much by foal survival as it is by adult survival (Eberhardt et al. 1982); foal survival is strongly affected by other variables (such as weather). The BLM does not make decisions on predator management but can make recommendations to Oregon Department of Fish and Wildlife (ODFW). Relying on natural predation to maintain AML has not worked in the past, is extremely speculative, and would not meet the purpose and need for action.

III. AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

A. Introduction

This chapter details the affected environment, which is the baseline resource data displaying current conditions of each identified resource with an issue (i.e., the physical, biological, and resources) that could be potentially affected by any of the alternatives discussed in chapter II. For example, in the affected environment section for wild horses and burros in this EA, the wild horse and burro population in the area of the potential impact is currently estimated as 943 animals, including foals. Without this baseline data there can be no effective comparison of alternatives. The intent of this chapter is to give enough information for the reader to compare the present with the predicted future condition resulting from enactment of the project activities (environmental effects, discussed next), and for the decision maker to make an informed decision.

This chapter also details the environmental effects section, which is the analytic basis for comparing the potential effects of enacting each of the alternatives detailed in chapter II. Direct effects are caused by the action and occur at the same time and place. Indirect effects are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. For example, in the environmental consequences discussion for riparian zones in this EA, it is stated that "The proposed action would reduce and maintain the wild horse and burro population to within AML therefore reducing and minimizing their potential effect on riparian zones and wetlands. Maintaining populations within AML in this water-limited HMA aids in limiting the pressure placed on riparian exclosure fences. Currently Thorns Springs remains unfenced and may maintain or improve in condition with maintenance of wild horse and burro numbers within AML."

Cumulative effects are those impacts resulting from the incremental impact of an action when added to other past, present, or reasonably foreseeable future actions (RFFA), regardless of what agency or person undertakes such other actions. RFFAs include those Federal and non-federal activities not yet undertaken, but sufficiently likely to occur, that a responsible official of ordinary prudence would take such activities into account in reaching a decision. These Federal and non-federal activities that must be taken into account in the analysis of cumulative impact include, but are not limited to, activities for which there are existing decisions, funding, or proposals identified by the BLM. RFFAs do not include those actions that are highly speculative or indefinite. RFFAs for this project are continued livestock grazing, weed treatments, road maintenance, recreation and hunting activities, range improvement and maintenance projects, and treatments associated with the rehabilitation of wildfires, such as the Miller Homestead Emergency Stabilization and Rehabilitation (ESR) (DOI-BLM-OR-B060-2012-0047-EA) and the Coyote Fire ESR (DOI-BLM-ORWA-B050-2018-004-CX). These RFFAs are discussed under each resource, as applicable.

B. Identified Resource with Issue

Issues are analyzed when—

- Analysis is necessary for making a reasoned choice from among the alternatives (e.g., is there a measurable difference between the alternatives with respect to the issue?);
- The issue identifies a potentially significant environmental effect; or,
- Public interest or a law or regulation dictates that effects should be displayed.

Through internal and external scoping, the BLM Burns District IDT has reviewed and identified issues affected by the alternatives.

1. Wild Horses and Burros

The following issues are addressed in this section.

- *What would be the direct effects of gathering on wild horses and burros?*
- *What are the anticipated complications and rate of complications associated with the ovariectomy via colpotomy procedure (procedure)?*
- *If the mare is pregnant, would the procedure affect the development of the foal?*
- *Would the mare continue to have an estrous cycle following this procedure?*
- *What would be the anticipated long-term effects of the surgical procedure on mares?*
- *What are anticipated on-range effects following the release of spayed mares, including free-roaming behavior?*
- *How would the alternatives affect genetic diversity, health, and the self-sustaining nature of Warm Springs HMA wild horses?*
- *What are the potential risks of radio collaring wild horses and how would BLM ensure the animals would not be injured?*
- *What are the effects of PZP on a mare and the herd?*
- *What are the effects of ovariectomy via colpotomy on the population of wild horses in the Warm Springs HMA?*
- *What are the effects of PZP on the population of wild horses in the Warm Springs HMA?*
- *How would the alternatives affect wild horse and burro habitat?*

a. Affected Environment – Wild Horses and Burros

Habitat for wild horses and burros is comprised of four essential components: forage, water, cover, and space. These components must be present within the HMA in sufficient amounts to sustain healthy wild horse populations and healthy rangelands over the long term (H-4700-1 2010, chapter 3). Escalating problems are defined as conditions that deteriorate over time (H-4700-1 2010, 4.7.7). The key indicator of an escalating problem is a decline in the amount of forage or water available for wild horse use, which results in negative impacts to animal condition and rangeland health, causing horses to seek resources outside the HMA boundaries. Causal factors are normally drought or animal numbers in excess of AML (H-4700-1 2010, 4.7.1). In this HMA, water is the main limiting resource.

In 1979, the first Warm Springs Equine Herd Management Area Plan was written to "protect, manage, control, and maintain a viable population of wild horses [and burros] on the Warm Springs Herd Management Area on a continuing basis in coordination with forage, soil, watershed, wildlife and recreation resource values." The plan outlines the area the HMA encompassed as a total of 468,360 acres of public, State, and private lands. It also discusses the construction of the east-west division fence in fall 1977, existing inventory records, history and influence of horse type on the horses living in the HMA, gather records, resource data, and grazing capacity. The plan provided detail on the horse and burro type and color present in the area. "Horses are of domestic saddle horse variety. Due to present and past presence of Shetlands in the area, crossbreeding has occurred and these vary in size. Draft horse bloodlines are also apparent within the herd. Color varies greatly within the horse herd, from palominos, buckskins, bays, appaloosa, sorrels and browns. Crossbreeding between Shetlands and the other horse type have resulted in paints within the herd. The burros are all of the grey and dark brown color" (pp. 10–11). The plan recommended an objective to maintain a viable herd of 111 to 202 horses and 15 to 35 burros (p. 15).

The Drewsey, Andrews and Riley Management Framework Plan (MFP) Amendment (1987) resulted in an LUP decision that affirmed the AML in Warm Springs HMA at 111 to 202. Following this LUP amendment, an update to the Warm Springs HMA Plan occurred in December 1987. This plan establishes an objective to "Maintain a viable herd of 111 to 201 wild horses.... Burros are still found in the west unit but no management objectives nor plans have been identified."

Finally, the Three Rivers RMP/ROD (1992) reaffirmed the AML for Warm Springs HMA at a total AML of 111 to 202 animals. A management action (p. 2-45) called to "Manage burros for a maximum of 24 head in the west side of the Warm Springs HMA. The allocation of forage for burros is within the total allocation for the Warm Springs HMA."

The most common wild horse and burro management actions that have occurred in Warm Springs HMA are gathers, which are to be done when the herd surpasses the maximum established AML number and when monitoring data (census, utilization, use supervision, etc.) indicate that a thriving natural ecological balance would be disrupted. Depending on reproductive rates, results of rangeland monitoring data, funding and off-range holding space, horses and burros within the HMA have typically been gathered with removals to low AML on a four to five year cycle. The Warm Springs wild horse population has been gathered 14 times since 1978, most recently in 2010 (see Appendix H: Inventory, Gather and Release History since 1972). A majority of the horses gathered in 2010 exhibited saddle horse conformation with color phases including many appaloosa, roans, appy-roans, buckskins, duns, bays, sorrels, blacks, and four pintos. A majority also were gathered in fair to excellent body condition (body condition score 4–8, Henneke 1983) with only a few older horses in lower body condition.

Burros are typically captured via bait/water or horseback drive trapping. Burro trapping operations have been sporadic over the years due to the irregular nature of their population growth. Very low population growth was observed in this burro herd for many years, so in 1998 BLM translocated four burros (two males and two females) from a California herd to boost genetic variability. Since these introductions, field observations by BLM and range users indicate a notable population increase despite the difficulty in collecting accurate population data (burro aerial surveys would require transect line spacing that is far closer than that of horse aerial surveys, and burros can be difficult to see during surveys). The most recent trapping of burros occurred in 2014 and 2015 on two separate private land parcels: one inside the HMA and another outside. A total of 11 burros were removed during those bait trap gathers.

Figure III-1: Examples of conformation and variety of color found in Warm Springs HMA.

From 1978 to present, 18 inventories of the HMA have been completed. Data from these inventories and wild horse gathers have helped define the needs of current and future horse population management. The most recent June 2018 aerial survey was conducted using the simultaneous double-observer method (Lubow 2016) recommended by BLM policy (BLM 2010, IM 2010-057) and discussed in a recent NRC review (2013, p. 42–43). During this survey, 677 adult horses and 154 foals were observed. Sightability bias correction was then applied to the raw counts. This USGS unpublished data (2018) analysis estimated the sighting probabilities for horses with the raw counts corrected for systematic biases (undercounts) that are known to occur in aerial surveys (Lubow and Ransom 2016). These results included confidence intervals (which are measures of uncertainty) associated with the estimated population sizes. The USGS unpublished data (2018) provided an estimated population size of 694 adult horses and 158 foals at the time of the survey. Of the total number observed during the June 2018 survey, only 5 adult horses were outside the HMA boundaries (Appendix I, June 2018 Warm Springs HMA Survey Map).

Using the raw count data (Appendix H, Inventory, Gather and Release History since 1972) from the 2010 gather where the population was re-established at 105 adult horses, the 2014 inventory of 253 adult horses, and the 2016 inventory (Appendix J: Statistical Analysis for Warm Springs Horse Survey, Lubow 2016) of 513 adult horses, calculations of "apparent annual population growth rate" indicate a rate of nearly 35 to 40 percent. Such high rates are much higher than the overall wild horse average of 20 percent and are possible but not probable. Horses were gathered in fair to excellent body conditions (BCS 4–8 = moderately thin to fat) in 2010. These horses have ample feed year-round and tend to reduce their home range size during the hot season so as not to overexert and travel long distances for water, and there are very few natural predators in the area; thus allowing for a higher than average population growth rate. The NRC review (2013) recognized that adequate studies conducted on the population growth rate of free-ranging horses on western rangelands have "clearly demonstrated that growth rates approaching 20 percent or even higher are realized in many horse populations" (p. 65). The most likely explanation for the high apparent annual population growth rate is that the raw counts of horses seen during the 2010 and 2014 surveys represented a lower fraction of the true total numbers of animals present than the same fraction in 2016. Variable rates of observer bias (fraction of animals not seen) are specifically the problems that the simultaneous double-observer survey method is designed to overcome, because the observed data can be analyzed in a way to estimate the fraction of animals not seen by any observer. Reliable estimates of actual annual growth rates are possible to estimate when a greater number of simultaneous double-observer surveys have been conducted and analyzed. In June 2018, another simultaneous double-observer survey was conducted which estimated 694 adult horses plus 158 foals (USGS unpublished data, 2018). Using the data from both the 2016 and 2018 surveys, the annual population growth rate during that time period is approximately 16 percent. This population growth rate is more probable than the calculated rate between the 2014 direct count survey and the 2016 simultaneous double-observer survey and shows that the simultaneous double-observer survey method provides more reliable estimates.

The gestation period for a burro is approximately 12 months (Asdell 1964, Douglas and Hurst 1993), which allows for one foal per year in years with adequate precipitation. Studies cited in Douglas and Hurst (1993) indicate high levels of pregnancy in burros >2 years of age as well as a high adult survival rate. Like wild horses, feral burros are not known to be preyed upon by predators, with the possible exception of mountain lions. This combination of foaling rate, survivability, and lack of predators provides for a rapid rate of increase in burro populations. Annual rates of increase for feral burro populations in North America range from 1.2–29 percent (Douglas and Hurst 1993, White 1980, Morgart 1978) with a global average of 19 percent (Ransom et al. 2016). Consistent and accurate surveys have not taken place on burros in this HMA, making it difficult to estimate a population growth rate specific to this herd.

Genetic analysis of the Warm Springs wild horse herd was completed by E. Gus Cothran from Texas A&M University using blood samples collected from 56 horses during the 2001 gather and using hair samples collected from 83 horses during the 2010 gather. Genetic analysis was not conducted or required to have been conducted for the 2006 gather. Table III-1 is a summary of the two genetic reports within the Warm Springs HMA associated with the 2001 and 2010 gathers. As described in BLM Manual H-4700-1, WHB Management Handbook, Section 4.4.6.2, Interpreting Genetics Data, the observed heterozygosity (*Ho*) is a measure of how much diversity is found, on average, within individual animals in a wild horse herd. *Ho* is insensitive to sample size, although the larger the sample, the more robust the estimate. *Ho* values below the mean for feral populations are an indication that the wild horse herd may have diversity issues. Herds with *Ho* values that are one standard deviation below the mean are considered at critical risk; critical risk levels are shown in table III-1 below. The *Fis* is the estimated inbreeding level. *Fis* levels greater than 0.25 are considered critical level and suggestive of an inbreeding problem.

Table III-1: Warm Springs HMA 2001 and 2010 Genetic Variability Measures Comparison.

Warm Springs HMA - Genetic Variability Measures		
	Ho	*Fis*
2001 (blood samples)	0.387	-0.038
Critical Level (blood)	0.309	>0.25
Wild Horse Mean	0.360	-0.035
Standard Deviation	0.051	0.118
Domestic Horse Mean	0.371	-0.014
Standard Deviation	0.049	0.065
2010 (hair samples)	0.766	0.015
Critical Level (hair)	0.660	>0.25
Wild Horse Mean	0.716	-0.012
Standard Deviation	0.056	0.071
Domestic Horse Mean	0.710	0.012
Standard Deviation	0.078	0.086
*Data derived from Cothran 2002 and Cothran 2011.		

Following the 2001 gather, Cothran (2002) summarized that, "Genetic variability in the Warm Springs herd was above the average for horses in both individual variation and population diversity… [and] Genetic parameters indicate the Warm Springs herd is of mixed origins." In the recommendations section, Cothran (2002) noted that "No actions are indicated. Population size within the planned management levels are high enough to minimize loss of genetic variation."

Genetic similarity results following the 2010 gather indicated a herd with mixed ancestry (Cothran 2011). Cothran (2011) summarized that the genetic variability of this herd, in general, is on the high side but there was a high percentage of variation at risk, heterozygosity levels had declined since 2001, and *Fis* values went from an excess to a deficit. "Comparison of the two years indicates that diversity is in decline" (Cothran 2011). Recommendations stated that because variability levels were high enough, no action was needed at that point, but that the herd should continue to be monitored closely due to the high proportion of rare alleles and the apparent trend of declining variability. It is notable that this herd had undergone a number of gathers to low AML, but still had higher than average heterozygosity measures in both 2001 and 2010. Since the 2010 genetic sampling, the herd has increased exponentially; such population growth tends to preserve genetic diversity.

Warm Springs HMA encompasses both the East Warm Springs (#7001) and West Warm Springs (#7002) Allotments. Cattle are the livestock type authorized for these allotments. Refer to the livestock grazing management section for the details associated with livestock use.

Within the Great Basin, drought conditions are common and water is the main limiting factor within Warm Springs HMA. In Oregon in 2009 and in 2014 drought conditions affected water availability in several HMAs. In 2014, an emergency gather was conducted to remove imperiled animals from a portion of Palomino Buttes HMA where water was unavailable, but not before several died from water starvation or were euthanized as an act of mercy. Also in 2014, due to severe drought, emergency water hauling for wild horses was conducted in the East Warm Spring Allotment portion of the HMA; this action is thought to have saved approximately 80 horses. Extreme water scarcity does not happen each year but is an annual concern. The four essential habitat components (water, forage, cover, and space) for wild horse and burros "must be present within the HMA in sufficient amounts to sustain healthy wild horse and burro populations and healthy rangelands over the long term" (H-4700-1, 2010, p. 12).

There are large areas (upwards of 5 air miles across) of this HMA that remain ungrazed by both livestock and horses due to their distance from water sources. When adequate water is available, wild horses have been observed to be well dispersed across the HMA. With the severe drought the region has seen in recent years, the wild horse use areas grew smaller and became more concentrated around the limited water sources that remained. This was the same for the use areas of livestock and native ungulates. Limited resources and an overpopulation of wild horses can lead to competition for available resources with other users of the land (such as wildlife and permitted livestock, as summarized by Chambers et al. 2017). McInnis and Vavra (1987) found at least 88 percent of the mean annual diets of horses and cattle consisted of grasses; therefore, there is potential for direct competition for forage. However, dietary overlap is not sufficient evidence for exploitative competitions (Colwell and Futuyma 1971), and consequences of overlap partially depend upon availability of the resource (McInnis and Vavra 1987). Site observations indicate wild horses will typically use range farther from water than cattle and that adequate forage remains available in the major wild horse use areas. Miller (1983) found that wild horses generally stay within 4.8 km (2.98 miles) of a water source during the summer, while Pellegrini (1971) found wild horses will roam up to seven miles from water before returning, and Hampson and others (2010a) found that horses may move back and forth 10 miles per day between forage and water. Green and Green (1977) found wild horses range from three to seven miles from a water source, but the distance is related to forage availability. When water and forage are available together the range will be smaller, and when they are not available together wild horses concentrate in areas of ample forage and travel further distances to water (Green and Green 1977, as cited in Miller 1983). Nevertheless, horses can only travel so far before their condition or the condition of their young is affected. Research has also shown when wild horses have to share water sources with cattle and antelope, there is direct competition (Miller 1983). When resources become scarce, whether due to drought or overpopulation, resource concentration can create an aggregation of animals where direct contact between competing species is more common, increasing the likelihood of interference behavior (Valeix et al. 2007, Atwood et al. 2011, Gooch et al. 2017). "Feral horses have been found to be typically dominant in their social interactions with native Great Basin ungulates, due to their large size… and often aggressive behavior (Gooch et al. 2017, Berger 1985)." Work by Perry and others (2015) and Hall and others (2016a) confirms this. In a study of interactions with desert bighorn sheep (*Ovis canadensis nelsoni*), domestic horses were experimentally placed near water sources, which resulted in no direct aggression; however, the mere presence of horses resulted in a 76 percent decline in bighorn use of water holes at those locations (Ostermann-Kelm et al. 2008, Gooch et al. 2017). Gooch and others (2017) investigated the interference competition between pronghorn antelope and feral horses at water sources within the Great Basin, particularly the Sheldon National Wildlife Refuge (NWR), which is approximately 100 miles south of Warm Springs HMA. They found that nearly half of the pronghorn/horse interactions observed were negative and resulted in pronghorn being excluded from the water source as a result of horse activity (Gooch et al. 2017). Although they did not measure the consequences of these interactions on pronghorn antelope water consumption and fitness, since about 40 percent of interactions resulted in pronghorn antelope exclusion from water, these pronghorn/horse interactions are likely associated with some costs of fleeing (the cost of leaving the water source prematurely and the energy expended on departure; Frid and Dill 2002) for pronghorn antelope (Gooch et al. 2017). These effects could have detrimental impacts on pronghorn fitness and population dynamics, particularly under adverse conditions when surface water availability is limited and monopolized by horses (Gooch et al. 2017). With the current estimated wild horse populations in the HMA, interference competition and the indirect consequences are more likely to occur and impact other species sharing the HMA.

Overall, forage availability has not been an issue in this HMA; therefore, if adequate water is available year-round then horses and burros will maintain adequate body condition. However, BLM has observed the impacts of limited water on wild horses and burros as well as wild ungulates in the area. During the Severe Drought (designated by the National Oceanic and Atmospheric Administration (NOAA)) in 2014, wild horses and burros were forced to congregate closer to the few remaining water sources in the HMA. Livestock permittees (who were authorized less than 50 percent active use that year) had been ordered to remove all remaining livestock from the impacted area, and cooperative agreements were being exercised to operate wells to provide water to horses in the absence of livestock. In an effort to avoid the need for emergency removals or large scale mortality, Burns District began hauling water to an existing waterhole and temporary troughs where approximately 80 wild horses were congregating. At the time, the potential for wild horse mortality was high. During ODFW's summer 2014 flights to check antelope composition, they noticed congregations of antelope near the same dwindling water source as the horses; this was the only remaining water for miles. ODFW was pleased to see BLM hauling water as the additional sources were a benefit to the fitness of wildlife (Autumn Larkins, ODFW, personal communication, 2014).

The Wild Horse and Burro Management Handbook explains that to maintain a thriving ecological balance "an adequate year round quantity of water must be present within the HMA to sustain wild horse and burro numbers within AML" (H-4700-1, 2010). The Merck Veterinary Manual (accessed June 22, 2017) states that "[w]ater requirements depend largely on environment, amount of work or physical activity being performed, nature of the feed, and physiologic status of the horse." The manual suggests the minimum daily water requirement is 0.4 gallon per 100 pounds of weight, with the average daily intake being closer to 0.65 gallon per 100 pounds. The manual also recognizes this will increase under specific conditions, such as sweat loss, increased activity, and lactation, with the increase being as much as 200 percent, up to 1.3 gallons per 100 pounds per day. Wild horses within the Warm Springs HMA range from 950 to 1,300 pounds. Assuming an average weight of 1,125 pounds, horses within Warm Springs HMA require a minimum daily water intake of 4.5 gallons, with an average daily intake of 7.3 gallons, but the requirement may be as high as 14.6 gallons. This water requirement ranges from about 432 gallons per day at low AML for horses (96 animals) and using only the minimum amount of water, to almost 2,599 gallons per day at high AML for horses alone (178 animals) and requiring a water intake 200 percent above average. Over the course of a year, this translates to a range of 157,680 gallons of water (minimum) to 948,635 gallons of water (maximum), plus use by burros. The maximum water requirements would be even higher for the HMA when horse and burro numbers exceed the AML.

As the wild horse and burro population continues to grow well above the AML, there is cause for concern regarding the potential for degradation of rangeland resources in typical home ranges surrounding the limited reliable water sources. Unlike managed livestock grazing, wild horse and burro grazing occurs year-round. If there are ample, well-distributed resources then there is little to no concern for resource degradation. However, when resources are limited and habitat use is concentrated into a small number of areas, desirable key forage species receive heavier levels of use during the growing season. This type of use is acceptable if it occurs only on a periodic basis, but not annually. Repetitive use during the growing season that prevents key forage species from completing their growth and reproductive cycles tends to reduce plant vigor as carbohydrate reserves are spent on regrowth as opposed to seed production. Maintaining the herd sizes of wild horses and burros within AML would decrease this concern.

b. Environmental Consequences – Wild Horses and Burros

Effects Common to Both Alternatives

Results of WinEquus Population Modeling

Both alternatives were run through the WinEquus wild horse population model for comparison (see table III-2 below).

The on-range behavioral study treatment and control populations were run through the WinEquus wild horse population model for years 2018–2022, the extent of the study. In addition, four separate treatment options were run though the model separately to compare outcomes over the 7 remaining years of this analysis (2022–2028). These options for 2022–2028 were all run with a gather to low AML (96 horses) in year 2022, so they all had the same starting population. Results of these four management options provide estimates on average population growth rate, gather frequency and removal numbers, and anticipated number of animals to be treated. Here, population growth rate expresses the annual percentage increase in the total number of animals. The no action alternative was also run through the model. Refer to Appendix K, Warm Springs HMA WinEquus Simulations, for descriptions of model inputs for all trials and results. As stated in the Wild Horse and Burro Management Handbook (H-4700-1, 2010, p. 28), an objective of the modelling is to identify whether any of the alternatives would be likely to cause a "crash" of the population, based on a number of stochastic factors (varying environmental conditions). None of the simulations run through the model for this analysis caused a "crash" in the population or influenced the population's ability to self-sustain.

Table III-2: WinEquus Population Modelling Comparison Table

		Avg. Growth Rate (%)	Next Projected Gather	Est'd. No. of Horses Removals in 7 yrs. [c]	Est'd. No. Females Treated in 7 yrs.	Est. Pop. Size by Next Projected Gather
No Action (2018–2028)		20.4	n/a	0	0	6,085
Proposed Action						
On-Range Study 2018–2022	Control Population	19.5	2022[a]	146	0	210[d]
	Treatment Population	14.0	2022[a]	102	26	168[d]
Post Study 2022–2028	Option 1: Spay all females 2+ yrs old	10.4	2028/2029[b]	0	64	175
	Option 2: Spay all females 5+ yrs old	13.8	2027	76	28	192
	Option 3: Removals Only, No Treatments	19.9	2027	136	0	245
	Option 4: PZP all females 2+ years old	17.5	2027	110	45	218

[a] End of on-range behavioral study; gather to low AML.

[b] Option 1 does not exceed high AML 178 until after 2028, likely within 2029.

[c] Estimated removals in options 1–4 do not include those animals removed during the 2022 gather to low AML.

[d] The Control and Treatment populations would be gathered to the low end of AML at the end of the study (2022).

No Action

Under this alternative, any risks to horses and burros due to gathering, handling, and transport would be avoided. However, it is not possible to predict whether or when wild horses may need to be gathered in an emergency situation. If growth continues unabated and the region enters another severe drought, it is inevitable that there would be episodes of water starvation as a result.

Based upon the most recent aerial survey (June 2018) and the normal 20 percent annual population growth rate for wild horse herds, the no action alternative (no gather or removal) would begin with 852 horses (694 adults and 158 foals, USGS unpublished data 2018) in the HMA by fall 2018. Results from the WinEquus population modelling program using the no action alternative indicate by 2028 there could be approximately 6,085 horses in the HMA. Or, calculating the population size over a 10-year period using a 20 percent annual growth rate provides an estimated 4,297 adults and 859 foals: 5,156 total horses. WinEquus is not designed for modelling burro populations, however, by using a 19 percent annual growth rate to estimate the burro population based on the current estimate of 68 adults, the estimated burro herd would be approximately 387 adult animals by 2028.

The no action alternative allows unchecked growth of wild horses and burros and would therefore only exacerbate the threat to wild horses and burros during periods of drought. In 2014, the raw count of wild horses seen during an aerial survey was 253 adults and 44 foals; for reasons already discussed, this number is lower than the true number of horses present at that time, but it is not clear by how much. Based on the 2016 simultaneous double-observer survey and expected 20 percent growth rates, in the fall of 2018 it is expected that there would be an estimated 852 total horses. NOAA recently released its U.S. Seasonal Drought Outlook for the period of April 19 through July 31, 2018, which shows eastern Oregon with persistent drought and explains that "Below-normal precipitation and above-normal temperatures promoted drought persistence across central and eastern Oregon…monthly and seasonal outlooks both depict enhanced changes for below-normal precipitation and above-normal temperatures, which favors persistence through the end of August" (NOAA 2018).

As wild horse and burro populations increase, not only would the horses and burros have competition for forage and water from wildlife and livestock, but amongst themselves as well. Horses usually occupy home ranges (undefended, nonexclusive areas); however, when resources are limited, mutual avoidance occurs but can intensify into increased aggression for territories (defended, exclusive areas). In a wild horse behavior study in the Grand Canyon, Berger (1977) found that home ranges for all bands decreased in size in successive warm months, probably due to increased ambient temperature and drought, resulting in greater utilization of spring areas that led to increased interband confrontation and agonistic display. Miller and Denniston (1979) reported that even females participated along with male groupmates when threatening another group of horses at water. Increased occurrences of aggressive activities, caused by lack of necessary resources, and the consequent acute injuries or effects to the health and wellbeing of wild horses and burros would not follow BLM's mandate of managing for a thriving natural ecological balance within an HMA.

The objectives set forth in the HMA plans from 1979 through 2010 to maintain AML, provide yearlong water sources so all species will have adequate and reliable water; and maintain the healthy, free-roaming nature of wild horses and burros within the HMA would not be achieved under the no action alternative with the existing estimated population size and the projected population size within the 10-year timeframe of this analysis. The no action alterative would also be in nonconformance with several objectives of the Oregon GRSG ARMPA (2015) including the objective to "Coordinate with professionals from other Federal and State agencies, researchers at universities, and others to utilize and evaluate new management tools (e.g., population growth suppression, inventory techniques, and telemetry) for implementing the WHB program" (MD WHB 9) and objectives from the Three Rivers RMP/ROD (1992), specifically to "Provide facilities and water sources necessary to ensure the integrity of the individual herds" (WHB 2.4).

Although BLM is unable to quantify cumulative effects under the no action alternative, the effects of this alternative on present and RFFAs and in wild horse and burro habitat would be detrimental. Failure to achieve objectives from HMA plans (HMAP), the Three Rivers RMP/ROD (1992), and the Oregon GRSG ARMPA (specifically the AML, population growth suppression research, and water resources objectives) would be realized more rapidly under the no action alternative as compared to the action alternative, which aims to maintain populations within AML. The no action alternative does not encourage the success of noxious weed treatments, wildfire rehabilitation efforts, and livestock grazing management activities. Similarly, the success of the wildfire rehabilitation projects would be hindered as the wild horse and burro populations continued to increase. As forage and water availability would dwindle due to expected wild horse and burro population increases, BLM would work with the livestock grazing permittees to make further adjustments to their authorized use and rotations to prevent additional resource damage. However, as the wild horse and burro populations grow, increased competition for forage, water, and home ranges between wild horse bands would become apparent, increasing risk to herd health as forage and water quantity and quality become more limited.

In its 2013 review, the NRC concluded that "free-ranging horse populations are growing at high rates because their numbers are held below levels affected by food limitation and density dependence. Regularly removing horses holds population levels below food-limited carrying capacity. Thus, population growth rate could be increased by removals through compensatory population growth from decreased competition for forage" (NRC Review 2013). This portion of the NRC Review (2013) often leads interested publics to believe that no gathers and "self-regulation" would be an acceptable manner of wild horse and burro management. However, the review also pointed out that animal responses to density dependence, due to food limitation, will increase the number of animals that are in poor body condition and dying from starvation (NRC Review 2013). In addition, rangeland health, as well as food and water resources for other animals that share the range, would be affected by resource limited horse populations, which could be in conflict with the legislative mandate that BLM maintain a thriving natural ecological balance (NRC Review 2013). Populations growing to the point where resources are limited would not only be in conflict with this legislative mandate but would have far harsher impacts (e.g. starvation) than alternatives that propose fertility control techniques.

The BLM would continue to have limited information quantifying the feasibility of spaying wild horse mares and the on-range behavioral outcomes under the no action alternative.

Proposed Action

This alternative initiates with a gather intended to remove excess animals and allow for study of a method to slow the population growth before additional damage to the range occurs. Over the past 35 years, various effects to wild horses resulting from gather activities have been observed. Under the proposed action, effects to wild horses and burros would be both direct and indirect, occurring to both individual horses and the population as a whole. 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 effects to the animals during gather operations. The procedures outlined in IM 2015-151 (Appendix D) would be implemented to ensure a safe and humane gather occurs, which would minimize potential stress and injury to wild horses and burros.

Effects of Gathers

In any given gather, gather-related mortality averages about 0.5 percent (Government Accountability Office, GAO-09-77, p. 49), which is considered very low when handling wild animals. An average of about 0.7 percent of the captured animals are humanely euthanized in accordance with BLM policy (refer to Appendix G, IM 2015-070) due to pre-existing conditions (Government Accountability Office, GAO-09-77, p. 49). These data affirm that 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 public lands. BLM Manual 4720.41 prohibits the capture of wild horses by using a helicopter during the foaling period (generally March 1 to June 30), which is defined as 6 weeks on either side of the peak foaling period. However, IM 2013-146 allows for the use of helicopter gathers during peak foaling season due to emergency conditions and escalating problems.

Both helicopter gathers and bait/water trapping can be stressful to wild horses and burros. There is policy in place for gathers (both helicopter and bait/water) to enable efficient and successful gather operations while ensuring humane care and treatment of the animals gathered (IM 2015-151). This policy includes SOPs such as time of year and temperature ranges for helicopter gathers to reduce physical stress to the horses while being herded toward a trap; maximum distances to helicopter herd horses based on climatic conditions, topography, and condition of horses; and handling procedures once the animals are in the trap. In Oregon, wild horse or burro fatalities related to gather operations are less than 1 percent of the animals captured for both helicopter and bait/water trap gathers. Injuries generally occur once the animal is in the confined space of the trap. When capture and handling of wild animals is required to achieve management objectives, it is the responsibility of the management professionals to plan and execute operations that minimize the animals' risks of injury and death. However, when capturing any type of large, wild animal one must expect a certain percentage of injury or death. Multiple studies in the wildlife research and management field have worked to improve understanding of the margins of safe capture and handling and have documented their findings of capture-related mortality. Delgiudice and others (2005) reported 984 captures and recaptures of white-tailed deer (*Odocolleus virginianus*), primarily by Clover trap,[5] under a wide range of winter weather conditions. Their results showed the incidence of capture accidents (e.g., trauma-induced paralysis or death) was 2.9 percent. ODFW Assistant District Wildlife Biologist, Autumn Larkins, stated the general consensus between biologists on capture-related mortality in wildlife is that, "...anything up to 4 percent is the reality of the aerial capture process. Once you get over 5 percent you need to reevaluate because something is not working, either the conditions are too poor, the methods are inappropriate, etc." (Autumn Larkins, ODFW, pers. comm., 2014).

Individual effects to wild horses and burros include the stress associated with the roundup, capture, sorting, handling, and transport. The intensity of these effects 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 may include bruises, scrapes, or cuts to feet, legs, face, or body from rocks and brush. Rarely, because of their experience with the locations of fences in the HMA, wild horses encounter barbed wire fences and receive wire cuts. These injuries are treated onsite until a veterinarian can examine the animal and determine if additional treatment is required. Other injuries may occur after a horse or burro has been captured and is either within the trap site corral or the temporary holding corral, or during transport between facilities, or during sorting and handling.

Occasionally, animals may sustain a spinal injury or a fractured limb, but based on prior gather statistics, serious injuries requiring humane euthanasia occur in less than one animal per every 100 captured. Similar injuries could be sustained if captured through bait and/or water trapping as the animals still need to be sorted, aged, transported, and otherwise

[5] Clover trap: A portable net trap to capture deer. This trap has been modified over the years since its original design by Clover in 1954. The trap is constructed with a pipe or tubing frame with netting stretched over the frame. A drop gate is activated by a trip cord (Schemnitz 1980).

handled following their capture; these injuries result from kicks and bites, or from collisions with corral panels or gates.

To minimize potential for injuries from fighting, horses are transported from the helicopter trap site to the temporary (or short-term) holding facility where stallions are sorted from mares and foals 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 receive injuries or die. On some gathers, due to the temperaments and physical conditions of the horses, they are not as calm and injuries are more frequent.

Indirect individual effects are those that occur to individual animals after the initial event. These may include miscarriages in females, increased social displacement, and conflict between dominant males. These effects, like direct individual effects, are known to occur intermittently during gather operations. An example of an indirect individual impact would be the brief, 1- to 2-minute skirmish between older stallions that ends when one stallion retreats. Injuries typically involve a bite or kick with bruises that do not break the skin. Like direct individual effects, the frequency of these effects varies with the population and the individuals. Observations following capture indicate the rate of miscarriage varies but can occur in about 1 to 5 percent of the captured mares, particularly if the mares are in very poor body condition or health.

A few foals may be orphaned during a helicopter gather. This can occur 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 mothers rejected them or died. These foals are usually in poor condition. Every effort is made to provide appropriate care to orphan foals. Electrolyte solutions may be administered or orphan foals may be fed milk replacer as needed to support their nutritional needs. Orphan foals may be placed in foster homes in order to receive additional care. Despite these efforts, some orphan foals may die or be humanely euthanized as an act of mercy if the prognosis for survival is very poor.

During a summer helicopter gather, foals are smaller than during gathers conducted during the winter months. Water requirements are greater than in the winter due to the heat. If forage or water is limiting, animals may be travelling long distances between water and forage and may become more easily dehydrated. To minimize potential for distress during summer gathers, capture operations are often limited to early morning hours when temperatures are cooler. The distance animals must travel to the trap is also shortened to minimize potential stress. The BLM and gather contractor make sure there is plenty of clean water for the animals to drink once captured. A supply of electrolytes is kept on hand to apply to the drinking water if necessary. Electrolytes help to replace the body fluids that may be lost during capture and handling.

Through the capture and sorting process, wild horses and burros are examined for health, presence of injuries, and other physical defects. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy. BLM's Animal Health, Maintenance, Evaluation and Response (Appendix G, IM 2015-070) is used as a guide to determine if animals meet the criteria and should be humanely euthanized.

Wild horses and burros not captured may be temporarily disturbed and move into another area during the gather operation. With the exception of changes to herd demographics from removals, direct population dynamics effects have proven to be temporary in nature with most, if not all, effects disappearing within hours to several days of release. No observable effects would be expected within 1 month of release, except for a heightened awareness of human presence.

By maintaining wild horse and burro population size within the AML, there would be a lower density of animals across the HMA, reducing competition for resources and allowing all species to utilize their preferred habitat. Maintaining population size within the established AML would be expected to improve forage quantity and quality and promote healthy 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 overpopulation would be avoided. Managing populations in balance with available habitat and other, multiple uses would lessen potential for individual animals or the herd to be affected by climatic fluctuations such as drought and reductions in available forage and water. Population management would lead to avoidance of or minimize the need for emergency gathers and increase success of the herd over the long term.

<u>Transport, Short-term Holding, Adoption Preparation, and Sale or Transfer to Government Agency</u>

All captured animals would be transported from the capture/temporary holding corrals to the designated BLM short-term holding corral facility(s). As noted above, BLM would identify a subset of animals that would be candidates for return to the range, and other animals that would be prepared for BLM off-range management, including making them available for adoption or sale to qualified individuals or sending them to long-term holding (grassland) pastures. Over the 10-year implementation of management actions, the disposition of removed excess horses and burros would follow existing or updated policies.

Animals selected for removal from the range are transported to the receiving short-term holding facility by straight deck semi-trailers or gooseneck stock trailers. Vehicles are inspected by the BLM COR or PI prior to use to ensure wild horses and burros can be safely transported and the interiors of the vehicles are in sanitary condition. Animals are segregated by age and sex and loaded into separate compartments.

A small number of mares/jennies may be shipped with foals. Transportation of recently captured wild horses and burros is limited to a maximum of 8 hours. During transport, potential effects to individual animals can include stress, as well as slipping, falling, kicking, biting, or being stepped on by another animal. Unless animals are in extremely poor condition, it is rare for them to be seriously injured or die during transport.

Upon arrival at the short-term holding facility, 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 animals begin to eat and drink immediately and adjust rapidly to their new situation. Any animals affected by a chronic or incurable disease, injury, lameness, or serious physical defect (such as severe tooth loss or wear, clubfeet, and other severe congenital abnormalities) would be humanely euthanized using methods under the guidelines in IM 2015-070 (Appendix G). Wild horses and burros in underweight 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, generally mares/jennies, in underweight condition may have difficulty transitioning to feed. Some of these animals are in such poor condition it is unlikely they would have survived if left on the range. Similarly, some mares/jennies may lose their fetuses. Every effort is taken to help the mares/jennies 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 or transfer. Preparation involves freeze marking the animals with a unique identification number, drawing a blood sample to test for equine infectious anemia, vaccinating against common diseases, castration (of males) as necessary, and deworming. During the preparation process, potential effects 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 can occur.

At short-term corral facilities, a minimum of 700 square feet per animal is provided. Mortality at short-term holding facilities averages approximately 5 percent per year (GAO-09-77, p. 51) and includes animals euthanized due to pre-existing conditions, animals in extremely poor condition, animals that are unable to transition to feed, and animals that are seriously injured or accidentally die during sorting, handling, or preparation.

Adoption or Sale with Limitations, Transfer, and Long-Term Pasture

Adoption applicants are required to have at least a 400 square foot corral with panels at least 6 feet tall for horses over 18 months of age. Fences must be at least 4.5 feet high for ungentled burros. Applicants are required to provide adequate shelter, feed, and water. The BLM retains title to the animal for 1 year, and the animals and facilities are inspected to ensure the adopter is complying with the BLM's requirements. After 1 year, the adopter may take title to the animal, at which point the horse or burro becomes the property of the adopter. Adoptions are conducted in accordance with 43 CFR 4750.

Potential buyers must fill out an application and be pre-approved before they may buy a wild horse or burro. A sale-eligible wild horse or burro is any animal more than 10 years old; or which has been offered unsuccessfully for adoption 3 times. The application also specifies all buyers are not to resell the animal to slaughter buyers or anyone who would sell the animal to a commercial processing plant. Sales of wild horses and burros would be conducted in accordance with BLM policy under IM 2018-066 or any future BLM direction on sales.

Potential effects to animals from transport to adoption, sale, transfer, or long-term holding are similar to those previously described. One difference is when shipping wild horses and burros for adoption, sale, transfer, or long-term holding, 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 (adjusted accordingly for larger or smaller horses, burros, and foals) 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 stress of offloading and reloading is likely to be greater than the stress involved in the additional period of uninterrupted travel.

Transfer of excess wild horses and burros to Federal, State, and local government agencies for use as work animals would follow the policy outlined in the IM of the same name (IM 2018-052).

Long-term pastures are designed to provide excess wild horses with humane, lifelong care in a natural setting off public rangelands. Currently, no burros are being cared for in long-term pastures. Wild horses are maintained in grassland pastures large enough to allow free-roaming behavior and with forage, water, and shelter necessary to sustain them in good condition. About 34,000 wild horses, in excess of the existing adoption or sale demand (because of age or other factors), are currently being held in long-term pastures. These animals are generally more than 10 years of age. Located in mid or tall grass prairie regions of the United States, these long-term holding pastures are highly productive grasslands as compared to more arid western rangelands.

Generally, mares and castrated stallions (geldings) are segregated into separate pastures. No reproduction occurs in the long-term grassland pastures, but foals born to pregnant mares are gathered and weaned when they reach about 8 to 10 months of age and are then shipped to short-term facilities where they are made available for adoption.

Handling by humans is minimized to the extent possible, although regular on-the-ground observation and weekly counts of 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 underweight 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 long-term holding pastures averages approximately 8 percent per year, but can be higher or lower depending on the average age of the horses pastured (GAO-09-77, p. 52).

Ovariectomy via Colpotomy Procedure

Despite CSU's withdrawal from this portion of the study, the spay procedures and after care would remain the same under BLM oversight and be conducted by a contracted veterinary team with experience in performing ovariectomy via colpotomy and standing sedation on wild horse mares. In the original CSU proposal, they had planned to contract with a veterinarian, not affiliated with CSU, to actually perform the procedures because they did not have the experience in both ovariectomy via colpotomy and standing sedation of wild horses. The change in veterinarians overseeing the procedures and monitoring does not change the procedure's anticipated outcomes described here. None of the literature provided here describing anticipated outcomes relied on the presence of the now-departed CSU personnel.

The anticipated effects of the spay treatment are both physical and behavioral. Physical effects would be due to post-surgical healing and the possibility for complications. Colpotomy is a surgical technique in which there is no external incision, reducing susceptibility to infection. For this reason, ovariectomy via colpotomy has been identified as a good choice for feral or wild horses (Rowland et al. 2018). Ovariectomy via colpotomy is a relatively short surgery, with a relatively quick expected recovery time.

In 1903, Williams first described a vaginal approach, or colpotomy, using an ecraseur to ovariectomize mares (Loesch and Rodgerson 2003). The ovariectomy via colpotomy procedure has been conducted for over 100 years, normally on open (non-pregnant) domestic mares. It is expected that the surgeon should be able to access ovaries with ease in mares that are in the early- or mid-stage of pregnancy. The anticipated risks associated with the pregnancy are described below. When wild horses are gathered or trapped for fertility control treatment there would likely be mares in various stages of gestation. Removal of the ovaries is permanent and 100 percent effective; however, the procedure is not without risk. In its review, the NRC (2013) briefly discussed surgical ovariectomy (removal of the ovaries) as a method of female-directed fertility control, noting that although ovariectomy is commonly used in domestic species, it has been seldom applied to free-ranging species. The committee cautioned that "the possibility that ovariectomy may be followed by prolonged bleeding or infection makes it inadvisable for field application" (NRC Review 2013); however, they explained that ovariectomy via colpotomy was an alternative approach that avoids an external incision and reduces the chances of complication and infection (NRC Review 2013). This NRC Review (2103) was prior to the Collins and Kasbohm (2016) publication where 114 feral horse mares were treated with ovariectomy via colpotomy with results showing a less than two percent mortality rate. The NRC (2013) also noted that no fertility control method existed that did not affect physiology or behavior. The committee warned that the impacts of not managing population numbers were potentially harsher than contraception, as population numbers would likely be limited by starvation (NRC Review 2013).

Anticipated Effects of Surgery on a Pregnancy

The average mare gestation period ranges from 335 to 340 days (Evans et al. 1977). There are few peer reviewed studies documenting the effects of ovariectomy on the success of pregnancy in a mare. An NRC committee that reviewed research proposals in 2015 explained, "The mare's ovaries and their production of progesterone are required during the first 70 days of pregnancy to maintain the pregnancy" (BLM 2015). In 1977, Evans and others stated that by 200 days, the secretion of progesterone by the corpora lutea is insignificant because removal of the ovaries does not result in abortion (p. 376). "If this procedure were performed in the first 120 days of pregnancy, the fetus would be resorbed or aborted by the mother. If performed after 120 days, the pregnancy should be maintained. The effect of ovary removal on a pregnancy at 90–120 days of gestation is unpredictable because it is during this stage of gestation that the transition from corpus luteum to placental support typically occurs" (BLM 2015). In 1979, Holtan and others evaluated the effects of bilateral ovariectomy at selected times between 25 and 210 days of gestation on 50 mature pony mares. Their results show that abortion (resorption) of the conceptus (fetus) occurred in all 14 mares ovariectomized before day 50 of gestation, that pregnancy was maintained in 11 of 20 mares after ovariectomy between days 50 and 70, and that pregnancy was not interrupted in any of 12 mares ovariectomized on days 140 or 210. Those results are similar to the suggestions of the NRC committee (BLM 2015).

Complications to the mare associated with pregnancy loss are a potential. With pregnancy loss in early pregnancy, and even into mid-pregnancy, the fetal material and membranes are often resorbed, so little if any external evidence or complications would reveal pregnancy loss (Whitwell 2011). Embryonic loss in early pregnancy would go undetected (externally) and without complication (Ball 2011). Potential complications from the loss of early- and mid-gestation pregnancies could include cramping and intrauterine infections or metritis. These typically have little or no effect on the mare's overall health and usually resolve spontaneously without treatment. Serious sequelae as a result of early- and mid-gestation pregnancy loss have never been reported in BLM facilities and are not expected in this instance.

For those pregnancies that are maintained following the procedure, likely those past approximately 120 days, the development of the foal is not expected to be affected. However, because this procedure is not commonly conducted on pregnant mares the rate of complications to the fetus has not yet been quantified. There is the possibility that entry to the abdominal cavity could cause premature births related to inflammation. However, after five months the placenta should hormonally support the pregnancy regardless of the presence or absence of ovaries. Gestation length was similar between ovariectomized and control mares (Holtan et al. 1979).

<u>Anticipated Complications and Complication Rates Associated with Ovariectomy via Colpotomy</u>

Between 2009 and 2011, the Sheldon NWR in Nevada conducted ovariectomy via colpotomy surgeries (August through October) on 114 feral mares and released them back to the range with a mixture of sterilized stallions and untreated mares and stallions (Collins and Kasbohm 2016). Gestational stage was not recorded, but a majority of the mares were pregnant (Gail Collins, US Fish and Wildlife Service (USFWS), pers. comm.). Only a small number of mares were very close to full term. Those mares with late term pregnancies did not receive surgery as the veterinarian could not get good access to the ovaries due to the position of the foal (Gail Collins, USFWS, pers. comm.). After holding the mares for an average of 8 days after surgery for observation, they were returned to the range with other treated and untreated mares and stallions (Collins and Kasbohm 2016). During holding the only complications were observed within 2 days of surgery. The observed mortality rate for ovariectomized mares following the procedure was less than 2 percent (Collins and Kasbohm 2016, Pielstick pers. comm.).

During the Sheldon NWR ovariectomy study, mares generally walked out of the chute and started to eat; some would raise their tail and act as if they were defecating; however, in most mares one could not notice signs of discomfort (Bowen 2015). In their discussion of ovariectomy via colpotomy, McKinnon and Vasey (2007) considered the procedure safe and efficacious in many instances, able to be performed expediently by personnel experienced with examination of the female reproductive tract, and associated with a complication rate that is similar to or less than male castration. Nevertheless, all surgery is associated with some risk. Bilateral ovariectomy through either a colpotomy or flank approach can be performed efficiently in a standing mare, but potentially serious complications can occur with these approaches; unidentified and potentially fatal hemorrhage from the mesovarium, intestinal and mesenteric trauma, peritonitis, adhesions, and death are complications associated with both approaches (Rodgerson et al. 2001). Loesch and and Rodgerson (2003) add to the potential risks with colpotomy: pain and discomfort, delayed vaginal healing, evisceration of the bowel, incisional site hematoma, intra-abdominal adhesions to the vagina, and chronic lumbar or bilateral hind limb pain. Shock is also a possibility that could be associated with any surgery. Most horses, however, tolerate ovariectomy via colpotomy with very few complications, including feral horses (Collins and Kasbohm 2016). Prado and Schumacher (2017) considered evisceration a possibility, but considered it rare. Mortality due to surgery or post-surgical complications is not anticipated, but it is a possibility and therefore every effort would be made to mitigate risks.

In September 2015, the BLM solicited the USGS to convene a panel of veterinary experts to assess the relative merits and drawbacks of several surgical ovariectomy techniques that are commonly used in domestic horses for potential application in wild horses. A table summarizing the various methods was sent to the BLM (Bowen 2015) and provides a concise comparison of several methods. Of these, ovariectomy via colpotomy was found to be relatively safe when practiced by an experienced surgeon and was associated with the shortest duration of potential complications after the operation. The panel discussed the potential for evisceration through the vaginal incision with this procedure. In marked contrast to a suggestion by the NRC Review (2013) who explained that domestic mares are typically cross-tied to keep them standing for 48 hours post surgery to prevent evisceration through the unclosed incision in the anterior vagina, this panel of veterinarians (Bowen 2015) identified evisceration as not being a probable risk associated with ovariectomy via colpotomy and "none of the panel participants had had this occur nor had heard of it actually occurring."

One reason why evisceration is rarely observed could be the small, vaginal incision (1–3 cm long) enlarged by blunt dissection. "This method separates rather than transects the muscle fibers so the incision decreases in length when the vaginal muscles contract after the tranquilization wanes post-surgery. Three days post-op the incision edges are adhered, and healed after 7–10 days" (Bowen 2015).

Most spay surgeries on mares have low morbidity[6] and with the help of medications pain and discomfort can be mitigated. Pain management is an important aspect of any ovariectomy (Rowland et al. 2018); according to the surgical protocol described in the proposed action, a long-lasting direct anesthetic would be applied to the ovarian pedicle, and systemic analgesics in the form of butorphanol and flunixin meglumine would be administered. In a study of the effects of bilateral ovariectomy via colpotomy on 23 mares, Hooper and others (1993) reported that post-operative problems were minimal (1 in 23, or 4 percent). Hooper and others (1993) noted that four other mares were reported by owners as having some problems after surgery, but that evidence as to the role the surgery played in those subsequent problems was inconclusive. In contrast, Röcken and others (2011) noted a morbidity of 10.8 percent for mares that were ovariectomized via a flank laparoscopy. "Although 5 mares in our study had problems (repeated colic in 2 mares, signs of lumbar pain in 1 mare, signs of bilateral hind limb pain in 1 mare, and clinical signs of peritonitis in 1 mare) after surgery, evidence is inconclusive in each as to the role played by surgery" (Hooper et al. 1993). A recent study showed a 2.5 percent complication rate where one mare of 39 showed signs of moderate colic after laparoscopic ovariectomy (Devick et al. 2018).

The NRC (BLM 2015) who reviewed an ovariectomy via colpotomy protocol on wild horse mares believed "this procedure could be operationalized immediately to sterilize mares, with the caveat that fatalities may be higher than the 1% reported in the literature…and quoted in the protocol, which is based on domestic mares." The NRC did not

[6] Morbidity is defined as the frequency of the appearance of complications following a surgical procedure or other treatment. In contrast, mortality is defined as an outcome of death due to the procedure.

explain what literature they were referencing. However, the near 1 percent reference in the protocol was referring to the, at that time, unpublished (now Collins and Kasbohm 2016) ovariectomy via colpotomy study conducted on feral horse mares at the Sheldon NWR where they documented a less than 2 percent loss.

Anticipated Effects on Mare Health and Behavior on the Range

No fertility control method exists that does not affect physiology or behavior of a mare (NRC Review 2013). Any action taken to alter the reproductive capacity of an individual has the potential to affect hormone production and therefore behavioral interactions and ultimately population dynamics in unforeseen ways (Ransom et al. 2014a). The health and behavioral effects of spaying wild horse mares that live with other fertile and infertile wild horses has not been well documented, but the literature review below can be used to make reasonable inferences about their likely behaviors.

Horses are anovulatory (do not ovulate/express estrous behavior) during the short days of late fall and early winter, beginning to ovulate as days lengthen and then cycling roughly every 21 days during the warmer months, with about 5 days of estrus (Asa et al. 1979, Crowell-Davis 2007). Estrus in mares is shown by increased frequency of proceptive behaviors: approaching and following the stallion, urinating, presenting the rear end, clitoral winking, and raising the tail towards the stallion (Asa et al. 1979, Crowell-Davis 2007). In most mammal species other than primates estrus behavior is not shown during the anovulatory period, and reproductive behavior is considered extinguished following spaying (Hart and Eckstein 1997). However, mares may continue to demonstrate estrus behavior during the anovulatory period (Asa et al. 1980). Similarly, ovariectomized mares may also continue to exhibit estrous behavior (Scott and Kunze 1977, Kamm and Hendrickson 2007, Crabtree 2016), with one study finding that 30 percent of mares showed estrus signs at least once after surgery (Roessner et al. 2015) and only 60 percent of ovariectomized mares cease estrous behavior following surgery (Loesch and Rodgerson 2003). Mares continue to show reproductive behavior following ovariectomy due to non-endocrine support of estrus behavior, specifically steroids from the adrenal cortex. Continuation of this behavior during the non-breeding season has the function of maintaining social cohesion within a horse group (Asa et al. 1980, Asa et al. 1984, NRC Review 2013). This may be a unique response of the horse (Bertin et al. 2013), as spaying usually greatly reduces female sexual behavior in companion animals (Hart and Eckstein 1997). In six ponies, mean monthly plasma luteinizing hormone[7] levels in ovariectomized mares

[7] Luteinizing hormone (LH) is a glycoprotein hormone produced in the pituitary gland. In females, a sharp rise of LH triggers ovulation and development of the corpus luteum. LH concentrations can be measured in blood plasma.

were similar to intact mares during the anestrous season and during the breeding season were similar to levels in intact mares at mid-estrus (Garcia and Ginther 1976).

The likely effects of spaying on mares' social interactions and group membership can be inferred from available literature, even though wild horses have rarely been spayed and released back into the wild, resulting in few studies that have investigated their behavior in free-roaming populations. Wild horses and burros are instinctually herd-bound and this behavior is expected to continue. However, no study has documented the rate at which spayed mares will continue to remain with the stallion and band from which the mare was most recently attached. Overall, the BLM anticipates that some spayed mares may continue to exhibit estrus behavior that could foster band cohesion. If free-ranging ovariectomized mares show estrous behavior and occasionally allow copulation, interest of the stallion may be maintained, which could foster band cohesion (NRC Review 2013). This last statement could be validated by the observations of group associations on the Sheldon NWR where feral mares were ovariectomized via colpotomy and released back onto the range with untreated horses of both sexes (Collins and Kasbohm 2016). No data were collected on inter- or intra-band behavior (e.g. estrous display, increased tending by stallions, etc.). During multiple aerial surveys in years following treatment, all treated individuals appeared to maintain group associations, and there were no groups consisting only of treated males or only of treated females (Collins and Kasbohm 2016). In addition, of solitary animals documented during surveys, there were no observations of solitary treated females (Collins and Kasbohm 2016). These data help support the expectation that ovariectomized mares would not lose interest in or be cast out of the social dynamics of a wild horse herd. As noted by the NRC Review (2013), the ideal fertility control method would not eliminate sexual behavior or change social structure substantially.

A study conducted for 15 days in January 1978 (Asa et al. 1980), compared the sexual behavior in ovariectomized and seasonally anovulatory (intact) pony mares and found that there were no statistical differences between the two conditions for any measure of proceptivity or copulatory behavior, or days in estrous. This helps explain why treated mares at Sheldon NWR continued to be accepted into harem bands; they were basically acting the same as a non-pregnant mare. Five to ten percent of pregnant mares exhibit estrous behavior (Crowell-Davis 2007). Although the physiological cause of this phenomenon is not fully understood (Crowell-Davis 2007), it is thought to be a bonding mechanism that assists in the maintenance of stable social groups of horses year-round (Ransom et al. 2014b). The complexity of social behaviors among free-roaming horses is not entirely centered on reproductive receptivity, and fertility control treatments that suppress the reproductive system and reproductive behaviors should contribute to minimal changes to social behavior (Ransom et al. 2014b, Collins and Kasbohm 2016).

The BLM expects that wild horse family structures would continue to exist under the proposed action because fertile mares, stallions, and their foals would continue to be a component of the herd. It is not expected that spaying a subset of mares would significantly change the social structure or herd demographics (age and sex ratios) of fertile wild horses.

Movement, Body Condition, and Survival of Ovariectomized Mares

The free-roaming behavior of wild horses is not anticipated to be affected by this alternative as the definition of free-roaming is the ability to move without restriction by fences or other barriers within an HMA (H-4700-1, 2010) and there are no permanent physical barriers being proposed. However, the on-range behavioral study would document the movement patterns of both herd segments to determine any difference in use areas and distances travelled.

In domestic animals spaying is often associated with weight gain and associated increase in body fat (Fettman et al. 1997, Beckett et al. 2002, Jeusette et al. 2006, Belsito et al. 2009, Reichler 2009, Camara et al. 2014). Spayed cats had a decrease in fasting metabolic rate, and spayed dogs had a decreased daily energy requirement, but both had increased appetite (O'Farrell and Peachey 1990, Hart and Eckstein 1997, Fettman et al. 1997, Jeusette et al. 2004). In wild horses, contracepted mares tend to be in better body condition than mares that are pregnant or that are nursing foals (Nuñez et al. 2010); the same improvement in body condition is likely to take place in spayed mares. In horses spaying has the potential to increase risk of equine metabolic syndrome (leading to obesity and laminitis), but both blood glucose and insulin levels were similar in mares before and after ovariectomy over the short term (Bertin et al. 2013). For wild horses the quality and quantity of forage is unlikely to be sufficient to promote over-eating and obesity.

Coit and others (2009) demonstrated that spayed dogs have elevated levels of LH-receptor and GnRH-receptor mRNA in the bladder tissue, and lower contractile strength of muscles. They noted that urinary incontinence occurs at elevated levels in spayed dogs and in post-menopausal women. Thus, it is reasonable to suppose that some ovariectomized mares could also suffer from elevated levels of urinary incontinence.

Sterilization had no effect on movements and space use of feral cats or brushtail possums (Ramsey 2007, Guttilla and Stapp 2010), or greyhound racing performance (Payne 2013). Rice field rats (*Rattus argentiventer*) tend to have a smaller home range in the breeding season, as they remain close to their litters to protect and nurse them. When surgically sterilized, rice field rats had larger home ranges and moved further from their burrows than hormonally sterilized or fertile rats (Jacob et al. 2004). Spayed possums and foxes (*Vulpes vulpes*) had a similar core range area after spay surgery compared to before and were no more likely to shift their range than intact females (Saunders et al. 2002, Ramsey 2007).

The likely effects of spaying on mares' 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). It is unlikely that spayed mares will change their spatial ecology, but being emancipated from constraints of lactation may mean they can spend more time away from water sources and increase their home range size. Lactating mares need to drink every day, but during the winter when snow can fulfill water needs or when not lactating, horses can traverse a wider area (Feist and McCullough 1976, Salter 1979). During multiple aerial surveys in years following the mare ovariectomy study at the Sheldon NWR, it was documented that all treated individuals appeared to maintain group associations, no groups consisted only of treated females, and none of the solitary animals observed were treated females (Collins and Kasbohm 2016). Since treated females maintained group associations, this indicates that their movement patterns and distances may be unchanged.

Spaying wild horses does not change their status as wild horses under the WHB Act (as amended). In terms of whether spayed mares would continue to exhibit the free-roaming behavior that defines wild horses, BLM does expect that spayed mares would continue to roam unhindered in the Warm Springs 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 spayed 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 spaying wild horses will cause them to lose their free-roaming nature.

In this sense, a spayed wild mare would be just as much "wild" as defined by the WHB Act as any fertile wild mare, even if her patterns of movement differ slightly. Congress specified that sterilization is an acceptable management action (16 U.S.C. 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 U.S.C. 1333.2.C.d). The BLM must adhere to the legal definition of what constitutes a wild free-roaming horse,[8] based on the WHB Act (as amended). The BLM is not obliged to base management decisions on personal opinions, which do not meet the BLM's principle and practice to "[u]se 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).

Spaying is not expected to reduce mare survival rates. Individuals receiving fertility control often have reduced mortality and increased longevity due to being released from the costs of reproduction (Kirkpatrick and Turner 2008). Similar to contraception studies, in other wildlife species a common trend has been higher survival of sterilized females (Twigg et al. 2000, Saunders et al. 2002, Ramsey 2005, Jacob et al. 2008, Seidler and Gese 2012). Observations from the Sheldon NWR provide some insight into long-term effects of ovariectomy on feral horse survival rates. The Sheldon NWR ovariectomized mares were returned to the range along with untreated mares. Between 2007 and 2014, mares were captured, a portion treated, and then recaptured. There was a minimum of 1 year between treatment and recapture; some mares were recaptured a year later and some were recaptured several years later. The long-term survival rate of treated wild mares appears to be the same as that of untreated mares (Collins and Kasbohm 2016). Recapture rates for released mares were similar for treated mares and untreated mares.

Bone Histology

The BLM knows of no scientific, peer-reviewed literature that documents bone density loss in mares following ovariectomy. A concern has been raised in an opinion article (Nock 2013) that ovary removal in mares could lead to bone density loss. That paper was not peer reviewed nor was it based on research in wild or domestic horses, so it does not meet the BLM's standard for "best available science" on which to base decisions (Kitchell et al. 2015). Hypotheses that are forwarded in Nock (2013) appear to be based on analogies from modern humans leading sedentary lives. Post-menopausal women have a greater chance of osteoporosis (Scholz-Ahrens et al. 1996), but the BLM is not aware of any research examining bone loss in horses following ovariectomy. Bone loss in humans has been linked to reduced circulating estrogen. There have been conflicting results when researchers have attempted to test for an effect of reduced estrogen on animal bone loss rates in animal models; all experiments have been on laboratory animals, rather than free-ranging wild animals. While some studies found changes in bone cell activity after ovariectomy leading to decreased bone strength (Jerome et al. 1997,

[8] "Wild free-roaming horses and burros" means all unbranded and unclaimed horses and burros on public lands of the United States.

Baldock et al. 1998, Huang et al. 2002, Sigrist et al. 2007), others found that changes were moderate and transient or minimal (Scholz-Ahrens et al. 1996, Lundon et al. 1994, Zhang et al. 2007) and even returned to normal after 4 months (Sigrist et al. 2007).

Consistent and strenuous use of bones, for instance using jaw bones by eating hard feed, or using leg bones by travelling large distances, may limit the negative effects of estrogen deficiency on micro-architecture (Mavropoulos et al. 2014). The effect of exercise on bone strength in animals has been known for many years and has been shown experimentally (Rubin et al. 2001). Dr. Simon Turner, Professor Emeritus of the Small Ruminant Comparative Orthopaedic Laboratory at CSU, conducted extensive bone density studies on ovariectomized sheep, as a model for human osteoporosis. During these studies, he did observe bone density loss on ovariectomized sheep, but those sheep were confined in captive conditions, fed twice a day, had shelter from inclement weather, and had very little distance to travel to get food and water (Simon Turner, CSU Emeritus, written comm., 2015). Dr. Turner indicated that an estrogen deficiency (no ovaries) could potentially affect a horse's bone metabolism, just as it does in sheep and human females when they lead a sedentary lifestyle, but indicated that the constant weight bearing exercise, coupled with high exposure to sunlight ensuring high vitamin D levels, are expected to prevent bone density loss (Simon Turner, CSU Emeritus, written comm., 2015).

Home range size of horses in the wild has been described as 4.2 to 30.2 square miles (Green and Green 1977) and 28.1 to 117 square miles (Miller 1983). A study of distances travelled by feral horses in "outback" Australia shows horses travelling between 5 and 17.5 miles per 24 hour period (Hampson et al. 2010a), travelling about 11 miles a day even in a very large paddock (Hampson et al. 2010b). Thus extensive movement patterns of wild horses are expected to help prevent bone loss. The expected daily movement distance would be far greater in the context of larger pastures typical of BLM long-term holding facilities in off-range pastures. A horse would have to stay on stall rest for years after removal of the ovaries in order to develop osteoporosis (Simon Turner, CSU Emeritus, written comm. 2015), and that condition does not apply to any wild horses turned back to the range or any wild horses that go into off-range pastures.

Effects on Genetic Diversity

It is true that spayed mares are unable to contribute to the genetic diversity of a herd, but that does not lead to an expectation that the Warm Springs HMA would necessarily experience high levels of inbreeding because there would continue to be a core breeding population of mares present, because there was high genetic heterozygosity in the herd at the last measurement, because horses could always be introduced to augment genetic diversity if future monitoring indicates cause for that management action, and because there is an expectation of continued positive growth in the herd (Cothran 2002, 2011). Here, population growth rate expresses the annual percentage increase in the total number of animals. "Fertility control application should achieve a substantial treatment effect while maintaining some long-term population growth to mitigate the effects of environmental catastrophes" (BLM IM 2009-090). This statement applies to all population growth suppression techniques, including spaying. According to the WinEquus population model trials of removal with fertility control (for both trials with PZP treatment and with spay treatments), the health of individual animals or the long-term viability of the herd would not be threatened because between 2022–2028 the lowest possible population growth rate would be 10.4 percent (refer to Table III-2, WinEquus Comparison Table and Appendix K, Warm Springs HMA WinEquus Simulations). The WinEquus trials run for this proposed action also include a gather to low AML at the end of the study (2022) and a proposed gather the next time high AML is achieved. Under this scenario there would be another gather anywhere from 2025 to 2029, depending on the treatment type chosen, at which time hair samples would be collected and genetic analysis completed to determine if appropriate management changes (such as translocations from a nearby HMA) are needed. Periodic gathers allow BLM to collect DNA samples, closely monitor the genetic variability of the herd, and make appropriate changes (e.g. translocation from other HMAs) when testing deems them necessary.

Although BLM is unable to precisely quantify cumulative effects under the proposed action, the effects of this alternative on present and RFFAs and in wild horse and burro habitat would aid in the long-term maintenance of habitat conditions necessary for a thriving natural ecological balance within the HMA. By maintaining AML and potentially slowing the population growth rate of wild horses, the objectives from HMAPs, the Three Rivers RMP/ROD (1992), and the Oregon GRSG ARMPA (specifically the AML, population growth suppression research, and water resources objectives) would be achieved and maintained over the long term (at least 10 years). Maintenance of an appropriate wild horse and burro population under this alternative encourages the success of noxious weed treatments, wildfire rehabilitation efforts, and livestock grazing management activities. Maintenance of AML provides consistency in the annual livestock grazing authorizations, with the exception of climatic fluctuations that may influence timing or level of use. Interference competition and/or direct competition for resources among wild horses, burros, wildlife, and livestock would be reduced or avoided by maintaining AML.

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 Review (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. 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 HMA or complex. Also, there is no BLM-wide policy that requires BLM to allow each female in a herd to reproduce before she is treated with contraceptives. Introducing 1–2 mares every generation (about every 10 years) is a standard management technique that can alleviate potential inbreeding concerns (BLM 2010). There would be little concern for effects to genetic variability of the herd because the proposed action incorporates BLM's management plan for genetic monitoring and maintenance of genetic variability.

In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM, including Warm Springs HMA. As a result, most alleles that are present in any given mare are likely to already be well represented in her siblings, cousins, and more distant relatives on the HMA. Fifty-six blood samples were used for Warm Springs HMA genetic diversity monitoring in 2001 (Cothran 2002), and 83 hair follicle samples were used for monitoring in 2010 (Cothran 2011). Both recent genetic monitoring reports for the Warm Springs HMA indicate that: the horses there come from a mixed ancestry of domestic breeds; there were no unique blood type, biochemical markers, or alleles found there; and there was high genetic diversity there both in terms of observed heterozygosity and allelic diversity (Cothran 2002, 2011). In the 2001 sample, one unusual variant associated with Spanish or heavy draft breeds was identified, but it was not flagged as unique. The Warm Springs HMA herd has not been identified as containing a high contribution of Iberian bloodlines (NRC 2013). A number of microsatellite alleles had frequencies below 0.05, which is to be expected with such a high allelic diversity (Cothran 2011); the fact that the alleles present at Warm Springs are not unique means that they are also represented in other HMAs. 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 Review 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.

The Warm Springs HMA would have only a low risk of loss of genetic diversity because the proposed action incorporates BLM's management plan for genetic monitoring and maintenance of genetic variability. After the initial gather, subsequent sterilization and PZP vaccine treatments would take place only after gathers. Wild horses in most HMAs are descendants of a diverse range of ancestors coming from many breeds of domestic horses, and this is apparently true in Warm Springs HMA as well. Genetic monitoring did not identify any unique alleles in Warm Springs HMA. 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 the 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 (5 percent per year), and very large fractions of the female population are permanently sterilized.

Risks Associated with Radio Collaring

Relatively few studies have incorporated the use of radio collars on wild equids. Nevertheless, those studies have successfully generated data for the study of animal movement, behavior, and habitat use (Collins et al. 2014). In this on-range behavioral study, radio collars and tags would be used to locate and monitor wild horse individuals and gain an understanding of their home range and habitat use. Radio collars and tags are also important for locating animals to conduct behavioral observations and to record data on fertility and fecundity.

Based on other studies that have used radio collars and tags to study the ecology of wild ungulates, these devices are expected to have minimal effects on the animals wearing them. However, while every effort is being made to develop a collar that is safe and comfortable, and experienced personnel would fit them, one cannot rule out the possibility of an accident, complication, or mortality of a horse wearing a collar as part of research. Although in the past 3 years USGS researchers have reported only minor rubbing abrasions from collars and a few instances of the collar going over the ears (and then removed using the remote release mechanism), the following effects are possible:

- Collar going over the ear: In other equids this has been observed to happen in males (G. Collins, USFWS and P. Kaczensky Vetmeduni Vienna, pers. comm.), which would therefore be fitted with tags rather than collars in this study. In a current BLM-funded study in Wyoming, radio collars have also been observed to go over mares' ears. All animals wearing collars and tags would be observed at least once a month throughout the year. Should the collar go over the ears of mares, the remote-release (also known as the drop-off mechanism) would be deployed remotely (by radio-tracking the individual and walking to within 200m of it) as has been done in Wyoming. If this fails, the collar would be removed after capturing the animal via helicopter-drive trapping, bait or water trapping, or darting, depending on what options are best in the specific situation.
- Neck abrasions/sores: Rubbing and sores have not been reported in other studies where equids have been collared (e.g., Collins et al. 2014) and were not seen in any mares during the first 5 months of USGS's collar test at Paul's Valley adoption facility, Oklahoma. Minor rubbing and small wounds have been observed in current BLM-funded studies involving radio collars in Utah and Wyoming. Therefore this problem can be anticipated, but is expected to happen only at a low rate and with minor wounds possible. All horses would be visually checked at least 1–2 times monthly, and this check includes looking for rubbing or sores. Horses in the wild are susceptible to wounds, most of which heal relatively quickly. If sores caused by a collar have not healed within 4 weeks of when they were sighted, that individual would have its collar remotely triggered to drop off. If this fails, the collar would be removed after capturing the animal via helicopter-drive trapping, bait or water traps, or darting, depending on what options are best in the specific situation.
- Collar too tight: Every effort would be made to put collars on at the correct tightness, which for horses means snug when the head is raised and looser when the head is lowered. Should an individual

put on an unusually large amount of weight, it is conceivable that the collar may become too tight. In this case the collar would be removed with the remote release mechanism or the individual would be captured and the collar removed.

- Tags: No negative effects of the tags are expected; however, it is possible that they may form an irritation to individuals should vegetation get tangled in the tail. In this case, the tag would be ultimately expected to rip out of the hair (leaving no injury) as the horse rubs it.

Effects of PZP

Gathers following the completion of the on-range behavioral study could implement the use of PZP fertility control treatment if the results of the spay treatment and on-range behavioral study indicate the method is not feasible as a long-term management tool for this HMA. Up to 90 percent of the mares released following an AML gather would be treated with the 2-injection liquid PZP (ZonaStat-H; Science and Conservation Center, Billings, Montana) or the PZP-22 vaccine pellets or another comparable fertility treatment if one becomes available during the 10-year timeframe of analysis. PZP acts as a vaccine against pregnancy by stimulating the production of zona pellucida antibodies in female mammals (Ransom et al. 2011, Liu et al. 1989, Sacco 1977). These antibodies provide a barrier that prevents sperm from binding to the surface of an ovum and results in limited penetration of the zona pellucida and subsequent limited pregnancy in horses (Ransom et al. 2011, Kirkpatrick et al. 1990, Liu et al. 1989).

In a study where 2-injection PZP was applied to wild mares in Nevada, Turner and others (1997) determined that the 2-injection protocol brought the reproductive success rate to around 4.5 percent versus the 53 percent success rate of untreated mares. However, the effect of PZP treatment in 2-injection mares was sustained through 1, but not 2, breeding seasons, indicating a return to fertility after 1 year (Turner et al. 1997). Some mares given the standard 2-injection protocol will become fertile the second breeding season following the treatment but some will remain infertile for another or even 2 years, thus, there should be some reduction in foaling up to 4 years out (Dr. Jay Kirkpatrick, written comm., 2013). However, continued research on PZP-22 by Turner indicates that current formulations of PZP-22 lead to only 1 year of contraception, not 2 (2014 Progress Report to BLM). Instances of PZP-22 application in HMAs within the Burns District BLM indicate that it remains minimally effective at slowing population growth between gather cycles (4–5 years). A multi-year, high efficacy rate would be more desirable for long-term (3–5 years) population management, specifically in HMAs where wild horses are inaccessible. In an effort to broaden the scope for successful contraceptive management with the use of a single-treatment, multi-year contraceptive vaccine, results from Rutberg and others (2017) found that initial PZP-22 primer treatments on mares showed disappointing effectiveness, although a single PZP booster administered 2–3.2 years later effectively reduced fertility across 3 consecutive years (Rutberg et al. 2017). Whether delivered by dart or by hand, PZP boosters reduced foaling rates in treated mares by roughly 65–72 percent relative to untreated control mares over 3 years (Rutberg et al. 2017). Authors were encouraged by the demonstration of management flexibility in PZP-22 application because data suggested that the interval between initial and booster treatments (2–3.2 years) does not obviously influence effectiveness or longevity of the booster (Rutberg et al. 2017). Their findings provide evidence of a double-treatment, multi-year contraceptive that is already available for use, which is a major step toward improving vaccine longevity. Although the study by Rutberg and others (2017) involved a booster dose of PZP-22 remotely delivered, BLM does not plan to use darting for PZP-22 delivery until there is more demonstration that PZP-22 can be reliably delivered via dart.

Contradictory evidence exists regarding the effect of PZP on the behavior of mares treated and on the social structure of a herd. Powell (1999) reported that PZP-treated mares continually undergo non-conceptive cycles (demonstrated estrous behavior throughout the season), causing stallions to continue to tend and mate with mares until they ceased to cycle in the fall. In addition, results of a study conducted by Madosky and others (2010) on Shackleford Banks Island horses indicated that PZP used to control population numbers has a significant negative effect on harem stability. Ransom and others (2010) found that direct effects of PZP treatment on the behavior of feral horses appear to be limited primarily to reproductive behaviors, and most other differences detected were attributed to the effects of body condition, band fidelity, or foal presence. Ransom and others (2010) found that treated females received considerably (54.5 percent) more reproductive behaviors from stallions than did control females. However, Madosky (2011) found that PZP contracepted mares changed harems significantly more often than control mares (PZP caused a decrease in harem fidelity regardless of season), and Nuñez and others (2014) found that PZP-treated mares exhibited higher infidelity to their band stallion during the non-breeding season than control mares. Results from the study by Nuñez and others (2014) show that mares in the midst of changing groups exhibit increased fecal cortisol levels. They acknowledge that the results show that PZP treatment itself does not increase cortisol levels in recipient animals, however, consistent band changes may put them at higher risk of chronic stress (Nuñez et al. 2014). While studying the return of previously PZP-treated mares to their physiological and behavioral baselines, Nuñez and others (2017) found that mares previously receiving 4+ treatments changed groups more frequently than did untreated mares. However, the results also show that with less frequent treatment (i.e. PZP-22 applied during the gather cycles of the proposed action) some of these effects can be ameliorated with time and therefore enable more flexible population management.

An additional concern associated with the use of PZP is the potential for late foaling dates on previously treated mares. Nuñez and others (2010) concluded that PZP recipient mares exhibited a change in their reproductive schedule; recipient mares gave birth over a broader time period than did non-recipients. The study by Nuñez and others (2010) provides the first evidence that mares treated with PZP can extend ovulatory cycling beyond the normal breeding season. Results from a study by Ransom and others (2011) support early investigations by Liu and others (1989) and Kirkpatrick and others (1990) that application of PZP does not affect pregnancies in progress. Parturition phenology (birthing season) for North American feral horses has been shown to peak during May (Berger 1986, Garrott and Siniff 1992, Nuñez et al. 2010), and photoperiod and temperature are powerful inputs driving the biological rhythms of conception and birth in horses. With an 11-month gestation period, this timing maximizes the likelihood that foals will be born and spend their first few months of life at a time when the weather is warm and food is plentiful (Crowell-Davis 2007). Ransom and others (2013) 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 and others (2013), however, showed that over 81 percent of the documented births in this study were between March 1 and June 21, that is, within the normal, peak, spring foaling season. Ransom and others (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 and others (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 and others (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).

Another concern that has been raised is that persistent use of any immunocontraceptive could lead to an increase in the prevalence of genes associated with a poor immune response (Cooper and Larson 2006, Ransom et al. 2014a). 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. The BLM is not aware of any studies that have quantified the heritability of a lack of response to PZP vaccine in horses. Magiafoglou and others (2003) clarify that if the variation in immune response is due to environmental factors (e.g. body condition or social rank) and not due to genetic factors, then there will be no expected effect of the immune phenotype on future generations.

Concern has been raised over the potential that repeated PZP treatment may lead to longer-term sterility and that sterility may result from PZP treatment before puberty. In their study of reversibility of PZP treatments of wild horses, Kirkpatrick and Turner (2002) showed that most mares receiving 2 initial injections and up to 1 subsequent annual booster returned to fertility within 1 year, whereas mares receiving 3 or 4 consecutive years of treatment experienced delays of 3 to 4 years in return to foaling (Rutberg et al. 2017). In the study that began in 1988 by Kirkpatrick and Turner (2002), mares were treated with PZP vaccine for 1, 2, 3, 4, 5, or 7 consecutive years. "All five mares treated for 4 or 5 consecutive years have also returned to fertility, but over longer periods of time. Mares treated for 7 consecutive years have not returned to fertility, but several, while still infertile, have started ovulating again" (Kirkpatrick and Turner 2002). The proposed action does not include annual treatment of mares with PZP (refer to Alternatives Considered but Eliminated from Further Analysis, Intensive Fertility Control, II.C.5) and would be similar to treatments conducted by Rutberg and others (2017). Therefore, mares would return to fertility within 3–4 years. In her graduate thesis, Knight (2014) reported evidence of sterility caused by timing of the initial dose of PZP prior to puberty. Based on BLM's removal criteria for horses removed from the HMA, it is not likely that any of the mares returned to the range would have not passed puberty because the 1–4 year olds are the first priority for removal. Even if there is potential for sterility of mares treated by PZP prior to puberty, there would be little concern for effects to genetic variability of the herd because all action alternatives incorporate BLM's management plan for genetic monitoring and maintenance of genetic variability. The effects of mare sterility on genetic diversity in this herd are noted above under consideration of the effects of spaying. Effects of PZP on genetic diversity would be expected to be similar but less pronounced, as it is expected that most PZP-treated mares would return to fertility.

For additional effects analysis related to the use of PZP, refer to Appendix L, PZP Literature Review.

2. Cultural Resources

The following issue is addressed in this section.

- *What would be the effect of the wild horse and burro population management plan alternatives on cultural resources?*

a. Affected Environment – Cultural Resources

Two hundred and one archaeological sites are known to occur within the Warm Springs HMA. Of this number, 42 sites (21 percent) are located within 200 feet of water developments, primarily playa lake stock reservoirs. The remaining 159 sites are not located near man-made water developments but some are located near areas of natural ponding from seasonal run-off. A small fraction of the HMA has been inventoried for cultural resources. It is likely that hundreds and, potentially, thousands more archaeological sites occur in the nearly half million acre HMA. Based on past observations and experience on Burns District, it is likely that at least 20 percent of these additional undiscovered sites are near man-made or natural water sources.

The 400-foot diameter zone around man-made or natural water sources is considered a "congregation" area where the effects of livestock/horse/burro trampling, wallowing, and scuffing the ground surface are concentrated. Any surface or shallowly buried archaeological site within this zone is susceptible to the abovementioned effects and can be disturbed to a depth of at least 12 inches. Within this zone of disturbance, archeological material can be mixed both up and down and in a horizontal direction and artifacts can be broken. What results is total loss of site context and scientific value.

The extent that sites have been affected by livestock trampling in the past has not been adequately measured and quantified due to a historic lack of information on the sites themselves prior to the late 1970s when archaeologists were first employed by the BLM for inventory and monitoring.

"Generalized" grazing (i.e. grazing away from congregation areas) is not believed to affect archaeological sites because it is believed that historic grazing before 1935 was at a much higher level than today. However, increasing the horse and burro herd to over 5,000 animals could expand congregation areas and produce additional congregation areas that are not evidenced under the current grazing regime.

b. Environmental Consequences – Cultural Resources

No Action

The no action alternative would result in greater numbers of horses and burros over the next 10 years to the point that their grazing effects would be at least five times the current effects in congregation areas. Increasing the horse and burro herd to over 5,000 animals could expand congregation areas and produce additional congregation areas that are not evidenced under the current grazing regime. If fertility control and gathers are not implemented, then over 20 percent of the known archaeological sites in this HMA would be damaged below a 12-inch depth from increased congregation near man-made or natural water sources.

Congregation areas could expand under the no action alternative and grazing effects in what are currently considered "generalized" grazing areas and additional archaeological sites could be affected.

For the purposes of this analysis, the cumulative effects analysis area (CEAA) for cultural resources is within the HMA. The extent that sites have been affected by livestock trampling in the past has not been adequately measured and quantified due to a historic lack of information on the sites themselves prior to the late 1970s when archaeologists were first employed by the BLM for inventory and monitoring. Therefore, with the increased number of horses and burros in the HMA far and above AML, cumulative effects from wild horse and burro congregation could increase the size of congregation areas, thereby having a greater effect on a greater number of cultural resources than under the proposed action.

Proposed Action

The proposed action, with its focus on fertility control and gathers would eliminate or minimize additional effects to archaeological sites within 200 feet of any man-made or natural water source. Archaeological sites within "generalized" grazing areas would remain unaffected.

For the purposes of this analysis, the cumulative effects analysis area (CEAA) for cultural resources is within the HMA. The proposed action and other ongoing and RFFAs would not lead to cumulative effects to cultural resources because proposed projects would be localized or the sites would be completely avoided per incorporated project design features. Potential direct and cumulative effects to cultural resources would be mitigated through project-specific cultural resource inventory and mitigation measures prior to any project implementation.

3. Riparian Zones, Wetlands, and Water Quality

The following issue is addressed in this section.

- *What would be the effects of the alternatives on water quality and riparian conditions within the HMA?*

a. Affected Environment – Riparian Zones, Wetlands, and Water Quality

Riparian areas within the Warm Springs HMA are monitored through permanent photo points, proper functioning condition (PFC) assessments, and site visits. Riparian monitoring occurs approximately every 2–5 years, depending on the monitoring type. Perennial water sources are regularly monitored, while intermittent streams are periodically evaluated.

Buzzard Creek is a temporal and spatially intermittent stream that flows into Silver Lake playa. Water is dispersed into the creek from spring runoff, other high water events, and subsurface flow from Buzzard Spring. Primary use is as a water source for wildlife, wild horses, burros, and livestock. This stream is not an Oregon Department of Environmental Quality (ODEQ) 303(d) listed stream, is not fish-bearing, does not contribute to any fish-bearing stream, and is not a source for public drinking water.

Ross Springs is a spring that is excluded from livestock, wild horse, and burro grazing and has high species diversity with vegetation that appears vigorous. Photo monitoring shows a stable trend, and this site was rated at PFC in 2015.

Seiloff Dikes is a wetland habitat created by a series of constructed dikes to pond water supplied by Seiloff Spring. This area is excluded from livestock and wild horse and burro grazing, with water piped outside the exclosure to a watering trough. A PFC assessment was conducted in 2015, and the site was rated at PFC. The site capability is that of an altered/created wetland. A series of dikes and headgates pond the water that historically would have flowed onto a larger playa lakebed. The dikes/ponds were built to create waterfowl habitat and an exclosure fence surrounds most of the wetland. Monitoring photos show a stable trend.

Thorn Springs is a highly productive spring with high species diversity and vegetation that appears vigorous. This is the only perennial water source that is not fenced. A PFC assessment was conducted in 2015, and the site was rated at the upper end of functioning at risk (FAR). The primary reasons for the FAR category were due to the recent, unauthorized waterhole/dugout that had been created near the wetlands spring source and the presence of a small patch of the noxious weed, perennial pepperweed. Monitoring photos show a stable trend.

Bigfoot Reservoir is located on the East Warm Springs Allotment. It was expanded from a 1.8-acre waterhole to a 160-acre reservoir and fenced in 1975. Two goose nesting islands were created at that time, and various woody species, riparian, and aquatic vegetation were planted throughout the area. Since then, willows have survived, expanded, and show high vigor along with cattails, reed canary grass, and various sedges and rushes. This area has been under drought conditions over the past 5 years, severely reducing the water level in the reservoir. Monitoring has not been conducted on this reservoir.

Numerous playa lakebeds exist within the HMA with many containing waterholes. Presently, these areas receive seasonal use by livestock, wild horses, burros, and wildlife each year. Indicators for rangeland health and riparian monitoring data from 2015, for both West and East Warm Springs Allotments, indicate all standards for rangeland health are either not present, achieved, or if not achieved, livestock/wild horses/burros are not a causal factor.

b. Environmental Consequences – Riparian Zones, Wetlands, and Water Quality

Common to both Alternatives

The CEAA for both alternatives for riparian zones, wetlands, and water quality is the thirteen watersheds that overlap the HMA boundary. The thirteen watersheds are Big Stick Creek, Wilson Creek, Flybee Lake, Buzzard Creek, Jackass Creek, Juniper Creek-Dry Valley, Little Tank Creek, Big Tank Creek, Lower Silver Creek, Harney Lake-Malheur Lake, Lower Donner und Blitzen River, Middle Donner and Blitzen, and Walls Lake Reservoir. No cumulative effects under any of the alternatives to the Little Tank Creek-Big Tank Creek and Juniper Creek-Dry Valley watersheds are expected because so little of these watersheds fall within the HMA.

Past and present actions, such as those described in the affected environment above, have influenced the existing environment within the CEAA. The RFFAs in the CEAA that may contribute to cumulative effects to riparian zones, wetlands, and water quality include recreation, maintenance of existing range improvements, fire rehabilitation actions, and noxious weed treatments.

No Action

The no action alternative could cause an increase in the wild horse and burro population up to 5000+ in the HMA, which would result in greater use and degradation of the unfenced Thorn Springs wetland area. This would result in a decline in riparian function. Riparian area vegetation would be degraded, as additional horse and burro use would decrease vegetation recruitment, reproduction, and survivability. In addition, riparian vegetation community types and distribution would be changed, root density lessened, and canopy cover reduced. This would lead to reduced spring/seep dynamics and further deterioration of this system. The year-round grazing within riparian zones favors the increase of xeric species within the plant communities. The removal of riparian herbaceous species cover due to heavy grazing from horse and burro populations exceeding AML would also affect the function of this vegetation for the retention of sediment during high water events.

Although BLM is unable to quantify cumulative effects under the no action alternative, the effects of this alternative by past, present, and RFFAs on riparian zones, wetlands, and water quality would be detrimental. The no action alternative would negatively affect the resources listed above. Riparian zones, wetlands, and water quality would see increased impact due directly to increased numbers in wild horses and burros. The population increase would strain the above resources causing degradation that is difficult and expensive to restore.

Greater pressure would be placed on wetland/riparian exclosure fences as wild horse and burro populations exceed carrying capacity and water availability. Fences would likely be breached and horses and burros would have access to these habitats. Under this scenario, effects to fenced riparian areas would be the same as those described above for Thorn Springs.

Proposed Action

The proposed action would reduce and maintain the wild horse and burro population to within AML, therefore reducing and minimizing their potential effect on riparian zones and wetlands. Maintaining populations within AML in this water-limited HMA aids in limiting the pressure placed on riparian exclosure fences. Currently Thorns Springs remains unfenced and may maintain or improve in condition with maintenance of wild horse and burro numbers within AML.

Although BLM is unable to quantify cumulative effects under the proposed action, the effects of past, present, and RFFAs would benefit riparian zones, wetlands, and water quality. By maintaining AML and applying population growth suppression to wild horses, the population would potentially slow and provide opportunity for improvement in riparian areas, wetlands, and water quality.

4. Livestock Grazing Management

The following issue is addressed in this section.

- *What would be the effects of the alternatives on livestock grazing management and associated ranch operations?*

a. Affected Environment – Livestock Grazing Management

Within the Warm Springs HMA, there are two grazing allotments. All of the allotments and pastures are entirely inside the HMA boundaries. Refer to Appendix M, Allotments and Water Development Map. There are a total of nine livestock operators currently authorized to graze livestock in the HMA. The BLM allocated forage for livestock use through the Three Rivers RMP/ROD (1992) and specifically allocated 19,392 AUMs of active preference to livestock for forage each year within these allotments. These allocations were based on the analysis of monitoring data that included actual use, utilization, climate data, long-term trend studies, and professional observations. Table III-3, following, summarizes the livestock use information for the allotments in the HMA. Actual livestock use across the HMA has varied due to drought and the 2012 Miller Homestead Wildfire causing periods of rest from grazing. Average actual use since 2008 for the allotments is found in table III-4 and table III-5.

Table III-3: Authorized Livestock Use Within the Warm Springs HMA.

Allotment	BLM Administered Acres	% of Allotment in HMA	Permittees	Permitted Season of Use	Permitted Active Use AUMs
East Warm Springs	178,144	100%	5	4/11–8/31	8,225
West Warm Springs	297,375	100%	4	4/1–9/15	11,167

Table III-4: Actual Use within Warm Springs HMA by Allotment

Allotment	Year	Actual AUMs Used	Percent of Permitted AUMs
East Warm Springs	**2017**	**6,530**	**79%**
	2016	**5,713**	**69%**
	2015	**4,889**	**59%**
	2014	**4,612**	**56%**
	2013	**4,701**	**57%**
	2012	**5,592**	**68%**
	2011	**7,004**	**85%**
	2010	**5,798**	**70%**
	2009	**5,802**	**71%**
	2008	**6,483**	**79%**
West Warm Springs	2017*	7,548	68%
	2016*	8,046	72%
	2015*	7,966	71%
	2014*	6,569	59%
	2013	7,158	64%
	2012	6,109	55%
	2011	6,399	57%
	2010	6,530	58%
	2009	4,916	44%
	2008*	6,415	57%

*Not all users actual use was turned in these years so billed use was used to supplement these calculations, as it was the best available information.

Table III-5: Total Combined Actual Use within Warm Springs HMA by Year

YEAR	Combined Actual Use AUMs	Percent of Permitted AUMs
2017	14,078	73%
2016	13,759	71%
2015	12,855	66%
2014	11,181	58%
2013	11,859	61%
2012	11,701	60%
2011	13,403	69%
2010	12,328	64%
2009	10,718	55%
2008	12,898	67%

The allotment management plans (AMP) associated with these two allotments established objectives to maintain or improve key herbaceous species in the respective allotments. These AMPs provide grazing prescriptions that allow for periodic growing season rest for key forage species to aid in maintaining plant vigor and reproduction. Both of the AMPs also set target utilization levels of a maximum of 50 percent on native species and 60 percent on non-native species (e.g. crested wheatgrass). Burns District BLM monitors annual utilization levels on key forage species by all uses (i.e. livestock, horses, and wildlife). The method most commonly used on Burns District to monitor utilization levels is the Landscape Appearance Method.[9] These target levels aid in determining the need for action or adjustments if utilization levels exceed 50 or 60 percent, respectively. Utilization is not specific to domestic livestock. If utilization objectives are reached prior to turnout or early in the grazing schedule, then removal of domestic livestock would occur. For both West and East Warm Springs Allotments, indicators for rangeland health and riparian monitoring data through 2015 indicate standards for rangeland health are either not present, achieved, or if not achieved, livestock are not a causal factor. Monitoring of trend in condition of upland vegetation at representative sites in both East and West Warm Springs Allotments is static overall with some areas seeing a downward trend and some areas indicating an upward trend in key herbaceous species. Long-term upland trend plots have been revisited approximately every 5 years across the HMA with the most recent for East Warm Springs Allotment in 2013 and 2015 and for West Warm Springs Allotment in 2012, 2015, and 2017. Although assessments have found portions of the HMA are achieving upland rangeland health standards, local areas of declining bunchgrass health have been observed, generally in areas around the limited reliable water sources, and within some of the wild horse and livestock congregation areas.

It is estimated that by fall 2018, the wild horse population would be approximately 694 adult horses plus 158 foals. Wild horses and burros within the Warm Springs HMA have 2,424 AUMs of forage allocated to their use at high AML of 202 animals. If the population reaches the 694 adult horses estimate, they would be utilizing 8,328 AUMs, exceeding their allocated use by 5,904 AUMS. Upland forage utilization monitoring documents moderate to high utilization levels in portions of the HMA experiencing concentrated wild horse and livestock use. In 2017, moderate to heavy use was indicated in several areas of the HMA where lower levels of livestock use occurred.

Some horse herds make a substantial part of their use in areas not used by cattle. However, in this HMA many of the areas of major horse and burro use are also major use areas for cattle. This, in general, is due to the availability of reliable water sources. There are a few wells within the HMA; however, most of the water sources in this HMA are constructed

[9] Landscape Appearance Method is defined as a qualitative assessment technique that uses an ocular estimate of forage utilization based on the general appearance of the rangeland. Utilization levels are determined by comparing observations with written descriptions of each utilization class. An example description of a utilization class is as follows: (21–40 percent) *The rangeland may be topped, skimmed, or grazed in patches. The low value herbaceous plants are ungrazed and 60 to 80 percent of the number of current seed stalks of herbaceous plants remain intact. Most young plants are undamaged.* There are 6 Utilization Classes; No Use (0–5%), Slight (6–20%), Light (21–40%), Moderate (41–60%), Heavy (61–80%), and Severe (81–100%).

stock reservoirs that are fed by winter snow melt leading to runoff and filling the reservoirs or playas. During the late summer grazing period, water becomes limited through evaporation and use. In addition, in years where snow accumulation is limited, water scarcity restricts use in this HMA to very few areas, generally just at the well sites.

b. Environmental Consequences – Livestock Grazing Management

There are many similarities between livestock use and wild horse and burro use. However livestock use in the HMA is managed to provide periodic growing season rest to desirable forage species to help maintain or achieve a healthy functioning landscape. This is achieved through management of timing, duration, and intensity of livestock use. These tools are not available for wild horse and burro management. One result is horses will spend much of the year in their preferred area causing grazing pressure year-round.

For the purposes of this analysis, the CEAA for livestock grazing management consists of the pastures within the HMA. Past and present actions, such as those described in Affected Environment, have influenced the existing environment within the CEAA. Past and RFFAs that have and would affect livestock grazing management and would contribute to cumulative effects are fence and water developments and maintenance, wildfires, prescribed burns, wild horse and burro utilization, periodic wild horse and burro gathers, wildlife use, hunting and other recreational pursuits, ongoing noxious weed treatments, and road maintenance. Maintaining existing water developments, and constructing new water sources, would allow for more reliable water for horses throughout the year and disperse their use more evenly across the HMA into areas previously not available for use due to the lack of water. Increasing the composition of perennial grasses, forbs, and shrubs in these communities inherently increases herbaceous forage production for all grazers.

No Action

Under the no action alternative, no gathers with removals would occur and the population would continue to grow. Using a 20 percent population growth rate, wild horse numbers would increase from the fall 2018 estimate of 694 adults and 158 foals to approximately 1,726 adult horses and 345 foals by 2023 (5 years is one normal gather cycle). That would mean forage utilized by wild horses would increase dramatically and AUMs used by adult horses would be up to 20,712. By fall 2028, the end of the 10-year timeframe of this EA, the wild horse population would be estimated at 4,297 adult horses plus 859 foals, or 51,564 AUMs for adult horses. To put that into perspective, the current total allocated AUMs for cattle, wild horses, burros, deer, and antelope within the Warm Springs HMA is 22,149 AUMs. The horse use, alone, would be more than double that.

Wild horse and burro numbers above the AML result in utilization of more AUMs than they were allocated. At the current estimated use level, adult horses alone are using 8,328 AUMs, which is 5,904 AUMs more than they and burros are allocated. In order to meet annual utilization targets and continue to achieve land health standards, permitted livestock grazing would likely be reduced below full permitted use as wild horse and burro numbers continue to exceed AML. Heavy utilization is occurring in areas used by livestock, wild horses, burros, and wildlife, specifically around water sources. The indirect effects of the no action alternative would be damage to the forage resources, which would likely lead to land health standards not being achieved in the future. The no action alternative would lead to competition between livestock, wild horses, 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 fully use the forage they are authorized, possibly leading to the operators having to reduce numbers (table III-4 and table III-5).

Without the maintenance of AML, the allotment is at risk for not meeting standards in the future, despite management of livestock grazing animals. "Unmanaged or poorly managed non-native grazers, including horses, can have substantial impacts on ecosystem integrity, influencing a wide array of native flora (Smith 1986, Levin et al. 2002, Zalba and Cozzani 2004, Beever et al. 2008, Davies et al. 2014), fauna (Beever 2003, Beever and Brussard 2004, Beever and Herrick 2006, Hall et al. 2016a, Gooch et al. 2017), and ecosystem processes (Beever and Brussard 2000, Zeigenfuss et al. 2014)" (Collins and Kasbohm 2016).

The cumulative effects of the no action with past, present, and RFFAs would be detrimental to the outcome and efforts put toward completing successful projects such as noxious weed treatments, wildfire rehabilitation, and livestock grazing management actions to maintain or improve rangeland conditions.

Proposed Action

Livestock grazing would be expected to continue to occur in a manner that achieves the standards for land health and conforms to the Three Rivers RMP/ROD (1992) and to the GRSG ARMPA (2015). Utilization of the available vegetation would also be expected to continue at similar levels (up to 50 percent on native perennial grasses). Grazing management that provides for periodic grazing deferral and forage recovery would continue.

In some years, this may result in livestock being removed from the area prior to utilizing all of their permitted AUMs. Continuing to graze livestock in a manner consistent with grazing permit terms and conditions would be expected to achieve or make significant progress toward achieving land health standards.

Gather activities could result in direct effects by disturbing and dispersing the livestock present for a period of 5 to 7 days. Trapping activities would be scheduled in coordination with the rangeland management specialist to avoid conflicts with the authorized grazing rotations. Any removal of wild horses and burros would result in some level of reduced competition between the species for available forage and water. Indirect effects would include an increase in the quality and quantity of the available forage for the remainder of the grazing year. This benefit would decrease as wild horse and burro numbers increased until the next gather.

Under this alternative, the wild horse and burro herd size would be decreased periodically to the low end of AML as the population reaches high AML. Wild horse mares would be treated by spaying and/or PZP fertility control treatments following subsequent gathers during the 10-year timeframe of this analysis. The combination of these design features would result in a slower increase in the wild horse population. This would allow wild horse and burro use to remain within their allocated AUMs for the 10-year timeframe of this analysis, providing the availability of forage for livestock up to their full permitted use (dependent on annual rangeland conditions). The ability to continue gathers and wild horse fertility control treatments, as needed, over the next 10 years would decrease the risk of wild horse and burro numbers interfering with the ability of livestock to utilize permitted AUMs.

The cumulative effect of the proposed action with past, present, and RFFAs would be favorable to the outcome and efforts put toward completing successful projects such as noxious weed treatments, wildfire rehabilitation, and livestock grazing management actions to maintain or improve rangeland conditions. Maintaining wild horse populations within AML avoids competition with other uses and impacts on habitat requirements for other species.

5. Wildlife and Wildlife Habitat, Including Special Status Species

The following issue is addressed in this section.

- *What would be the effects of the alternatives on Greater Sage-Grouse habitat?*
- *What would be the effects of the alternatives on pygmy rabbit habitat?*
- *What would be the effects of the alternatives on large ungulate habitat in the HMA?*

a. Affected Environment – Wildlife and Wildlife Habitat, Including Special Status Species

The affected environment for wildlife habitat for each alternative at the Warm Springs HMA scale is described as predominately warm-dry (arid) sagebrush habitat with ecological site inclusions of low sagebrush, Wyoming big sagebrush, basin big sagebrush, old-growth western juniper (>150 years of age), and playas. Examples of common ecological sites are Claypan 10–12 precipitation zone (PZ), Loamy 10–12 PZ, and Cold Plateaus and Uplands 10–12 PZ, all of which are potential sagebrush steppe plant communities if alterations have not yet changed the vegetative reference plant community. Arid sagebrush steppes are vulnerable to threats that include wildfire, invasive exotic annual grasses, and continuous grazing by large herbivores such as cattle and wild horses.

The range of alternatives would affect potential habitats of documented Burns District terrestrial special status species (SSS), migratory birds, and locally important wildlife that occur in the HMA. For SSS this includes: Greater Sage-Grouse (GRSG) (*Centrocercus urophasianus*), Western bumblebee (*Bombus occidentalis*), golden eagle (*Aquila chrysaetos*), pygmy rabbit (*Brachylagus idahoensis*), pallid bat (*Antrozous pallidus*), Townsend's big-eared bat (*Corynorhinus townsendii*), and spotted bat (*Euderma maculatum*). Affected migratory birds include species such as Brewer's sparrow (*Spizella breweri*), vesper sparrow (*Pooecetes gramineus*), sage sparrow (*Artemisiospiza nevadensis*), mountain bluebird (*Sialia currucoides*), ferruginous hawk (*Buteo regalis*), and others that depend on habitats mentioned above to be in a functioning state. The Migratory Bird Treaty Act of 1918 identifies migratory birds, regardless of their status, as common or rare. Locally important species are pronghorn antelope (*Antilocapra Americana*) and mule deer (*Odocoileus hemionus*), with antelope being the majority big game animal across the HMA. This HMA is in one of ODFW's higher priority management units of highest quality for antelope.

This analysis is focused on GRSG habitat objectives (GRSG ARMPA 2015, table 2-2). All other sagebrush obligate species, such as pygmy rabbits, and the associated sagebrush steppe habitat would fall under the umbrella of analysis for each alternative. GRSG use the HMA yearlong and there are 18 pending leks within the HMA.

Warm Springs HMA is defined as both priority and general habitat management areas (PHMA and GHMA) for sage-grouse. Approximately 18 percent of the HMA is designated as PHMA and is part of the Dry Valley/Jack Mountain Priority Area of Conservation (PAC), 74 percent is GHMA, and the remaining 8 percent is designated as non-habitat. In

Oregon, approximately 11,775 km^2 of sage-grouse current range overlaps with BLM HMAs (11,991 km^2) (Beever and Aldridge 2011). Priority sage-grouse habitat are areas that have been identified as having the highest conservation value to maintain sustainable GRSG populations. These areas include breeding, late brood rearing, and winter concentration areas. General sage-grouse habitat is seasonally or year-round occupied habitat outside of priority habitat. The BLM has identified PHMA and GHMA in coordination with respective State wildlife agencies.

The Oregon GRSG ARMPA (2015) describes three general habitat types: breeding (lekking, nesting, and early brood rearing, March 1–June 30), brood rearing (summer and autumn, July 1–October 31), and winter (November 1–February 28), and the desired vegetative conditions/objectives for each (GRSG ARMPA, table 2-2). All three habitat types are present or there is the potential based on ecological sites that if restored could support a plant community with these habitat characteristics. Current GRSG use in the HMA is based on annual spring lek counts, 4-mile lek buffers, and in-the-field observations.

Most GRSG hens nest during late March to mid-June (late May to June nests are typically second attempts.). New growth of perennial herbaceous plants is minimal for early established nests and previous years' (residual) vegetation provides cover for those nests (Gregg et al 1994). The probability for nest success increases when there are available patches of sagebrush canopy cover greater than 15 percent and grass cover of both residual and current year's perennial grass growth is greater than 10 percent for arid sagebrush steppe. Furthermore, perennial grass and forb height have been measured to be critical for nest success and early brood rearing with $\geq$ 7 inches for arid sites (GRSG ARMPA, table 2-2). Herbaceous cover and height provide horizontal screening at the nest site, which obscures the nest from predators. Shrub and herbaceous cover is also critical during early brood rearing when GRSG chicks are small and vulnerable to predators. Brood-rearing habitat also occurs within the HMA, which includes the numerous playas in the HMA (>100 playas). During summer months GRSG hens would be predicted to move broods to these areas for foraging and water. These areas are also important to wild horses and burros because by mid to late summer developed waterholes in playas are some of the last places to have water. During winter months GRSG rely heavily on sagebrush leaves for food, especially winters with deep snow and cold weather that limits herbaceous forage availability.

Greater sage-grouse habitat objectives were determined by the 2015 GRSG ARMPA (table 2-2) and can be quantified by using Earth Sense Technology (EST), which uses remote sensing at multiple spatial and temporal scales. EST can be used to group GRSG habitat suitability into states as described in the State and Transition Models (STM) for GRSG

(Sant et al. 2014). This is a threat based model that identifies specific desirable or undesirable transitions in sagebrush habitat (Oregon Sage-SHARE 2017). The STMs are defined as State A: Sagebrush/Perennial Herbaceous State, State B: Perennial Herbaceous State, State C: Degraded Sagebrush State, and State D: Exotic Annual Grass State. State A is the most desirable habitat condition for sagebrush obligate species such as GRSG, whereas State D is the least desirable and considered unsuitable habitat.

Arid sagebrush STM data show 66 percent GRSG habitat is in State A, 4 percent State B, 15 percent State C, and 12 percent State D (table III-6 and Appendix N, State Transition Model and Sage-grouse Habitat Map.) Overall, lek populations have seen a drastic decline. In 2016, the Dry Valley/Jack Mountain PAC tripped a soft trigger by crossing a population threshold. This trigger is tripped when the population five-year running mean drops below the lower 95 percent confidence interval value. In 2017 this PAC tripped a hard trigger caused by a further decline in population. This trigger is tripped when the five-year running mean population drops below the lower standard deviation value.

Causal factors or plausible threats to habitat degradation and the drastic decline in population are wildfires, specifically the Miller Homestead Fire in 2012, invasive exotic annual grasses, prolonged drought limiting available water for brood rearing, and possibly yearlong grazing and competition for water resources by wild horses within the 4-mile lek buffer.

Table III-6. HMA STMs Sage-Grouse Habitat States Invasive Annual Grass Threat Model

Threat Model	Habitat State	Acres	Percent	Causal Factor Disturbance(D) or Succession(S)	State Trending Towards
Arid – Invasive annual grass	State A	316,916	66	S	State A
	State B	21,011	4	S	State A
	State C	72,629	15	D	State D
	State D	59,827	12	S & D	State D
Other Habitat Types	Juniper	5,436	1		
	Sparse Vegetation = Large Playas	10,964	2		

<u>Color Code</u>: Green = potential year round habitat; Yellow = seasonal habitat; Orange = seasonal habitat winter; Red = non-habitat

<u>Arid</u>: State A = sagebrush-perennial herbaceous; State B = perennial herbaceous; State C = degraded sagebrush; & State D = exotic annual grass

b. Environmental Consequences – Wildlife and Wildlife Habitat

Effects Common to All Alternatives

For the purposes of this analysis, the CEAA for wildlife includes the Jack Mountain/Dry Valley PAC and Warm Springs HMA boundaries to encompass possible movements/home range of GRSG that would be affected by management actions within the HMA. The total acreage of this HMA plus the CEAA is approximately 775,453 acres, with the HMA making up 64 percent of the CEAA. Primary threats to GRSG habitat are improper grazing management by wild horses or livestock, wildfire, exotic invasive annual grasses, and drought. The STM was also used to describe the current conditions of GRSG habitat across the CEAA (table III-7).

Suitable sagebrush habitat availability is becoming limited with only about 58 percent in State A. The other remaining states are either unsuitable habitat or transitioning from marginal to unsuitable.

Table III-7 CEAA STMs Sage-Grouse Habitat States Invasive Annual Grass Threat Model

Threat Model	Habitat State	Acres	Percent	Causal Factor Disturbance(D) or Succession(S)	State Trending Towards
Arid – Invasive annual grass	State A	445,324	58	S	State A
	State B	31,177	4	S	State A
	State C	195,593	25	D	State D
	State D	83,532	11	S & D	State D
Other Habitat Types	Juniper	6,322	< 1		
	Sparse Vegetation = Large Playas	10,964	1		

Color Code: Green = potential year round habitat; Yellow = seasonal habitat; Orange = seasonal habitat winter; Red = non-habitat

Arid: State A = sagebrush-perennial herbaceous; State B = perennial herbaceous; State C = degraded sagebrush; & State D = exotic annual grass

The RFFAs and current actions in the CEAA that may contribute to cumulative effects to GRSG and sagebrush habitat include management activities associated with livestock grazing, recreational activities, herbicide treatment of invasive weeds (in particular exotic annual grasses), wildland fire, seeding treatments, and other disturbed areas. Both completed and future treatments are to improve sagebrush habitat for species such as GRSG, migratory birds, and other sagebrush obligates. Past and RFFAs that have affected or may affect SSS or their habitat in the CEAA are found in table III-8.

Table III-8: Special Status Species – Sage-grouse & Locally Important Wildlife Past and RFFAs within the CEAA on BLM Managed Lands.

Action	Past Actions			Future Actions		
	Acres	Miles	Number	Acres	Miles	Number
Wildfires	254,331			Unknown		Unknown
Maintenance Level 1 Roads		1,122				
Maintenance Level 2 Roads		380				
Maintenance Level 3 Roads		265				
Maintenance Level 4 Roads		13				
Highways/Paved		7				
Fences		433			69	
Water Developments			455			66
Pipeline		31			3	
Juniper Treatments	745			0		
Crested or Rehabilitation Seedings	75,814			19,006		

Improper Grazing - Wild Horse and Burro Overpopulation Threat

The sagebrush plant communities that support GRSG are very complex spatially and successionally, as are the effects of livestock grazing within these communities, often making it difficult to form large-scale conclusions about the impacts of current livestock grazing practices on GRSG populations (Crawford et al. 2004). However, research suggests it is possible for grazing to be managed in a way that promotes forage quality for GRSG since grazing can set back succession, which may result in increased forb production (Vavra 2005). When grazing management is periodic and allows forbs to regrow or prevents utilization by livestock such as season of use, the number of forbs available to GRSG may increase (Vavra 2005). Anderson and McCuistion (2008) found grazing management, when upland birds are present, should be flexible but limited to a light to moderate use (30–50 percent utilization), such as using deferred or rest-rotation grazing disturbance during critical GRSG life stages such as nesting. Anderson and McCuistion also acknowledged the complexity of managing grazing within GRSG habitat and determined no one grazing system is best suited in all cases, but should be site specific, such as the allotment and pasture scale. While these references specifically refer to livestock, it is concluded that they apply to wild horses as well, since they are both large grazing animals. The differences between wild horse and livestock management are clear: wild horses are free roaming and develop congregation areas year round where impacts are mitigated by keeping populations within AML, whereas livestock are moved from pasture to pasture in a designed rotation each year to prevent congregation areas and impacts to key forage plant species.

Wild horse observations show high congregation areas are occurring within 4 miles of all pending leks (range of 15–120 horses per lek; average 49 horses per lek). Continuous yearlong impacts from horses to GRSG and species mentioned is a serious concern. Water resources are limited in this HMA, especially during drought years. Wild horse competition with native wildlife species for water sources is concerning especially in relation to recent GRSG lek trends in the HMA (drastic decline or loss) versus leks outside the HMA (stable). Research has found that horses, being the larger and more aggressive species, can dominate water sources and limit use by native wildlife species such as pronghorn antelope and elk by limiting their access to water, which reduced their time foraging and decreased overall species fitness (Perry et al. 2015; Gooch et al. 2017; Hall et al. 2016a; Hall et al. 2018). These findings are concerning and show that as wild horse numbers increase, native wildlife species richness and diversity decrease and are being displaced by the horses (Hall et al. 2016a; Beever and Brussard 2000). It is difficult to discern if horse congregation areas within the 4-mile lek buffers are the casual factor or one of several causal factors to the decline in GRSG populations in this HMA since unburned habitats appear to support adequate shrub and grass cover. However, recent research indicates there is a correlation of wild horses having negative effects on native wildlife species associated with limited water resources, which could be a link that influences the decline of wildlife populations (Davies et al. 2014). Furthermore, this HMA makes up 64 percent of potential GRSG habitat that would be negatively affected if wild horse and burro numbers are not consistently managed within AML.

In general, GRSG persist when grazing regimes are managed to provide residual vegetation and seasonal rest for key forage species. Grazing animals that are well distributed across the landscape and managed to reduce the scale and duration of congregation areas will not impact GRSG habitat; but poor grazing management would result in increased areas of heavy and even severe utilization that not only reduce available cover but, in time, can cause mortality of targeted forage plant species, such as blue bunch wheatgrass. When the resistance and resilience of an ecosystem/plant community is breached, degradation is eminent. In examples observed in arid sagebrush habitat, invasion by exotic annual grasses such as cheatgrass can be irreversible (Davies et al. 2009).

The Greater Sage-grouse Conservation Assessment and Strategy for Oregon, Hagen 2011 (hereafter referred to as the Strategy), and the GRSG ARMPA contain guidelines for wild horse and burro management as it relates to sagebrush habitat management (Strategy, p. 104 and GRSG ARMPA, p. 2-21).

The recommended conservation guidelines for wild horses and burros from the Strategy are incorporated into the recommended objectives for WHB from the GRSG ARMPA that are addressed in this EA, Chapter I, Purpose and Need for Action.

Wild Fire Threat

Wild fires have altered sagebrush steppe habitat across approximately 150,000 acres within the HMA and 254,331 acres across the CEAA. The Miller Homestead Fire in 2012 burned approximately 160,000 acres that directly impacted four pending leks. These leks are located on the southeast quarter of the HMA and eastern half of the CEAA, and were completely burned. This fire resulted in habitat alteration depicted as States D and B (table III-8). This area does not meet habitat objectives and is marginal at best for herbaceous cover, but much of the area has exotic invasive annuals throughout the landscape and is unsuitable for all general habitat types (GRSG ARMPA 2015). Furthermore, this fire impacted four other leks within 2 miles of the fire boundary. These eight leks were located in some of the most populated GRSG habitats in the HMA. There had already been observed population declines on many of these leks; however, following the fire GRSG have not been observed on these leks. Spring of 2018 flights were made in the attempt to locate new leks in the HMA, but none were found. Wildfires are an annual threat to sagebrush steppe habitats and on any given year habitat can be lost.

Exotic Invasive Annual Grass Threat

The dominant species found on disturbed areas in the HMA and CEAA is cheatgrass. Cheatgrass readily invades disturbed sites such as wildfires, rodent mounds, livestock watering areas, and continuous year-round congregation areas (Miller et al. 2013). Free-roaming horses have been shown to have the ability to spread cheatgrass successfully via their dung (King and Schoenecker 2018 *in press*). Arid sites are particularly vulnerable to these exotics, and once species such as cheatgrass become established it takes great economic investments to reduce this exotic plant and then to rehabilitate the treated site (Miller et al. 2013, Davies et al.

2011). Often rehabilitation in arid sites requires the use of non-native perennial grasses such as crested wheatgrass (Davies 2010; Davies et al. 2010; Davies et al. 2011).

Drought Threat

Data from three Remote Automated Weather Stations (RAWS) was gathered from Western Regional Climate Center (WRCC) 2018. The three RAWS sites are Foster Flat (5,000 ft.), which is in the CEAA; Rock Creek (5,640 ft.), which is located near the Hart Mountain Refuge headquarters about 18.5 miles southwest of the CEAA; and P Hill (4,860 ft.), which is located just outside the CEAA on the southeastern side and just above Frenchglen, Oregon. Data from 1994 to present was collected for each site since the Foster Flat RAWS site was established in 1994. The other two sites had data from prior years that was not used to have a comparable timeframe for each of the sites. Calculations were based on the water year, which starts October 1 and goes through September 30 the following calendar year.

Precipitation averages for the three sites for 1994–2016 (22 years) are Foster Flat – 8.40 inches, Rock Creek – 8.10 inches, and P Hill – 10.57 inches. At all three sites, the highest average monthly precipitation was in April, May, and June, with May being the highest of the three months. August is on average the driest month for each of the sites. Foster Flat and P Hill sites had 10 out of 22 years with precipitation less than 90 percent of average. The Rock Creek site had 9 of 22 years with precipitation less than 90 percent of average. All three sites had less than 90 percent of average precipitation in 5 out of 6 years between 1998–99 water year and 2003–04 water year. The Foster Flat site had very dry years – less than 70 percent of average in 2007–08, and 2011–12 through 2013–14 water years. The Rock Creek and P Hill sites had similar patterns of drought years with 2006–07, 2007–08, 2011–12, and 2013–14. The Rock Creek site had less than 70 percent of average in the last two drought water years while P Hill site had less than 70 percent in the first three of those drought years.

Precipitation data collected prior to 1994 exists as is presented in scientific papers produced from the Jack Creek telemetry study (Drut et al. 1994). Drut states that precipitation data for the Jack Creek telemetry study area on average was 25 cm (9.8 in.) with the two years of the study precipitation as 24 cm (9.4 in.) and 13 cm (5.1 in.). The Foster Flat RAWS station is within the Jack Creek study area and was probably the site for the rain gage before the RAWS station was installed. For Hart Mountain Refuge headquarters, the average precipitation was 29 cm (11.4 in.) with the two years precipitation data as 30 cm (11.8 in.) and 21 cm (8.3 in.). If this is the case, average precipitation for the Foster Flat area has decreased by 1.4 inches from the time period before 1990 to the time period after

1994. Drought occurrences have been one of the primary effects to water availability for wild horses and burros, livestock, and wildlife. In 2014, water was hauled in by the BLM WHB Program to save animals from dehydration. With no perennial streams or springs, drinking water availability depends on snow pack and heavy rains. The unpredictability of climate will continue to limit water resources and be a threat to wildlife as wild horse and burro numbers increase and outcompete native species.

No Action

The primary effect under this alternative would be the increase in horse and burro numbers, resulting in increased congregation area size and occurrence within the HMA. This would result in an exponential increase in herbaceous utilization of key grass and forb species in current congregation areas, and as the population grows, new congregation areas would be established where water sources are available. This would have direct detrimental impacts to the 18 leks in the HMA since increased use would occur within the 4-mile lek buffer, which is the most critical habitat use area for GRSG.

Cumulative effects by wild horses and burros would be continuous yearlong grazing and heavy to severe utilization levels that would reduce horizontal nesting cover for GRSG nests and chicks. These heavy use areas become more extensive as populations increase, which is occurring in this HMA with more than 700 horses and burros estimated to be in the HMA currently and with an estimated annual population growth rate of at least 20 percent. This is concerning for GRSG populations where critical nesting, early brood-rearing, and late brood-rearing habitat is being degraded at this level of disturbance. This alternative would expand heavy to severe use areas with an indefinite increase in wild horse and burro numbers. Findings from France and others (2008) suggest cattle initially concentrate grazing on plants between shrubs, and begin foraging on perennial grasses beneath shrubs as interspace plants are depleted. It can be assumed wild horse and burro use would mimic cattle use of perennial grasses, as the more accessible plants would be grazed first. France and others (2008) found cattle use of the under-canopy perennial grass was minimal until standing crop utilization reached about 40 percent, although this utilization level would likely vary depending on sagebrush density, sagebrush arrangement (e.g. patchy vs. uniform distribution), bunchgrass structure, forage production levels, and distance to water. As utilization levels increase across the HMA with increased wild horse numbers, it is expected that horizontal screening cover of GRSG nests would decline.

Increasing wild horse and burro numbers would also decrease the likelihood that individual perennial plants could receive a full growing season of rest from grazing use. When perennial plants lack adequate growing season rest periods (where they are able to complete a full reproductive cycle), the plant community composition, age class distribution, and productivity of healthy habitats is negatively affected, thus influencing the ability to achieve rangeland health standards 1 (watershed function – uplands) and 5 (native, SSS, migratory birds, and locally important species). Continued increases in wild horse and burro numbers could also lead to indirect effects on GRSG (e.g. grazing of nesting cover, reduction of available forbs for chicks and hens, disturbance of nests, etc.) during critical stages of the GRSG life cycle (nesting and brood rearing). Peak spatial overlap of free-roaming equids typically occurs during the breeding or late brood–rearing periods (Beever and Aldridge 2011). This overlap makes rangelands susceptible to changes in vegetation composition associated with free-roaming equid grazing and may contribute to decreases in grass height. Doherty et al. (2014) found that decreases in grass height were directly correlated with a decrease in sage-grouse nest survival. If wild horse and burro numbers continue to increase without any population controls the threat from invasive exotics would also increase.

This alternative would be expected to compound the cumulative effects to GRSG habitat across these populations' home range, and result in lower habitat quality for GRSG and contribute to the further decline of GRSG habitat and population numbers already occurring in the HMA.

The U.S. Fish and Wildlife Service (FWS) has a Candidate Conservation Agreement with Assurances (CCAA) for sage-grouse in place within Harney County. There are currently multiple landowners enrolled within the Dry Valley/Jack Mountain PAC (FWS 2018). No action to maintain wild horse and burro numbers within AML has potential to decrease rangeland conditions for livestock operators who may have enrolled private inholdings within the HMA and are permitted for grazing in allotments within this area (FWS 2018).

Proposed Action

In this alternative, GRSG would maintain resource availability as are currently present within the HMA. Habitat degradation is likely to continue across the analysis area, caused by the primary threats to sagebrush habitat (wildfires and exotic invasive annual grasses); however, maintaining good grazing practices and AML would be two less threats to habitat degradation. Horse and burro numbers within AML would reduce the occurrence of areas of critical GRSG habitat receiving continuous utilization at heavy intensities on a year-round basis.

Areas within the HMA near water sources would continue to be affected by concentrated grazing uses, but to a much lesser scale. When the HMA is at AML observations show horse numbers at water sources to be less than 20. However, with current horse numbers and predicted population growth, horse numbers would exceed 50 to 100 per water source. Wild horses not only compete with native wildlife for water, but also have intraspecific competition amongst themselves. Both interspecific and intraspecific competition for water would cause reduced fitness and eventually area abandonment or mortality for all fauna species. Portions of the HMA located away from existing waterholes and springs would have non-grazed areas, which would be expected to provide more suitable nesting sites for GRSG due to more residual grass cover. This would be expected to be highest in areas outside of the current use areas during drought years and lowest in these areas during wet years, since in those years it would be expected that all water sources would have water and attract grazers while dispersing their use. Residual grass cover provides horizontal screening at nest sites, in addition to screening from shrubs, which is believed to reduce predation (Gregg et al. 1994). Maintaining wild horse and burro numbers within AML would aid BLM land managers in their ability to provide quality GRSG habitat in the quantities needed for their survival and the maintenance of populations. This alternative would maintain achievement of rangeland health standard 5 for habitats that are still in State A with the goal of providing habitats that support healthy, productive, and diverse populations and communities of native plants and animals (including SSS and species of local importance) appropriate to soil, climate, and landform.

Cumulative effects as a result of wild horse and burro grazing within AML would not contribute to the decline of sagebrush habitat for GRSG or reduction of GRSG populations. Maintenance of the wild horse and burro population within AML has the potential to improve rangeland conditions for livestock operators who may have enrolled private inholdings within the HMA in the CCAA with FWS and are permitted for grazing in allotments within the area (FWS 2018).

6. Noxious Weeds

The following issue is addressed in this section.

- *How would the 10 year population management plan affect the spread and introduction of noxious weeds?*

a. Affected Environment – Noxious Weeds

Noxious weeds have been documented within the Warm Springs HMA (table III-9).

Table III-9: Noxious Weeds

Weed Species	Number of Sites	Acres
Cheatgrass	22	804.52
Whitetop	20	6.34
Bull Thistle	17	75.92
Canada Thistle	36	82.17
Russian Olive	6	10.04
Perennial Pepperweed	7	32.04
Dalmation Toadflax	1	0.01
Scotch Thistle	36	262.34
Totals	**145**	**1,273.38**

Most of the weed sites receive ongoing treatments and are monitored annually. Each site is entered in the National Invasive Species Information Management System (NISIMS), monitored, and treated where weeds still occur. Noxious weeds are treated using the most appropriate methods as analyzed in the district's current Integrated Invasive Plant Management EA (DOI-BLM-OR-B000-2011-0041-EA) or subsequent NEPA.

Cheatgrass, a very problematic weed to manage, is prevalent throughout the HMA. Cheatgrass contributes to fire spread and can become a component of an invasive annual grass – fire cycle vegetation state. Continued surveys and weed treatments are ongoing to reduce the opportunities of spread to further acres of the area.

Canada thistle occurs in many of the riparian areas. Improving desirable riparian vegetation, along with aggressive weed treatments, will reduce the dominance of this noxious weed and allow the riparian areas to recover and function properly. Scotch thistle has historically infested most of the disturbed areas (waterholes and animal congregation areas). It is still present, but has been reduced from aggressive monitoring and treatments. Unfortunately, the longevity of the seed lends itself to reappearing when conditions are right.

b. Environmental Consequences – Noxious Weeds

For the purpose of this analysis, the CEAA for noxious weeds encompasses the Warm Springs HMA. Past actions affecting noxious weeds in the Warm Springs HMA include large fires which have occurred throughout the HMA, including the Miller Homestead Fire that occurred in 2012. These past fires have been treated and continue to be monitored for noxious weeds. Present actions include ongoing ground treatments and surveys for noxious weeds. Future actions include treatments that are deemed necessary to control the spread of noxious weeds within the

HMA, including proposed aerial cheatgrass treatments in the 2017 Coyote Fire ESR.

No Action

The continued increase in wild horse and burro numbers above AML would lead to areas of higher concentrations causing more severe impacts to the vegetation due to overgrazing. This opens up more niches for noxious weeds to establish and spread. Areas of horse concentration and consequent heavy use typically are highest near water sources. This can lead to increases in Canada thistle and other riparian associated weeds such as perennial pepperweed and whitetop. Heavier use around already disturbed areas such as waterholes and congregation areas would lead to increased disturbance and consequent increases in noxious weed establishment. Heavy grazing during the active growth period of native perennial bunchgrasses in the spring gives a competitive advantage to cheatgrass. During this growth stage, the native perennials are more palatable and usually larger than the annual grasses. As a result, grazers eat the perennial bunchgrasses and leave the invasive annual grasses.

The no action alternative would adversely affect the current and future planned weed treatments within the HMA. Treatments would be less effective, with increased disturbed areas and a decrease in competitive vegetation allowing for the reintroduction of noxious weeds that were previously treated. Desirable grass species are competitive vegetation that the high concentration of horses and burros use as feed and trample. These plants are essential for the success of invasive annual grass treatments.

Proposed Action

By maintaining wild horse and burro populations within AML, vegetation in use areas within the HMA would receive less grazing pressure, allowing the desirable vegetation to be more vigorous and competitive and providing fewer opportunities for new weed infestations.

The general timing of helicopter gathers, after June 30, would minimize the opportunities for noxious weed introduction and spread due to dry conditions. Bait trapping may occur year round and could happen during wet, muddy conditions where the spread of noxious weed seed can increase. This concern is avoided by the trap placement, monitoring, and treatment project design features in place. Trap sites may be highly disturbed and would be monitored at least 2 years post gather. Any weeds found need to be treated in a timely manner using the most appropriate methods as analyzed in the district's current Integrated Invasive Plant Management EA (DOI-BLM-OR-B000-2011-0041-EA) or subsequent NEPA.

The proposed action would be beneficial for past, current, and future treatments. Decreasing and maintaining wild horse and burro populations to within AML would reduce disturbed areas and increase desirable competitive vegetation, which are essential factors for the success of weed treatments. The increase in desirable competitive vegetation is key to invasive annual grass treatments that were done in the past, are currently happening, and are planned for the future within the HMA.

7. Economic Values

The following issues are addressed in this section.

- *What are the anticipated costs associated with gathering wild horses and burros?*
- *What is the estimated cost per mare to conduct ovariectomy via colpotomy?*
- *What is the estimated cost per mare if PZP were used in the future?*
- *What are the anticipated costs associated with the study?*
- *What are the economic effects to other range users and the local economy?*

a. Affected Environment –Economic Values

As stated in an Office of Inspector General report (2010), "fiercely competing interests and highly charged differences of opinion currently exist between BLM and private individuals and organizations concerning the need for wild horse gathers, the methods used to gather, [methods for population growth suppression,] and whether horses are treated humanely by BLM and its contractors during and after gathers." Scoping comments received on this EA and previous NEPA documents proposing wild horse population management activities include a wide range of both support and opposition to various methods of population management.

Many of the individuals and groups showing concern derive benefit from the presence of wild horse and burro herds by actively participating in recreation to view the horses. A certain number of these individuals believe that any type of capturing and active management of wild horses is inhumane. Others value the existence of wild horses and burros without actually encountering them. This value represents a non-use or passive value commonly referred to as existence value. Existence values reflect the willingness to pay to simply know these resources exist. Conversely, a separate group of individuals may or may not support the existence of wild horses and burros on public land yet express concern about their current numbers and the adverse impacts on other resources and rangeland habitats. These "other resources" include, but are not limited to, the economic impacts that could result from reduced livestock grazing opportunities, impacts on recreational activities influenced by overpopulation of wild horses and burros, the impacts to wildlife and their habitat, and the resultant decline in hunting opportunities.

For the purposes of the Economic Values portion of this analysis, it is important to recognize the number of horses BLM manages across the United States in order to fully understand the effects analysis area and economic costs of the decision to be made. The national AML is 26,715 wild horses and burros. Currently there are an estimated 81,814 (as of March 1, 2018) wild horses and burros on the range with an additional 46,431 in BLM off-range facilities (as of February 2018). These numbers made it simple for the Office of Inspector General of the U.S. Department of the Interior (2016) to find that, "*BLM does not have a strategic plan in place to manage the wild horse and burro populations. The consistent on-range population growth drives the constant need for additional off-range holding and increased spending. If no plan is in place to control the on-range population source, the off-range holding and financial need will continue in this unsustainable pattern.*" In fiscal year (FY) 2017, $47.536 million (58 percent of the WHB Program budget) were allocated to off-range holding costs (WHB Quick Facts, BLM 2018).

The BLM placed 3,517 horses and burros into private care in 2017 through adoption, with another 582 sold to good homes. The estimated (20 percent) on range population growth in 2017 was approximately 14,535 animals. Therefore the amount adopted or sold is only 28 percent of the on range growth in 2017. The existing adoption and sale demand cannot keep up with the annual population growth on the range without effective population growth suppression methods.

The costs associated with certain activities included in the alternatives are described below. Not all activities are included in the list as it is extremely difficult to put a numerical value on such things as vegetative resource damage or decreased recreational opportunities, yet there are certainly economic values associated with their improvement, maintenance, or loss. The costs associated with holding, gathering, bait/water/horseback trapping, PZP fertility treatment, conducting an ovariectomy via colpotomy, radio collaring, and monitoring are listed below. A detailed budget for the study can be found in Appendix C, USGS Research Proposal (August 2018).

- Holding horses at the Oregon Wild Horse Corral Facility costs approximately $5 per day per horse. This includes the costs of hay, BLM staff, and equipment to operate the facility. Currently there are an average of 500 horses being held at the Oregon Facility. The cost per day to run the facility is approximately $2,500 or approximately $76,042 per month.

- Long-term holding (off-range pasture) costs average about $2.02 per day per horse.
- Unadopted animals receive an estimated 25 years of care, which adds up to approximately $46,000 per horse for the remainder of his or her life.
- Helicopter-drive gather operations are currently costing around $600 per horse captured.
- Bait, water, and horseback-drive trap gathers are currently averaging $1,100 per horse captured.
- Ovariectomy via colpotomy costs approximately $250–$300 per mare. The cost includes the expense of the antibiotic ($30 per dose), the sedation drugs, and the veterinarian's labor and travel.
- PZP-22 fertility treatment costs approximately $500 per mare treated. This includes the costs of one dose liquid primer (similar to ZonaStat-H used for remote darting) and one dose time-release pellets; plus holding and application costs – approximately $5 per day per horse.
- ZonaStat-H (used for remote darting) costs approximately $35 per dose.
- The cost of 44 radio collars, emergency drop-off mechanisms and replacements, 40 radio tags, 4 telemetry receivers, and miscellaneous supplies for tracking during this on-range study averages approximately $1,514 per individual animal tracked. This includes the cost of labor associated with collar placement and deployment. See Appendix C, USGS Research Proposal (August 2018) for the budget breakdown.
- Simultaneous double-observer method for aerial surveys of the wild horse and burro populations costs approximately $1,450 per hour with an average flight time for this HMA of 8 hours.

Livestock raising and associated feed production industries (growing hay) are major contributors to the Harney County economy. The highest individual agricultural sales revenue in the County was derived from cattle production, providing $51,065,000 in sales in Harney County in 2012, the most recent complete agriculture census in Oregon (USDA 2012).

The Federal government has a substantial economic and environmental presence in the area; nearly 73 percent of the land in Harney County is federally managed, with 59.2 percent managed by the BLM. Many ranching operations rely on public lands for livestock grazing during some portion of the year. Regulations and management decisions concerning these lands have the potential to affect the operation of ranches throughout the county.

b. Environmental Consequences –Economic Values

Given the complexity of issues surrounding free-ranging horses and burros, it is not surprising that Nimmo and Miller (2007) refer to them as having a pluralistic status: their bodies and behavior are sites of conflict (NRC Review 2013). Control methods for feral horses vary and must be weighed against logistic and economic constraints (Nimmo and Miller 2007). Some methods, while economically and ecologically viable, may be politically tenuous and vice versa (Nimmo and Miller 2007).

The CEAA for this EA is the extent of Harney County. Past actions such as wild horse gathers to maintain AML have influenced the existing environment within the CEAA. Present and foreseeable future actions including livestock grazing, weed treatments, recreation and hunting activities, range improvement/maintenance projects, and treatments associated with fire rehabilitation projects have the potential to improve rangeland health, thereby, maintaining or possibly increasing economic opportunities and fostering more desirable recreation opportunities (e.g., hiking, hunting, wild horse viewing, and photography) with associated economic benefits to the local economy. Under both alternatives, public lands in and around the HMA would continue to contribute to other public amenities such as open space and recreation. These amenities encourage tourism in the surrounding region and provide economic benefits to nearby communities. However, the specific contribution of this portion of public land to such amenities cannot be accurately estimated.

No Action

Under the no action alternative, the financial assistance agreement with USGS would be cancelled, and further research on spay feasibility and on-range behavioral outcomes would not be conducted in Warm Springs HMA.

Due to the lack of long-term and widely effective population control methods available to BLM, the no action alternative would continue the seemingly endless cycle of allowing horse populations to grow at a rapid rate, gathering excess horses, and sending removed horses to off-range holding facilities. In 2017, the total appropriations for the entire WH&B Program were $80.555 million; of which $47.536 million (58 percent) went to off-range holding costs (WHB Program Budget, BLM 2018).

A percentage of the public believes it is unacceptable for the BLM to fail to pursue additional methods of population growth suppression with some of the current populations of wild horses causing a decline in rangeland conditions, causing conflict with other land uses, and creating the growing costs to tax payers of maintaining horses in holding facilities. These concerns are evidenced by public comments observed during National Wild Horse Advisory Board meetings, during scoping for population control projects, and in various types of media. In choosing the no action alternative, BLM would be passing up an opportunity to pursue all the options made available in the WHB Act (§ 1333(b)(1)) to achieve AMLs.

The no action alternative would be disregarding the multiple-use mandate of FLMPA (1976) as the dramatic increase in the wild horse and burro population to approximately 5,000 animals at the end of the 10-year timeframe of this analysis would quite likely cause livestock permittees to find feed for their animals elsewhere. Competition for forage and limited water between wild horses, burros, livestock, and wildlife would become even more evident in the HMA. It is anticipated that within 10 years of no population management actions, portions of the range would be deteriorated and water sources would be unavailable, causing a situation where livestock active preference would be reduced accordingly to prevent further degradation to range conditions under authority of 43 CFR Ch. II, Subpart 4110.3, Changes in grazing preference (2017). Livestock permittees would have to find feed elsewhere, probably at the private land lease rate, which is significantly higher than the BLM lease rate, or sell their cattle. The BLM's rate per AUM in 2018 is $1.41 while private land lease rate is around $20.00 per AUM, or more, in Oregon. The existing grazing permits may become ineffective toward the sustainability of the livestock operations associated with this HMA if livestock are not turned out because the AUMs allocated to livestock are being utilized by wild horses and burros. The permits associated with the allotments in this HMA are held by small, family businesses. The no action alternative would have the potential of putting at least nine families out of business. A livestock operation in Harney County that is not sustainable economically would further burden the struggling economy of Harney County. In a county with a population of only about 7,300 residents and where agriculture, specifically livestock ranching, is the lead economic driver, losing four ranches and the families that depend on them is a substantial blow.

Aerial surveys to estimate wild horse and burro populations would continue, as funding allows, on a 2–3 year cycle. Within the 10-year timeframe of this analysis there would likely be at least three surveys at an estimated cost of $12,000 each.

Should a gather take place only after the 10-year timeframe of this plan, there would be a higher initial cost to BLM to capture and remove horses and burros as there would need to be more animals removed from the HMA and an expected higher number of animals sent to long-term holding facilities. The cost of the no action alternative would eventually become higher than any of the costs associated with the proposed action. The cost associated with rehabilitation of rangeland resources could total millions of dollars in noxious weed treatments, seeding treatments, and other rehabilitation efforts if the population of wild horses and burros continues to grow unchecked. Past research has elaborated that free-roaming horses can exert notable direct influences on sagebrush communities on structure and composition of vegetation and soils, as well as indirect influences on numerous animal groups whose abundance collectively may indicate the ecological integrity of such communities (Beever and Aldridge 2011). In a study to better understand feral horse effects on semi-arid rangeland ecosystems, Davies and others (2014) conclude that feral horse effects likely vary by intensity and frequency of use and that feral horses have some ecological impacts on semi-arid rangelands. Despite their conclusions that wild equids could cause ecosystem alterations that may increase the vulnerability of other species, Beever and Aldridge (2011) recognize free-roaming horses are undeniably charismatic, and have been used to symbolize power, freedom, wildness, and toughness. The BLM's mission is to sustain the health, diversity, and productivity of America's public lands for the use and enjoyment of present and future generations. Therefore, the benefits wild horses provide for various publics within society must be weighed against actual and potential ecological costs (Beever and Aldridge 2011).

Proposed Action

Under the proposed action, BLM would spay wild horse mares, and the USGS study of on-range behavioral outcomes would proceed, allowing for BLM to take steps toward a better understanding of the feasibility of spaying wild horse mares and the behavioral outcomes of returning them to the range. The analysis of this technique for application in any other HMA would be included in separate NEPA.

For a segment of the public, neither capturing and removing horses nor letting horses perish on the range as a result of limited resources is acceptable (Collins and Kasbohm 2016). Removing and holding horses has become a major expense to American taxpayers as described above in the discussion on holding costs. Methods to control population growth (e.g., fertility control or contraception) may reduce the need for intensive and controversial removals while ensuring that free-roaming horse populations do not become self-limited (NRC Review 2013, Collins and Kasbohm 2016). Controlling population growth would also provide significant cost savings to the American taxpayer (Bartholow 2007, de Seve and Griffin 2013, Collins and Kasbohm 2016) by affecting the ability to attain free-roaming horse management goals (NRC Review 2013).

If the initial gather in the proposed action occurred in fall 2018 it would cost approximately $511,200 to capture up to 100 percent of the estimated population of 694 adult horses and 158 foals. WinEquus population model trials predict an additional 2–3 helicopter gathers from 2022 (end of study gather to low AML) through 2028 under any management option run under the proposed action (See Appendix K, Warm Springs HMA WinEquus Simulations). The four management options run through WinEquus under the proposed action following the completion of the on-range study resulted in estimated numbers of animals removed from 2022–2028: *Option 1, Spay all females 2+ yrs. old* – zero animals removed; *Option 2, Spay all females 5+ yrs. old* – 76 removed; *Option 3, Removals Only* – 136 animals removed; and *Option 4, PZP all females 2+ yrs. old* – 110 animals removed (refer to Table III-2, WinEquus Population Modelling Comparison). If all of these animals went unadopted and were cared for by BLM in off-range corrals, the estimated cost for their care for the remainder of their lives would be: $0, $3.49 million, $6.25 million, and $5.06 million, respectively.

The cost of ovariectomizing 100 mares for the spay portion of this proposed action would be approximately $25,000. If the method is deemed feasible and a population growth suppression tool valuable for continued use, future costs of the procedure would likely remain the same per mare. Options 1 and 2 in Appendix K, Warm Springs HMA WinEquus Simulations, estimate that approximately 64 mares would be spayed following the completion of the on-range study, between 2022 and 2028, to maintain AML. These treated mares would never need handling again for any type of follow-up fertility control treatments, a cost savings to the American taxpayer as compared to repeat fertility control vaccine treatments and additional offspring being gathered and placed in holding facilities. Some would consider permanent sterilization more humane than short-duration fertility control vaccinations insofar as the mare would only require capture one time as compared to multiple captures or human interactions for fertility control inoculation. The BLM acknowledges that sterilized mares would likely be captured again if running in a band, but they would not receive the additional handling associated with application of fertility control and identification.

Duration of fertility inhibition has major practical importance and therefore longer-acting methods are preferable to minimize requirements for personnel and financial resources and to decrease the frequency of animal handling (NRC Review 2013). The lack of available fertility control vaccines with effectiveness longer than 1 year, along with a dwindling adoption demand, has led to a seemingly endless cycle of allowing horse populations to grow at a rapid rate, gathering excess horses, and sending removed horses to off-range holding facilities. Long-term holding of horses creates exorbitant costs to the American taxpayer, $47,536,000 in FY 2017 (WHB Program Budget, BLM 2018). The inability to remove excess horses from the range due to the lack of available holding space has led to a snowball effect of consequences to rangeland resources. Slowing the population growth rate using a relatively inexpensive single treatment method, reducing gather frequency, and maintaining or improving rangeland conditions within the HMA would have a positive economic influence for local land users and managers and the community.

Under this alternative, livestock permittees would be able to continue grazing their livestock at permitted levels in this HMA, further securing the possibility of economic benefits (e.g. income) for those permittees. This contributes to the local economies through taxes, the purchase of supplies, and other contributions to the local communities.

In addition, few horses would be removed from the range and sent to long-term holding facilities; therefore reducing the percentage of the WHB budget spent on care and maintenance of horses off range. That money could be allocated toward beneficial range improvement projects to improve habitat conditions for wild horses and burros and other species using the habitat within the HMA. Habitat quality for wildlife, livestock, and wild horses and burros would be maintained or improved with management of populations within AML. When horse and burro numbers are kept within AML, BLM is able to maintain healthy herds even during periods of extreme climatic fluctuation (e.g. drought or winters with heavy snow pack). This means horses and burros would have enough forage and water to maintain a healthy body condition throughout the year. Animals in good health are what range users and the public want to see, no matter if they are opposed to or proponents to gathers.

8. Soils and Biological Crusts

The following issue is addressed in this section.

- *What would be the effects of the alternatives on soils and biological crusts?*

Current discussion and analysis of potential effects to soils are tiered to the 1991 Three Rivers Proposed Resource Management Plan (PRMP)/Final Environmental Impact Statement (FEIS) and relevant information contained in the following sections is incorporated by reference: Three Rivers - Chapter 2, p. 2-15 (Soils Management) and Chapter 3, p. 3-3. For the purposes of this analysis, the CEAA for soils and biological crusts is at the HMA scale. Past activities that had the potential to affect soils and biological crusts within the HMA include the construction of range improvements, livestock grazing, wild horse and burro use, wildfire, ESR projects, noxious weed treatments, and recreation.

a. Affected Environment – Soils and Biological Crusts

Soils within the Warm Springs HMA are composed mainly of Raz-Brace-Anawalt soil association (greater than 95 percent). Additionally, trace amounts of the Fury-Skunkfarm-Housefield, Spangenburg-Enko-Catlow, Realis-Vergas-Lawen, Poujade-Ausmus-Swalesilver, Felcher-Skedaddle and Ninemile-Westbutte-Carryback associations are also present.

The Raz-Brace-Anawalt association includes cobbly or stony loams that evolved on hills and tablelands. These soils are shallow to moderately deep, generally well drained, and have a low potential for wind erosion and low to moderate potential for water erosion. These soils of cold plateaus and uplands support native vegetative communities dominated by Wyoming big sagebrush, low sagebrush, needlegrass species, and bluebunch wheatgrass.

The Fury-Skunkfarm-Housefield soil associations consists of very deep, somewhat poorly to very poorly drained soils that are formed in alluvium. They consist of fine silty to fine loamy soils which are found in lake basins, floodplains, floodplain steps, in depressions on stream terraces, and along drainage-ways. Slopes are generally 0–4 percent. Ponding in this soil series is frequent, with occasional flooding. Native vegetation associated with Fury-Skunkfarm-Housefield soils includes: hardstem bulrush (*Schoenoplectus acutus)*, sedges (*Carex* ssp), tufted hairgrass (*Deschampsia cespitosa)*, rushes (*Juncus* ssp), quackgrass (*Elymus repens)*, Sandberg bluegrass (*Poa secunda*), saltgrass (*Distichlis spicata)*, yarrow (*Achillea* ssp*)*, lupine (*Lupinus* ssp*)*, three-tip sagebrush (*Artemisia tripartite*), silver sagebrush (*Artemisia cana*), shrubby cinquefoil (*Dasiphora* ssp*)*, willow (*Salix* ssp), wildrye (*Leymus cinereus)*, creeping wildrye (*Leymus triticoides),* and wild rose (*Rosa woodsii*).

The Spangenburg-Enko-Catlow association consists of very deep, well-drained and moderately well-drained soils that formed in lacustrine sediments and deposits and alluvium derived from volcanic rocks and is generally found on lake terraces and alluvial fans and swales. Textures range from silty clay loam to very stony loams and can be found on slopes of 0–30 percent at elevations of 4,200 to 5,500 feet. There is a high potential for wind erosion. Dominant vegetation for this soil association includes: Basin big sagebrush (*Artemisia tridentata tridentata*), Wyoming big sagebrush (*Artemisia tridentata wyomingensis*), beardless wildrye (*Leymus triticoides)*, bluebunch wheatgrass (*Pseudoroegneria spicata)*, Thurber needlegrass (*Achnatherum thurberianum)*, basin wildrye (*Leymus cinereus)*, Indian ricegrass (*Achnatherum hymenoides,)* and needle-and-thread (*Hesperostipa comate).*

The Reallis-Vergas-Lawen soil association consists of very deep, well-drained soils that formed in gravelly or loamy alluvium and eolian materials derived from volcanic rocks and wind and water deposited sediments. This complex is found on alluvial fans, lake terraces, and in depressions on plateaus and has slopes of 0–8 percent. The association ranges from a loamy to sandy loam texture and is well drained with slow to moderate permeability resulting in a low to moderate risk of wind and water erosion. Native vegetation commonly found in this soil association is: basin big sagebrush (*Artemisia tridentata tridentata*), Wyoming big sagebrush (*Artemisia tridentata wyomingensis*), bluebunch wheatgrass (*Pseudoroegneria spicata)*, Thurber's needlegrass (*Achnatherum thurberianum)*, Sandberg's bluegrass (*Poa secunda*), needle-and-thread grass (*Hesperostipa comate)*, Indian ricegrass (*Achnatherum hymenoides)*, basin wildrye (*Leymus cinereus)*, and western needlegrass (*Achnatherum occidentale).*

The Poujade-Ausmus-Swalesilver soil association consists of very deep, somewhat poorly to moderately well-drained soils formed from lacustrine deposits derived from volcanic rocks and ash. The complex consists of very fine sandy loams to ashy silt loams and is generally found on low lake terraces and depressions on plateaus with slopes ranging from 0–5 percent. These soils are susceptible to frequent ponding from November through May, depending on the annual precipitation. Potential native vegetation associated with this complex is: basin big sagebrush (*Artemisia tridentata tridentata*), black greasewood (*Sarcobatus vermiculatus)*, basin wildrye (*Leymus cinereus)*, inland saltgrass (*Distichlis spicata)*, silver sagebrush (*Artemisia cana)*, Sandberg's bluegrass (*Poa secunda*), creeping wildrye (*Leymus triticoides)*, and mat muhly (*Muhlenbergia richardsonis).*

The Felcher-Skedaddle association consists of very shallow to moderately deep, well-drained soils which formed in colluvium and residuum derived from andesite, basalt, and volcanic rocks. Texture ranges from very stony clay loam to very cobbly loam. This association is found on mountains, hills, and plateaus with slopes of 4–75 percent. Erosion potential is moderate for water and slight for wind. Native vegetation associated with this soil association includes: bluebunch wheatgrass (*Pseudoroegneria spicata)*, Thurber's needlegrass (*Achnatherum thurberianum)*, Wyoming big sage (*Artemisia tridentata wyomingensis*), purple sage (*Salvia dorrii),* and squirreltail.

Ninemile-Westbutte-Carryback association is composed of well-drained, shallow and moderately deep soils that formed in residuum and colluvium and tend towards gravelly to very cobbly loams or stony to cobbly clays with areas of silty clay loam. They are found on plateaus, hills, and mountains that receive 12 to 16 inches of precipitation. Slopes range from 0–65 percent leading to a moderate hazard of water erosion. The associated native vegetation communities are: mountain big sagebrush (*Artemisia tridentata vaseyana*) and low sagebrush (*Artemisia arbuscula*) with needlegrass species (*Achnatherum* ssp*)* and Idaho fescue (*Festuca idahoensis*).

Identification of biological soil crusts (BSC) at the species level is often not practical for fieldwork. The use of some basic morphological groups simplifies the situation. Morphological groups are also useful because they are representative of the ecological function of the organisms (BLM Technical Reference (TR) 1730-2, p. 6). Using a classification scheme proposed in 1994, one can divide microbiota such as BSCs into three groups based on their physical location in relation to the soil: hypermorphic (above ground), perimorphic (at ground), and cryptomorphic (below ground).

The morphological groups are:
1. Cyanobacteria - Perimorphic/cryptomorphic
2. Algae - Perimorphic/cryptomorphic
3. Micro-fungi - Cryptomorphic/perimorphic
4. Short moss (under 10mm) - Hypermorphic
5. Tall moss (over 10mm) - Hypermorphic
6. Liverwort - Hypermorphic
7. Crustose lichen - Perimorphic
8. Gelatinous lichen - Perimorphic
9. Squamulose lichen - Perimorphic
10. Foliose lichen - Perimorphic
11. Fruticose lichen - Perimorphic

Morphological groups 4, 5, 7, 8, and 9 will likely be the dominant groups represented in the project area. Depending on precipitation amounts and microsites, groups 6, 10, and 11 may also be well represented where the site-specific conditions required for their growth exist. Morphological groups 1, 2, and 3 are difficult to discern in the field, as they require specialized tools that are not easily useable in the field. Soil surface micro topography and aggregate stability are important contributions from BSCs, as they increase the residence time of moisture and reduce erosional processes. The influence of BSCs on infiltration rates and hydraulic conductivity varies greatly; generally speaking, infiltration rates increase in pinnacled crusts and decrease in flat crust micro topography. The northern Great Basin has a rolling BSC micro topography, and the infiltration rates are probably intermediate compared to flat or pinnacled crustal systems. Factors influencing distribution of BSCs (TR-1730-2) include, but are not limited to, elevation, soils, and topography, percent rock cover, timing of precipitation, and disturbance. Possible disturbances that have occurred within the HMA include, but are not limited to, effects from livestock grazing, vehicles, wild horse and burro use, and human footprints. The specific contribution of these activities to current BSC condition and cover is not discernable from other historic disturbances.

b. Environmental Consequences – Soils and Biological Crusts

No Action

Under the no action alternative, gathers and removals would be deferred until horses and burros reach critical mass or an emergency dictates their removal. Like livestock, horses and burros tend to congregate in areas where resources, such as watering sites, are plentiful resulting in compacted soils and the permanent removal of complex BSCs. As horse and burros numbers increase, these areas will become larger, compacting more soil and removing more BSCs.

As an example, a 5-acre area of compaction would double in size in 4–5 years to 10 acres based on the 15–20 percent annual population growth. In another 4–5 years, that acreage would be 20 acres. If left unmanaged, this number would continue to grow. Once soils have been compacted, they would require active rehabilitation to return them to pre-existing conditions. By not gathering on a regular basis or providing some sort of population growth suppression, there would be more rehabilitation required within the HMA. Additionally, BSCs would permanently remain in the early successional stages, cyanobacteria, with continued compaction as per the BLM TR 1730-2, page 21. Additionally, horses and burros outside the HMA would not be gathered, and there would be similar impacts to soils and BSCs outside the HMA, including areas where BLM-designated special status plants could be located.

Past, present, and reasonably foreseeable future actions include, but are not limited to: wildfire, livestock grazing, hunting, recreational use, off and on-road vehicle use, and increases in horse and burro numbers. As populations grow, resulting in soil compaction and the loss of BSCs, the possibility of the establishment and increase in noxious and invasive weeds and annual grass could occur. Cumulative effects would be the reduction of intact rangeland, loss of wildlife and plant biodiversity, erosion, and an increase in time and funds spent to rehabilitate the affected areas. In addition to the loss of soils and BSCs, the increase in noxious and invasive weeds and annual grasses could increase the fire return interval in the area requiring emergency removal and causing loss of wildlife and habitat and loss of recreational usage due to potential closures after a fire.

Proposed Action

Gathering to the low AML and the application of fertility control treatments would prevent future impacts to soils and BSCs. Current soil compaction and early successional states of BSCs would remain in high use areas, such as watering sites; however, the areas would not increase in disturbance size and large scale (outside the current disturbance footprint) active rehabilitation would be avoided by not allowing these areas to increase exponentially.

Past, present, and reasonably foreseeable future actions include, but are not limited to, wildfire, livestock grazing, hunting, recreational use, off- and on-road vehicle use, and increases in horse and burro numbers. Cumulative effects of keeping horses and burros within the authorized AML, gathering on a regular basis, and taking action to reduce the annual population growth rate for horses would prevent additional loss of soils and BSCs by maintaining an acceptable level of disturbance instead of continually adding acres of compacted soils resulting in additional acres of lost BSCs. Additionally, current uses would be able to continue into the future without additional impacts stemming from wild horse and burro use.

9. Upland Vegetation

The following issue is addressed in this section.

- *What would be the effects of the alternatives on upland vegetation health?*

a. Affected Environment – Upland Vegetation

The dominant vegetation communities throughout the HMA are listed in the following table. These community types are based on the Natural Resource Conservation Service (NRCS) Ecological Site Descriptions found online (USDA-NRCS 2018). Approximately 75 percent of the HMA's ecological sites fit under the description cold plateaus and uplands in the 10–12 inch precipitation range with the dominant vegetation of big sagebrush and perennial grass species. Approximately 20 percent of the HMA falls under the cold plateaus and uplands in the 10–12 inch precipitation range with low sage and perennial grasses as the dominant vegetation. The remaining five percent is variable dependent on the soil type inclusion and does not affect vegetation communities within the HMA.

Table III-10: Warm Springs HMA Ecological Site Descriptions

Ecological Site ID	Site Name	Dominant Vegetation Community
023XY200OR	PONDED CLAY	/*Artemisia cana* ssp. *bolanderi/Poa nevadensis-Leymus triticoides*
023XY202OR	SWALE	/*Artemisia tridentata* ssp. *tridentata/Leymus cinereus-Pseudoroegneria spicata* ssp. *spicata*
023XY212OR	LOAMY	/*Artemisia tridentata* ssp. *wyomingensis/Achnatherum thurberianum-Pseudoroegneria spicata* ssp. *spicata*
023XY214OR	CLAYPAN	/*Artemisia arbuscula/Pseudoroegneria spicata*
023XY300OR	SOUTH SLOPES	/*Artemisia tridentata* ssp. *wyomingensis/Pseudoroegneria spicata* ssp. *spicata-Achnatherum thurberianum*
023XY308OR	NORTH SLOPES	/*Artemisia tridentata* ssp. *tridentata/Festuca idahoensis-Pseudoroegneria spicata* ssp. *spicata*
023XY316OR	DROUGHTY LOAM	/*Artemisia tridentata* ssp. *tridentata-Artemisia tridentata* ssp. *vaseyana/Festuca idahoensis-Achnatherum thurberianum*
023XY318OR	LOAMY	/*Artemisia tridentata* ssp. *vaseyana/Festuca idahoensis*
024XY001OR	SODIC FLAT	/*Sarcobatus vermiculatus/Distichlis spicata*
024XY003OR	SODIC BOTTOM	/*Sarcobatus vermiculatus/Leymus cinereus-Distichlis spicata*
024XY008OR	CLAYEY PLAYETTE	/*Artemisia tridentata* subsp. *wyomingensis/Elymus elymoides-Poa secunda*
024XY012OR	SANDY	/*Atriplex canescens-Artemisia tridentata* ssp. *tridentata/Hesperostipa comata-Achnatherum hymenoides*
024XY013OR	LOW SODIC TERRACE	/*Sarcobatus vermiculatus-Atriplex confertifolia/Elymus elymoides*
024XY015OR	DESERT LOAM	/*Atriplex confertifolia-Picrothamnus desertorum/Elymus elymoides*
024XY016OR	LOAMY	/*Artemisia tridentata* var. *wyomingensis/Achnatherum thurberianum-Pseudoroegneria spicata* ssp. *spicata*
024XY017OR	SHALLOW LOAM	/*Artemisia tridentata* subsp. *wyomingensis/Achnatherum thurberianum-Achnatherum hymenoides*
024XY113OR	SODIC FAN	/*Artemisia tridentata* subsp. *tridentata-Sarcobatus vermiculatus/Achnatherum hymenoides-Leymus cinereus*

Visual effects to vegetation from livestock grazing and wild horse and burro use are more obvious near congregation areas and not easily observed in other portions of the HMA. Bunchgrass vigor has the potential to decline in locally heavily-grazed areas due to utilization levels in excess of 50 percent over successive years. Conversely, bunchgrass vigor may also decline in lightly-grazed or non-grazed areas, due to plant decadence (growth may be limited by accumulation of old and dead tissue; Oesterheld and McNaughton 1991), especially where no fire or other event has occurred that would remove accumulations of dead material. Both conditions have been observed in the HMA.

Vigor of bunchgrass plants may be maintained, or even improved, by some disturbance that removes buildup of previous years' growth, either infrequently through large, sudden events such as wildfire (which may kill the plant), or more frequently with less intensity, as with grazing. The effect of defoliation to bunchgrasses, before and after wildfire, can be directly observed within the HMA. The effect on plant vigor from grazing is more subtle, and involves interplay between a plant's ability to reestablish photosynthetic activity and its ability to retain a competitive position in the plant community (Oesterheld and McNaughton 1991).

Monitoring of trend in condition of upland vegetation at representative sites in both East and West Warm Springs Allotments is static overall with some areas seeing a downward trend and some areas indicating an upward trend in key herbaceous species. Although assessments have found portions of the HMA are achieving upland rangeland health standards, local areas of declining bunchgrass health have been observed, generally in areas around the limited reliable water sources, and within some of the wild horse and livestock congregation areas.

For the purposes of this analysis, the CEAA for vegetation is at the HMA scale. Past activities that had the potential to affect vegetation within the HMA include the construction of range improvements, livestock grazing, wild horse and burro use, wildfire, ESR projects, noxious weed treatments, and recreation.

b. Environmental Consequences – Upland Vegetation

The CEAA for upland vegetation under the proposed action is the HMA boundary as this alternative aims to maintain the wild horse and burro population within AML within the HMA boundary. The no action alternative would have a CEAA for upland vegetation of an estimated 10 miles outside the HMA boundary in all directions. This area was chosen because the AML is currently exceeded and wild horses are residing outside the HMA boundary in two known locations. No action to maintain population within AML often causes animals to drift outside of an HMA as resources inside the HMA become limited. Past, present, and reasonably foreseeable future actions affecting upland vegetation include, but are not limited to: wildfire, livestock grazing, hunting, recreational use, off- and on-road vehicle use, and increases in horse and burro numbers.

No Action

Under the no action alternative, no removals of wild horses or burros would occur until the amount becomes critical or an emergency dictates their removal. Nor would actions be taken to slow the population growth rate. The increased number of horses and burros on the range would increase the level of utilization and decrease the amount of available forage. Consistent heavy utilization in wild horse and burro use areas could lead to rangeland health standards not being achieved in the future. No action to maintain the wild horse and burro population within AML would be expected to reduce vigor and resiliency of perennial grasses in the HMA as utilization levels increase, therefore increasing the potential for annual grass invasion. Invasive annual grasses can lead to an invasive annual grass fire cycle successional state. This completely transforms the characteristics of the plant community and reduces or eliminates most desirable ecological values. Annual grass communities lack the plant community structure, root occupancy of the soil profile, and ability to provide the amount and distribution of plant litter that native communities provide. Annual grass communities, as compared to the potential and capability of native perennial communities, lack the ability to protect the soil surface from raindrop impact; to provide detention of overland flow; to provide maintenance of infiltration and permeability; and to protect the soil surface from erosion (Rangeland Health Standards 1997). Under this alternative, increases in annual grasses would occur, and the condition of the range would deteriorate. These effects would influence future livestock, wild horse and burro, and wildlife carrying capacity if continued. The loss of native vegetation would lead to soil loss due to exposure to wind and water erosion and would expose previously uninfested areas to noxious and invasive weeds. Increases in erosion directly influence the potential to achieve rangeland health standards 1 - Uplands and 3 - Ecological Processes.

Cumulative effects under the no action alternative would include the reduction of intact rangeland, loss of wildlife and plant biodiversity, erosion, and an increase in time and funds spent to rehabilitate the affected areas. In addition to replacement of native perennial vegetation with invasive annual grasses, the increase in noxious and invasive weeds and annual grasses could increase the fire return interval in the area requiring emergency removal and causing loss of wildlife and habitat, and loss of recreational usage due to potential closures after a fire. Consequently, the potential for the success of any rangeland improvement project would decrease.

Proposed Action

Under the proposed action, wild horse and burro numbers would be reduced to the low AML with an initial gather in fall 2018 and periodic gathers as high AML is exceeded within the 10-year timeframe of analysis. Reducing wild horse and burro numbers to AML would reduce or minimize the potential for heavy annual utilization levels in their use areas.

Gathering the horses and burros in this HMA and removing excess animals may aid in breaking up the use patterns in the heavier use sites. A change in the intensity of use and timing of use (with fewer animals) would lessen the effects to upland vegetation by providing time to complete a full reproductive cycle and consequently increasing plant vigor. Managing duration, intensity, and timing of use on vegetation largely influences maintaining a thriving natural ecological balance and maintaining rangeland health standards, specifically Standard 1 - Watershed Function, Uplands. This standard is achieved when upland soils exhibit infiltration and permeability rates, moisture storage, and stability appropriate to soil, climate, and landform. Potential indicators of achieving this standard include amount and distribution of plant cover and bare ground and plant composition and community structure. Potential indicators of the condition of rangeland health are influenced by the timing and amount of utilization pressure received over a period of years.

Applying wild horse population growth suppression techniques to slow down the reproductive rate would reduce the grazing pressure over a longer period of time, disperse wild horse use areas, and give native vegetation a greater stronghold. Healthy, diverse, and productive plant communities promote improved resiliency, reducing the threat of noxious weed establishment and spread. Maintaining wild horses and burros within AML secures an adequate carrying capacity and prevents conditions where competition and limitations are placed on livestock, wild horses, burros, and wildlife.

Direct effects of trapping include hoof action and vehicle use that cause upland vegetation to become trampled and/or uprooted around trap sites. To minimize these effects, trap sites would be located in areas previously used or which have been disturbed in the past. The trap sites would be approximately 0.5 acre in size, which would have a minimal effect. Keeping gather sites in previously used areas or areas previously disturbed would minimize or reduce potential new effects to upland vegetation since vegetation would already have been impacted.

Cumulative effects under the proposed action alternative would include the maintenance of intact rangeland, maintenance of wildlife and plant biodiversity, and general soil stability. Native perennial vegetation would be maintained with limited invasive annual grasses. Limiting the amount of noxious weeds and invasive annual grasses could maintain a normal fire return interval in the area. Reducing the chance of wildfire reduces the need for emergency removals due to fire and reduces the loss of wildlife and habitat and the loss of recreational usage due to potential closures after a fire. Consequently, the potential for the success of any rangeland improvement project would increase.

10. Lands with Wilderness Characteristics

The following issue is addressed in this section.

- *What would be the effects of the alternatives on lands with wilderness characteristics?*

a. Affected Environment – Lands with Wilderness Characteristics

The West Warm Springs HMA contains eleven units of land with wilderness characteristics. In order for an area to qualify as lands with wilderness characteristics, it must possess sufficient size, naturalness, and outstanding opportunities for either solitude or primitive and unconfined recreation. Wilderness characteristics are defined in the following manner:

Size: Roadless areas with over 5,000 acres of contiguous BLM lands.

Naturalness: The area must appear to have been affected primarily by the forces of nature, and any work of human beings must be substantially unnoticeable.

Solitude or Primitive and Unconfined Recreation: The Wilderness Act states that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." Wilderness provides opportunities for people to experience: natural sights and sounds; remote, isolated, unfrequented, or secluded places; and freedom, risk, and the physical and emotional challenges of self-discovery and self-reliance. Any one wilderness does not have to provide all these opportunities, nor is it necessary that they be present on every acre of a given wilderness.

Some of the unit boundaries extend beyond the HMA boundaries. The area of analysis is the eleven wilderness character units comprising 371,103 acres of public land. The temporal timeframe is the ten-year plan identified in the EA.

Inventories of public lands for wilderness character are a snapshot in time. Lands with wilderness characteristics were identified in the BLM Wilderness Inventory for Oregon and Washington November 1980 Final Intensive Wilderness Inventory Decisions. The inventory decisions are not land use designations. They are inventories of acreages that contain wilderness characteristics.

Section 201 of FLPMA requires the BLM to maintain on a continuing basis an inventory of all public lands and their resources and other values, which includes wilderness characteristics. It also provides that the preparation and maintenance of the inventory shall not, of itself, change or prevent change of the management or use of public lands. Regardless of past inventory, the BLM must maintain and update as necessary, its inventory of wilderness resources on public lands. In some circumstances, conditions relating to wilderness characteristics may have changed over time, and an area that was once determined to lack wilderness characteristics may now possess them.

During the 2017 field season, a route analysis was conducted in the West Warm Springs Allotment on historic units named in the 1980 Final Intensive Wilderness Inventory Decisions. Some wilderness boundary roads described in the 1980 inventory were found to no longer meet the criteria for a boundary. As a result, some units were combined into larger units.

Once route analysis was completed, determinations of wilderness character were made. Criteria used to determine wilderness character were taken from BLM Manual 6310 "Conducting Wilderness Characteristics Inventory on BLM Lands." Using the criteria from BLM Manual 6310, it was found that of the eleven units evaluated for wilderness character, ten units had wilderness characteristics, and one unit did not.

Wilderness Character Inventory Units within area of analysis:

Units *with* Wilderness Characteristics
Lake Unit – ORB05-03209 – 68,127 acres. Extends onto Lakeview District.
Buzzard Lake Unit – ORB05-03208 – 22,238 acres. Extends onto Lakeview District.
Buckaroo Flats Unit – ORB05-03207 – 11,403 acres.
Yellow Spot Unit – ORB05-03206 – 25,063 acres.
Silver Lake Unit – ORB05-03205 – 7,660 acres.
Big Stick Unit – ORB05-03204 – 25,633 acres.
Wilson Lake Unit – ORB05-03212 – 30,367 acres.
Rimrock Lake Unit – ORB05-03203 – 19,118 acres.
Wilson Butte Unit – ORB05-03202 – 10,004 acres.
Deadhorse Unit – ORB05-03201 – 145,985 acres. Extends onto Lakeview District.

Units *without* Wilderness Characteristics
Weed Lake Unit – ORB05-03210 – 5,505 acres.

With the exception of the Weed Lake Unit, units in West Warm Springs Allotment were found to be in a natural condition. Primary uses in all units are livestock grazing and recreational activities. The unnatural features found in the units were typical livestock grazing installations such as waterholes, reservoirs, fences, wells, troughs, pipelines, and seedings. These installations were found along the boundary roads or on cherry-stemmed routes that ended where the features are located. Some features were found in the middle of the units, such as waterholes that captured drainage water. These features were created and left to do their job with little or no maintenance. Features such as seedings were considered unnatural due to the drill rows left behind by the seeding implement, however the size of the seedings is small (except the Weed Lake unit) compared to the size of the units they are in.

All ten units found to be in a natural condition were also found to have outstanding opportunities for solitude. Contour maps showing elevations were used to describe the variation in topography. Monitoring data provided dominate ground cover in the units. Topography and vegetation provide screening opportunities in each of the ten units.

All ten units were also found to have outstanding opportunities for a primitive type of unconfined recreation. All the units have a diverse assortment of opportunities available. Typical activities associated with primitive unconfined types of recreation are horseback riding, hunting, dispersed camping, hiking off trail, viewing wildlife, exploring, bush crafting, viewing the night sky, and many others.

All the units were found to have supplemental values as well. The units are rich in archeological history, they are on a migratory bird flyway, contain deer and antelope winter range, sage-grouse habitat, pygmy rabbit habitat, rare plants, and are in a wild horse and burro HMA.

b. Environmental Consequences – Lands with Wilderness Characteristics

Reasonably foreseeable future actions that may contribute to the cumulative effects analysis include livestock grazing management, wildfires, wild horse and burro gathers, and BLM road maintenance activities. Potential effects would include changes to the size of units having wilderness character due to road maintenance activities possibly creating new boundaries. Other effects would be changes to naturalness through actions that affect ecological conditions such as drill seeding or installations that are substantially noticeable. Additional wild horse and burro gathers contribute to naturalness by controlling the number of animals on the range, which effects the quantity of surface disturbances around places where animals gather for water or forage.

No Action

Taking no action to maintain wild horse and burro population levels over the 10-year timeframe of this analysis would have the following effects on wilderness characteristics (size, naturalness, and solitude).

Size: No maintenance activities associated with gather vehicle access on roads and routes in the area of analysis would take place under this alternative. There would be no effect to size of the units.

Naturalness: There would be no bait trap installations or helicopter gathers in this alternative. Wild horse and burro herd size would increase over time. An increase in herd size would increase surface disturbances near water sources and foraging areas. After ten years of not gathering and removing horses or burros, their population is estimated to increase to approximately 5,000 animals. That would be a seven-fold increase over the current population levels. Effects to naturalness, measured in acres of surface disturbance, would become larger each year.

Outstanding Opportunities for Solitude or a Primitive Type of Unconfined Recreation: Outstanding opportunities would not be affected in this alternative. There would be no gather, no helicopters, and no bait traps to create disturbances.

Proposed Action

Actions associated with population management in the proposed action would have the following effects on wilderness characteristics (size, naturalness, and solitude).

Size: Bait traps would be located on or near routes that are easily accessed by vehicles towing horse and equipment trailers. Site specific route maintenance activities are not anticipated to affect wilderness character unit boundaries. Route maintenance on existing wilderness character unit boundary roads would have no effect to the size of the units and therefore no effect to wilderness character.

Naturalness: Bait trap stations are temporary installations set up in areas where there are existing surface disturbances (e.g. near sources of water or existing roads). The stations are temporary and substantially unnoticeable in appearance. Naturalness is not affected.

Outstanding Opportunities for Solitude or a Primitive Type of Unconfined Recreation: Helicopter use during the gather creates temporary effects to outstanding opportunities. During the gather the sights and sound of the helicopter as it herds wild horses would disturb visitors seeking solitude.

Recreational activities such as camping, hiking, wildlife viewing, and others would be temporarily affected during the gather. Contractors on horseback or in helicopters, visitors who have come to view the gather, media personnel, and others would occupy the area near where the horses are herded into a corral. This group of people and the vehicles that transported them to the site would disturb visitors who are in the area to recreate. The disturbance to outstanding opportunities is temporary and would last only for the time of the gather.

IV. CONSULTATION AND COORDINATION

A. Tribes, Individuals, Organizations, or Agencies Consulted

Table IV-1 Tribes, Individuals, Organizations, or Agencies Consulted		
Name	**Purpose & Authorities for Consultation or Coordination**	**Findings & Conclusions**
Burns Paiute Tribe	Consultation as required by the American Indian Religious Freedom Act of 1978 (42 U.S.C. 1531) and the National Historic Preservation Act (NHPA) (Pub. L. 89-665; 54 U.S.C. 300101, et seq.).	A letter was mailed to the Burns Paiute Tribal Council Chairman on May 21, 2018, requesting government-to-government consultation. The Tribe has not responded identifying any concerns. Lack of response is interpreted by BLM to indicate that the Tribe has no concerns relative to the proposed action.
Fort McDermitt Paiute and Shoshone Tribes	Consultation as required by the American Indian Religious Freedom Act of 1978 (42 U.S.C. 1531) and NHPA (Pub. L. 89-665; 54 U.S.C. 300101, et seq.).	A letter was mailed to the Burns Paiute Tribal Council Chairman on May 21, 2018, requesting government-to-government consultation. The Tribe has not responded identifying any concerns. Lack of response is interpreted by BLM to indicate that the Tribe has no concerns relative to the proposed action.
Livestock Grazing Permittees	An effort to coordinate with permitted land users directly affected by the management of wild horse and burro populations with Warm Springs HMA.	A scoping letter was mailed to all livestock grazing permittees within the HMA on May 21, 2018.
U.S. Fish and Wildlife Service	No official consultation is required for this project, however a letter was written by BLM to announce the project in the Warm Springs HMA which is approximately 36% PHMA and is in the Dry Valley/Jack Mountain PAC for GRSG.	The USFWS support maintaining the wild horse and burro population within AML to improve rangeland conditions and prevent further adverse impacts on GRSG and their habitat. They support the use of fertility control vaccines, but suggest finding a less expensive, long-term solution to equid population growth (FWS 2018).

B. Summary of Public Participation

On February 22, 2018, a BLM IDT met to discuss alternatives to the proposed action and issues to analyze in detail in this EA. On May 21, 2018, the BLM mailed a scoping letter to 127 interested individuals, groups, and agencies regarding the proposed study and population management plan. The scoping letter was also posted to BLM's ePlanning website. Letters mailed to Burns District BLM and emails sent to blm_or_spaystudy_warmsprhma@blm.gov were received from 2,044 individuals, groups, and agencies during the scoping period. Comments received following the May 21, 2018, scoping period were incorporated into a draft EA that was released for a 30-day public comment period on June 29, 2018. The announcement of the availability of the EA for public comment was also emailed to 49 interested parties. In addition, the EA and unsigned FONSI were posted to BLM's ePlanning website, and a notice was posted in the Burns Times-Herald newspaper for one week, beginning on July 4, 2018. A total of 8,326 comment emails, letters, and faxes were received during the 30-day public comment period. The comments and issues identified in public letters and emails, along with the issues identified during the IDT meetings and through contact with other agencies, have been addressed by the BLM IDT. The Issue Identification section of chapter I identifies those issues analyzed in detail in chapter III. Chapter I also identifies issues considered but eliminated from further analysis.

C. List of Preparers

Interdisciplinary Team

Chad Rott, Supervisory Fuels Management Specialist (Air Quality and Fire Management)
Scott Thomas, District Archaeologist (American Indian Traditional Practices, Areas of Critical Environmental Concern, Cultural Resources, and Paleontological Resources)
Lindsay Davies, Planning and Environmental Coordinator (Environmental Justice)
Breanna O'Connor, Riparian Specialist (Fisheries, SSS Fish, Threatened and Endangered (T&E) Fish, Water Quality, and Wetland and Riparian Zones)
Lisa Grant, District Wild Horse and Burro Specialist (Project Lead: Wild Horses and Burros and Economic Values)
Tim Newkirk, Forester (Forestry and Woodlands)
Kyle Jackson, Rangeland Management Specialist (Grazing Management and Rangelands, Upland Vegetation)
Marsha Reponen, Resource Protection Specialist (Hazardous Materials or Solid Waste)
Travis Miller, Wildlife Biologist (Migratory Birds, SSS Wildlife, T&E Wildlife, and Wildlife or Locally Important Species and Habitat).
Ty Cronin, Environmental Protection Specialist (Noxious Weeds)
Tara McLain, Realty Specialist (Realty and Lands)
Dory Seeley, Outdoor Recreation Planner
Caryn Burri, Natural Resource Specialist (Soils and Biological Crusts, SSS Plants, T&E Plants)
Connie Pettyjohn, Management and Program Analyst (Transportation and Roads)

Thomas Wilcox, Outdoor Recreation Planner (Wild and Scenic Rivers, Wilderness Study Areas, and Lands with Wilderness Characteristics)

Advisory Team

Robert Sharp, Supervisory Wild Horse Management Specialist
Paul Griffin, Wild Horse and Burro Program Research Coordinator
Stacy Fenton, Geographic Information Specialist
Lindsay Davies, Planning and Environmental Coordinator
Jeffrey Rose, District Manager, Burns District BLM
Brenda Lincoln-Wojtanik, Program Analyst, Oregon State Office
Robert Hopper, State Wild Horse and Burro Specialist and Rangeland Management Specialist, Oregon State Office

V. REFERENCES

Altmann, J. 1974. Observational study of behavior: sampling methods. Behaviour 49:227–267.

Anderson, A., and K.C. McCuistion. 2008. Evaluating Strategies for Ranching in the 21st Century: Successfully Managing Rangeland for Wildlife and Livestock. Rangelands, Vol. 30, No. 2, pp. 8–14.

Asa, C.S., D.A. Goldfoot, O.J. Ginther. 1979. Sociosexual behavior and the ovulatory cycle of ponies (Equus caballus) observed in harem groups. Horm. Behav. 13:49–65.

Asa, C.S., D.A. Goldfoot, M.C. Garcia, and O.J. Ginther. 1980. Sexual behavior in ovariectomized and seasonally anovulatory pony mares (Equus caballus). Horm. Behav. 14:46–54.

Asa, C.S., D.A. Goldfoot, M.C. Garcia, and O.J. Ginther. 1984. The effect of estradiol and progesterone on the sexual behavior of ovariectomized mares. *Physiol. Behav.* 33:681–686.

Asdell, S.A. 1964. *Patterns of mammalian reproduction* (2nd edition). Pp. 530–532. Cornell University Press.

Atwood, T.C., T.L. Fry, and B.R. Leland. 2011. Partitioning of Anthropogenic Watering Sites by Desert Carnivores. Journal of Wildlife Management 75(7):1609–1615.

Baldock, P.A.J., H.A. Morris, A.G. Need, R.J. Moore, and T.C. Durbridge. 1998. Variation in the short-term changes in bone cell activity in three regions of the distal femur immediately following ovariectomy. *J. Bone Miner. Res.* 13:1451–1457.

Ball, B.A. 2011. Embryonic Loss. In *Equine Reproduction*, A.O. McKinnon, E.E. Squires, W.E. Vaala, and D.D. Varner (Eds.), Blackwell Publishing, pp. 2327–2338.

Bartholow, J. 2007. Economic benefit of fertility control in wild horse populations. The Journal of Wildlife Management 71:2811–2819.

Beckett, T., A. Tchernof, and M.J. Toth. 2002. Effect of ovariectomy and estradiol replacement on skeletal muscle enzyme activity in female rats. *Metabolism* 51:1397–1401.

Beever, E. 2003. Management implications of the ecology of free-roaming horses in semi-arid ecosystems of the western United States. Wildlife Society Bulletin 31(3):887–895.

Beever, E.A. and P.F. Brussard. 2000. Examining ecological consequences of feral horse grazing using exclosures. Western North American Naturalist 60(3):236–254.

Beever, E.A. and P.F. Brussard. 2004. Community- and landscape-level responses of reptiles and small mammals to feral-horse grazing in the Great Basin. Journal of Arid Environments 59:271–297.

Beever, E.A., and J.E. Herrick. 2006. Effects of feral horses in Great Basin landscapes on soil and ants—direct and indirect mechanisms. Journal of Arid Environments 66:96–112.

Beever, E.A., R.J. Tausch, and W.E. Thogmartin. 2008. Multi-scale responses of vegetation to the removal of horse grazing from the Great Basin (USA) mountain ranges. Plant Ecology 196:163–184.

Beever, E.A. and C.L. Aldridge. 2011. Influences of free-roaming equids on sagebrush ecosystems, with a focus on Greater Sage-Grouse. Pp. 273–290 in S.T. Knick and J.W. Connelly (editors). *Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology* (vol. 38), University of California Press, Berkeley, CA.

Belsito, K.R., B.M. Vester, T. Keel, T.K. Graves, and K.S. Swanson. 2009. Impact of ovariohysterectomy and food intake on body composition, physical activity, and adipose gene expression in cats. J. Anim. Sci. 87:594–602.

Berger, J. 1977. Organizational Systems and Dominance of Feral Horses in the Grand Canyon. Behavioral Ecology and Sociobiology, Vol. 2, No. 2, pp. 131–146.

Berger, J. 1985. Interspecific interactions and dominance among wild Great Basin ungulates. J. Mammal. 66:571–573.

Berger, J. 1986. *Wild Horses of the Great Basin, Social Competition and Population Size*. Wildlife Behavior and Ecology Series. The University of Chicago Press.

Bertin, F.R., K.S. Pader, T.B. Lescun, and J.E. Sojka-Kritchevsky. 2013. Short-term effect of ovariectomy on measures of insulin sensitivity and response to dexamethasone administration in horses. Am. J. Vet. Res. 74:1506–1513.

Bourjade, M., L. Tatin, S.R.B. King, and C. Feh. 2009. Early reproductive success, preceding bachelor ranks and their behavioural correlates in young Prezewalski's stallions. Ethology Ecology and Evolution 21:1–14.

Bowen, Z. 2015. Assessment of spay techniques for mare in field conditions. Letter from US Geological Survey to D. Bolstad, BLM. November 24, 2015.

Camara, C. *et al.* 2014. Effect of ovariectomy on serum adiponectin levels and visceral fat in rats. *J. Huazhong Univ. Sci. Technol. Medical Sci.* 34:825–829.

Chambers, J.C.; J.L. Beck, J.B. Bradford, J. Bybee, S. Campbell, J. Carlson, T.J. Christiansen, K.J. Clause, G. Collins, M.R. Crist, J.B. Dinkins, K.E. Doherty, F. Edwards, S. Espinosa, K.A. Griffin, P. Griffin, J.R. Haas, S.E. Hanser, D.W. Havlina, K.F. Henke, J.D. Hennig, L.A. Joyce, F.M. Kilkenny, S.M. Kulpa, L.L. Kurth, J.D. Maestas, M. Manning, K.E. Mayer, B.A. Mealor, C. McCarthy, M. Pellant, M.A. Perea, D.A. Pyke, L.A. Wiechman, A. Wuenschel. 2017. Science Framework for Conservation and Restoration of the Sagebrush Biome: Linking the Department of the Interior Secretarial Order 3336 to Long-Term Strategic Conservation Actions. Part 1. Science Basis and Applications. RMRS-GTR-360. USGS, CO: U.S Department of Agriculture, Forest Service, Rocky Mountain Research Station. https://www.treesearch.fs.fed.us/pubs/53983.

Code of Federal Regulations. 2017. 43 CFR Ch. II, Subchapter D – Range Management (4000), Part 4100 – Grazing Administration.

Code of Federal Regulations. 2017. 43 CFR Ch. II, Subchapter D - Range Management (4000), Part 4700 – Protection, Management, and Control of Wild Free-Roaming Horses and Burros.

Coit V.A., F.J. Dowell, and N.P. Evans. 2009. Neutering affects mRNA expression levels for the LH-and GnRH-receptors in the canine urinary bladder. Theriogenology 71:239–247.

Collins, G.H. and J.W. Kasbohm. 2016. Population Dynamics and Fertility Control of Feral Horses. The Journal of Wildlife Management 81(2):289–296.

Collins, G.H., S.L. Petersen, C.A. Carr, and L. Pielstick. 2014. Testing VHF/GPS collar design and safety in the study of free-roaming horses. PLoS ONE 9:e103189.

Colwell, R.K., and D.J. Futuyma. 1971. On the Measurement of Niche Breadth and Overlap. Ecology, Vol. 52, No. 4, pp. 567–576.

Cooper, D.W. and E. Larsen. 2006. Immunocontraception of mammalian wildlife: ecological and immunogenetic issues. Reproduction 132:821–828.

Cothran, E.G. 2002. Genetic analysis of the Warm Springs, OR HMA. University of Kentucky, Department of Veterinary Science, Report to BLM.

Cothran, E.G. 2011. Genetic analysis of the Warm Springs, OR HMA. University of Kentucky, Department of Veterinary Science, Report to BLM.

Crabtree, J.R. 2016. Can ovariectomy be justified on grounds of behaviour? Equine Vet. Educ. 28:58–59.

Crawford, J.A., R.A. Olson, N.E. West, J.C. Mosley, M.A. Schroeder, T.D. Whitson, R.F. Miller, M.A. Gregg, C.S. Boyd. 2004. Synthesis Paper: Ecology and management of sage-grouse and sage-grouse habitat. J. Range Management, 57:2–19.

Crowell-Davis, S.L. 2007. Sexual behavior of mares. Horm. Behav. 52:12–17.

Davies, K.W. 2010. Revegetation of Medusahead-Invaded Sagebrush Steppe. Rangeland Ecology and Management 63:564–571.

Davies, K.W., A.M. Nafus, and R.L. Sheley. 2010. Non-native competitive perennial grass impedes the spread of an invasive annual grass. Biological Invasions 12:3187–3194.

Davies, K.W., T.J. Svejcar, and J.D. Bates. 2009. Interaction of historical and nonhistorical disturbances maintains native plant communities. Ecological Applications 19(6):1536–1545.

Davies, K.W., C.S. Boyd, J.L Beck, J.D. Bates, T.J. Svejcar, and M.A. Gregg. 2011. Saving the sagebrush sea: An ecosystem conservation plan for big sagebrush plant communities. Biological Conservation 144:2573–2584.

Davies, K.W., G. Collins, and C.S. Boyd. 2014. *Effects of feral free-roaming horses on semi-arid rangeland ecosystems: an example from the sagebrush steppe*. Ecosphere 5(10):127. http://dx.doi.org/10.1890/ES14-00171.1.

de Seve, C.W. and S.L. Boyles-Griffin. 2013. An economic model demonstrating the long-term cost benefits of incorporating fertility control into wild horse (*Equus caballus*) management in the United States. Journal of Zoo and Wildlife Medicine 44(4s:S34–S37).

Delgiudice, G.D., B.A. Sampson, D.W. Kuehn, M. Carstensen Powell, and J. Fieberg. 2005. Understanding margins of safe capture, chemical immobilization, and handling of free-ranging white-tailed deer. Wildlife Society Bulletin. Summer 2005, 33(2):677.

Devick, I.F., B.S. Leise, S. Rao, and D.A. Hendrickson. 2018. Evaluation of post-operative pain after active desufflation at completion of laparoscopy in mares undergoing ovariectomy. Can Vet J. 2018;59:261–266.

Doherty, K.E., D.E. Naugle, J.D. Tack, B.L. Walker, J.M. Graham, and J.L. Beck. 2014. Linking conservation actions to demography: grass height explains variation in greater sage-grouse nest survival. Wildlife Biology, 20(6):320–325.

Douglas, C.L., and T.L. Hurst. 1993. *Review and Annotated Bibliography of Feral Burro Literature*. Western Region National Park Service, Department of the Interior and University of Nevada, Las Vegas.

Drut, M.S., W.H. Pyle, and J.A. Crawford. 1994. Diets and Food Selection of Sage Grouse Chicks in Oregon. Journal of Range Management, Vol. 47, No. 1, pp. 90–93.

Duncan, P. 1980. Time-Budget of Camargue Horses: II. Time-Budgets of Adult Horses and Weaned Sub-Adults. Behaviour, Vol. 72, No. ½, pp. 26–49.

Eberhardt, L.L., A.K. Majorowicz, and J.A. Wilcox. 1982. Apparent Rates of Increase for Two Feral Horse Herds. Journal of Wildlife Management, Vol. 46, No. 2, pp. 367–374.

Evans, J. Warren, A. Borton, H.F. Hintz, and L.D. Van Vleck. 1977. *The Horse*. San Francisco, California: W.H. Freeman and Company, pp. 373–377.

Federal Land Policy and Management Act (FLPMA). 1976, as amended.

Feist, J.D. and D.R. McCullough. 1976. Behavior patterns and communication in feral horses. Zietschrift für Tierpsychologie 41:337–371.

Fettman, M.J. *et al.* 1997. Effects of neutering on bodyweight, metabolic rate and glucose tolerance of domestic cats. Res. Vet. Sci. 62:131–136.

Fischoff, I.R., S.R. Sundaresan, J.E. Cordingley, and D.I. Rubenstein. 2007. Habitat use and movements of plains zebra (*Equus burchelli*) in response to predation danger from lions. Behavioral Ecology 18:725–729.

Fowler. Murray E. 2008. Restraint and Handling of Wild and Domestic Animals, Third Edition. Wiley-Blackwell Publishing.

France, K.A., D.C. Ganskopp, and C.S. Boyd. 2008. Interspace/Undercanopy Foraging Patterns of Beef Cattle in Sagebrush Habitat. Rangeland Ecology and Management, Vol. 61, No. 4, pp. 389–393.

Frid, A. and L.M. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6(1):11.

Garcia, M.C., and O.J. Ginther. 1976. Effects of Ovariectomy and Season on Plasma Luteinizing Hormone in Mares. Endocrinology, Vol. 98(4), pp. 958–962.

Garrott, R.A. and D.B. Siniff. 1992. Limitations of male-oriented contraception for controlling feral horse populations. Journal of Wildland Management 56(3):456–464.

Girard, T.L., E.W. Bork, S.E. Nielson, and M.J. Alexander. 2013. Seasonal variation in habitat selection by free-ranging feral horses within Alberta's Forest Reserve. Rangeland Ecology and Management 66:428–437.

Gooch, A.M, S.L. Petersen, G.H. Collins, T.S. Smith, and B.R. McMillan. 2017. The impacts of feral horses on the use of water by pronghorn in the Great Basin. Journal of Arid Environments: in press.

Goodloe, R.B., R.J. Warren, D.A. Osborn, and C. Hall. 2000. Population characteristics of feral horses on Cumberland Island, Georgia and their management implications. Journal of Wildlife Management 64:114–121.

Government Accountability Office (GAO). October 2008. *Bureau of Land Management; Effective Long-Term Options Needed to Manage Unadoptable Wild Horses*, GAO-09-77.

Green, N.F. and H.D. Green. 1977. *The Wild Horse Population of Stone Cabin Valley, Nevada: A Preliminary Report*. Proceedings National Wild Horse Forum April 4–7, 1977.

Gregg, M.A., J.A. Crawford, M.S. Drut, and A.K. DeLong. 1994. Vegetational Cover and Predation of Sage Grouse Nests in Oregon. The Journal of Wildlife Management, Vol. 58, No. 1, pp. 162–166.

Griffin, P.C. 2015. Estimated Abundance of Wild Burros Surveyed on Bureau of Land Management Lands in 2014. U.S. Department of the Interior and U.S. Geological Survey Open-File Report 2015-1084.

Gross, J.E. 2000. A dynamic simulation model for evaluating effects of removal and contraception on genetic variation and demography of Pryor Mountain wild horses. Biological Conservation 96:319–330.

Guttilla, D.A. and P. Stapp. 2010. Effects of sterilization on movements of feral cats at a wildland-urban interface. J. Mammal. 91:482–489.

Hailer, F., B. Helander, A.O. Folkestad, S.A. Ganusevich, S. Garstad, P. Hauff, C. Koren, T. Nygård, V. Volke, C. Vilà, and H. Ellegren. 2006. Bottlenecked but long-lived: high genetic diversity retained in white-tailed eagles upon recovery from population decline. Biology Letters 2:316–319.

Hagen, C. 2011. *Greater Sage-Grouse Conservation Assessment and Strategy for Oregon: A Plan to Maintain and Enhance Populations and Habitat*. Oregon Department of Fish and Wildlife. April 22, 2011.

Hall, L.K., R.T. Larsen, M.D. Westover, C.C. Day, R.N. Knight, and B.R. McMillan. 2016a. Influence of exotic horses on the use of water by communities of native wildlife in a semi-arid environment. Journal of Arid Environments 127:100–105.

Hall, L.K., R.T. Larsen, R.N. Knight, and B.R. McMillan. 2018. Feral horses influence both spatial and temporal patterns of water use by native ungulates in a semi-arid environment. Ecosphere 9:1–15. e02096. 10.1002/ecs2.2096

Hall, S.E., B. Nixon, and R.J. Aiken. 2016b. Non-surgical sterilization methods may offer a sustainable solution to feral horse (*Equus caballus*) overpopulation. Reproduction, Fertility and Development, published online: https://doi.org/10.1071/RD16200.

Hall, L.K., R.T. Larsen, R.N. Knight, and B.R. McMillan. 2018. *Feral horses influence both spatial and temporal patterns of water use by native ungulates in a semi-arid environment*. Ecosphere 9(1):e02096

Hampson, B.A., M.A. De Laat, P.C. Mills, and C.C. Pollitt. 2010a. Distances travelled by feral horses in outback Australia. *Equine Vet. J.* 42:582–586.

Hampson, B.A. *et al.* 2010b. Monitoring distances travelled by horses using GPS tracking collars. Aust. Vet. J. 88:176–181.

Hart, B.L. and R.A. Eckstein. 1997. The role of gonadal hormones in the occurrence of objectionable behaviours in dogs and cats. *Appl. Anim. Behav. Sci.* 52:331–344.

Henneke, D.R., G.D. Potter, J.L. Kreider, and B.F. Yeates. 1983. Relationship between condition score, physical measurements and body fat percentage in mares. Equine Veterinary Journal 15(4):371–372.

Holtan, D.W., F.L. Squires, D.R. Lapin, and O.J. Ginther. 1979. Effect of Ovariectomy on Pregnancy in Mares. *Journal of Reproduction and Fertility Suppl.* 27:457–463.

Hooper, N.R., T.S. Taylor, D.D. Varner, and T.L. Blanchard. 1993. Effects of Bilateral Ovariectomy Via Colpotomy in Mares: 23 Cases (1984–1990). Journal of the American Veterinary Medical Association 203(7):1043–1046.

Huang, R.Y., L.M. Miller, C.S. Carlson, and M.R. Chance. 2002. Characterization of bone mineral composition in the proximal tibia of Cynomolgus monkeys: effect of ovariectomy and nandrolone decanoate treatment. *Bone* 30:492–497.

Jacob, J., J. Matulessy, and Sudarmaji. 2004. Effects of Imposed Sterility on Movement Patterns of Female Ricefield Rats. *J. Wildl. Manage.* 68:1138–1144.

Jacob, J., G.R. Singleton, and L.A. Hinds. 2008. Fertility control of rodent pests. *Wildl. Res.* 35:487–493.

Jerome, C. P., Turner, C. H. & Lees, C. J. Decreased bone mass and strength in ovariectomized cynomolgus monkeys (\emph{Macaca fascicularis}). *Calcif. Tissue Int.* 60, 265–270 (1997).

Jeusette, I., J. Detilleux, C. Cuvelier, L. Istasse, and M. Diez. 2004. Ad libitum feeding following ovariectomy in female Beagle dogs: effect on maintenance energy requirement and on blood metabolites. J. Anim. Physiol. Anim. Nutr. (Berl). 88:117–121.

Jeusette, I. *et al.* 2006. Effect of ovariectomy and ad libitum feeding on body composition, thyroid status, ghrelin and leptin plasma concentrations in female dogs*. J. Anim. Physiol. Anim. Nutr. (Berl). 90:12–18.

Kaczensky, P., R. Kuehn, B. Lhagvasuren, S. Pietsch, W. Yang, and C. Walzer. 2011. Connectivity of the Asiatic wild ass population in the Mongolian Gobi. Biological Conservation 144:920–929.

Kamm, J.L. and D.A. Hendrickson. 2007. Clients' perspectives on the effects of laparoscopic ovariectomy on equine behavior and medical problems. *J. Equine Vet. Sci.* 27:435–438.

King, S.R.B., and J. Gurnell. 2005. Habitat use and spatial dynamics of takhi introduced to Hustai National Park, Mongolia. Biological Conservation 124:277–290.

King, S.R.B., and K. Schoenecker. 2018. Potential spread of cheatgrass (*Bromus tectorum*) by feral horses (*Equus caballus*) in western Colorado. Rangeland Ecology & Management. *In press.*

Kirkpatrick, J.F., I.K.M. Liu, and J.W. Turner, Jr. 1990. Remotely delivered immunocontraception in feral horses. Wildlife Society Bulletin 18:326–330.

Kirkpatrick, J., and A. Turner. 2002. Reversibility of action and safety during pregnancy of immunization against porcine zona pellucida in wild mares *(Equus caballus*). Reproduction. Supplement, 60:197–202.

Kirkpatrick, J.F. and A. Turner. 2008. Achieving population goals in a long-lived wildlife species (Equus caballus) with contraception. *Wildl. Res.* 35:513.

Kirkpatrick, J.F. 2013. Director, the Science and Conservation Center. 2100 S. Shiloh Road, Billings, MT 59106. Written communication.

Kitchell, K., S. Cohn, R. Falise, H. Hadley, M. Herder, K. Libby, K. Muller, T. Murphy, M. Preston, M.J. Rugwell, and S. Schlanger. 2015. Advancing Science in the BLM: An Implementation Strategy. Department of the Interior, Bureau of Land Management, Washington, DC.

Knight, C.M. 2014. The effects of porcine zona pellucida immunocontraception on health and behavior of feral horses (*Equus caballus*). Graduate thesis, Princeton University.

Knopff, K.H., A.A. Knopff, A. Kortello, and M.S. Boyce. 2010. Cougar Kill Rate and Prey Composition in a Multiprey System. Journal of Wildlife Management, Vol. 74, No. 7, pp. 1435–1447.

Kobluk, C.N., T.R. Ames, and R.J. Geor. 1995. Surgery of the Reproductive Tract in the Horse: Diseases and Clinical Management. Philadelphia: W.B. Saunders. Pp. 1036–1038.

Krueger, K., B. Flauger, K. Farmer, and C.K. Hemelrijk. 2014. Movement initiation in groups of feral horses. Behavioral Processes 103:91–101.

Lee, M. and D.A. Hendrickson. 2008. *A Review of Equine Standing Laparoscopic Ovariectomy.* Journal of Equine Veterinary Science. Vol. 28, No. 2.

Levin, P.S., J. Ellis, R. Petrik, and M.E. Hay. 2002. Indirect effects of feral horses on estuarine communities. Conservation Biology 16:1364–1371.

Linklater, W.L. 2000. Adaptive explanation in socio-ecology: lessons from the Equidae. Biological Reviews 75:1–20.

Liu, I.K.M., M. Bernoco, and M. Feldman. 1989. Contraception in mares heteroimmunized with pig zonae pellucidae. Journal of Reproduction and Fertility, 85:19–29.

Loesch, D.A. and D.H. Rodgerson. 2003. *Surgical Approaches to Ovariectomy in Mares.* VetLearn.com. Compendium 25(11). November 2003.

Lubow, B. 2016. *Statistical analysis for 2016 horse survey of horse populations in Warm Springs HMA and Stinkingwater HMA, Oregon.* Report to United States Department of the Interior, Bureau of Land Management, IIF Data Solutions.

Lubow, B.C., and J.I. Ransom. 2016. Practical bias correction in aerial surveys of large mammals: validation of hybrid double-observer with sightability method against known abundance of feral horse (*Equus caballus*) populations. PLoS ONE 11(5):e0154902. doi:10.1371/journal.pone.0154902

Lundon, K., M. Dumitriu, and M. Grynpas. 1994. The long-term effect of ovariectomy on the quality and quantity of cancellous bone in young macaques. Bone Miner. 24:135–149.

Madosky, J.M., D.I. Rubenstein, J.J. Howard, and S. Stuska. 2010. The effects of immunocontraception on harem fidelity in a feral horse (*Equus caballus*) population. Applied Animal Behaviour Science, 128:50–56.

Madosky, J.M. 2011. *Factors that affect harem stability in a feral horse (Equus caballus) population on Shackleford Banks Island, NC.* Department of Biological Sciences. University of New Orleans, New Orleans, LA, USA.

Magiafoglou, A., M. Schiffer, A.A. Hoffman, and S.W. McKechnie. 2003. Immunocontraception for population control: will resistance evolve? Immunology and Cell Biology 81:152–159.

Mavropoulos, A., S. Kiliaridis, R. Rizzoli, and P. Ammann. 2014. Normal masticatory function partially protects the rat mandibular bone from estrogen-deficiency induced osteoporosis. *J. Biomech.* 47:2666–2671.

McCue, P.M., D.A. Hendrickson, and M.B. Hess. 2000. Fertility of Mares after Unilateral Laparoscopic Tubal Ligation. Veterinary Surgery 29:543–545.

McInnis, M.L., and M. Vavra. 1987. Dietary Relationships among Feral Horses, Cattle, and Pronghorn in Southeastern Oregon. Journal of Range Management. 40(1), January 1987.

McKinnon, A.O. and J.R. Vasey. 2007. *Current Therapy in Equine Reproduction: Selected Reproductive Surgery of the Broodmare.* St. Louis, Missouri: Saunders Elsevier, pp. 146–160.

Merck Veterinary Manual. 2017. *Nutritional Requirements of Horses.* https://www.merckvetmanual.com/management-and-nutrition/nutrition-horses/nutritional-requirements-of-horses. Accessed June 22, 2017.

Merrill, J.A., E.G. Cooch, and P.D. Curtis. 2006. Managing an overabundant deer population by sterilization: effects of immigration, stochasticity and the capture process. J. Wildl. Manage. 70:268–277.

Miller, R. 1983. Habitat Use of Feral Horses and Cattle in Wyomings's Red Desert. Journal of Range Management, Vol. 36, No. 2, pp. 195–199.

Miller, R. and R.H. Denniston. 1979. Interband Dominance of Feral Horses. Z. Tierpsychol., 51:41–47.

Miller, R.F., J.C. Chambers, D.A. Pyke, F.B. Pierson, and C.J. Williams. 2013. *A Review of Fire Effects on Vegetation and Soils in the Great Basin Region: Response and Ecological Site Characteristics*. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-308.

Mills, L.S. and F.W. Allendorf. 1996. The one-migrant-per-generation rule in conservation and management. Conservation Biology 10:1509–1518.

Morgart, J.R. 1978. Burro Behavior and Population Dynamics, Bandelier National Monument, New Mexico. (Thesis). Arizona State University.

National Environmental Policy Act (NEPA). 1970. 42 U.S.C. 4321-4347.

National Oceanic and Atmospheric Administration (NOAA). 2018. U. S. Seasonal Drought Outlook. http://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_discussion.php. Accessed May 14, 2018.

National Research Council (NRC). 2013. Using science to improve the BLM wild horse and burro program: a way forward. National Academies Press. Washington, DC.

Nimmo, D.G. and K.K. Miller. 2007. Ecological and human dimensions of management of feral horses in Australia: a review. Wildlife Research 34:408–417.

Nock, B. 2013. *Liberated Horsemanship: Menopause ...and Wild Horse Management.* Liberated Horsemanship Press, Warrenton, MO.

Nuñez, C.M., J.S. Adelman, and D.I. Rubenstein. 2010. Immunocontraception in wild horses (*Equus caballus*) extends reproductive cycling beyond the normal breeding season. PLoS one, 5(10), p.e13635.

Nuñez, C.M.V, J.S. Adelman, J. Smith, L.R. Gesquiere, and D.I. Rubenstein. 2014. Linking social environment and stress physiology in feral mares (*Equus caballus*): group transfers elevate fecal cortisol levels. General and Comparative Endocrinology. 196:26–33.

Nuñez, C.M., J.S. Adelman, H.A. Carr, C.M. Alvarez, and D.I. Rubenstein. 2017. Lingering effects of contraception management on feral mare (*Equus caballus*) fertility and social behavior. Conservation Physiology 5(1): cox018; doi:10.1093/conphys/cox018.

Nuñez, C.M.V. 2018. Consequences of porcine zona pellucida immunocontraception to feral horses. Human-Wildlife Interactions 12:131–142.

O'Farrell, V. and E. Peachey. 1990. Behavioural effects of ovariohysterectomy on bitches. *J. Small Anim. Pract.* 31:595–598.

Oesterheld, M. and S.J. McNaughton. 1991. Effect of Stress and Time for Recovery on the Amount of Compensatory Growth after Grazing. Oecologia 85(3):305–313.

Office of Inspector General, U.S. Department of the Interior. 2010. Bureau of Land Management Wild Horse and Burro Program. Report No.: C-IS-BLM-0018-2010. December 2010.

Office of Inspector General, U.S. Department of the Interior. 2016. The Bureau of Land Management's Wild Horse and Burro Program Is Not Maximizing Efficiencies or Complying with Federal Regulations. Report No.: 2016-WR-027.

Oregon Department of Fish and Wildlife. 2017a. *Oregon Cougar Management Plan.* October 2017.

Oregon Department of Fish and Wildlife. 2017b. *Pronhorn Antelope Regulations.* http://www.eregulations.com/oregon/17orhd/pronghorn-antelope-regulations/. Accessed March 22, 2018.

Oregon Sage-SHARE. 2017. *Sage-grouse Conservation: Linking Practices to Habitat Metrics.* Outcomes and Impacts: Executive Summaries and Full Reports, USDA-Natural Resources Conservation Innovation Grant.

Ostermann-Kelm, S., E.R. Atwill, E.S. Rubin, M.C. Jorgensen, W.M. Boyce. 2008. Interactions between Feral Horses and Desert Bighorn Sheep at Water. Journal of Mammalogy, 89(2):459–466.

Owen-Smith, N. and V. Goodall. 2014. Coping with savanna seasonality: comparitive daily activity patterns of African ungulates as revealed by GPS telemetry. Journal of Zoology 293:181–191.

Payne, R.M. 2013. The effect of spaying on the racing performance of female greyhounds. *Vet. J.* 198:372–375.

Pellegrini, S.W. 1971. Home Range, Territoriality and Movement Patterns of Wild Horses in the Wassuk Range of Western Nevada (thesis). University of Nevada - Reno.

Perry, N.D., P. Morey and G.S. Miguel. 2015. Dominance of a Natural Water Source by Feral Horses. The Southwestern Naturalist 60:390–393.

Powell, D.M. 1999. Preliminary evaluation of porcine zona pellucida (PZP) immunocontraception for behavioral effects in feral horses (*Equus caballus*). Journal of Applied Animal Welfare Science 2:321–335.

Prado, T., and J. Schumacher. 2017. How to perform ovariectomy through a colpotomy. Equine Veterinary Education 13:doi: 10.1111/eve.12801

Public Rangelands Improvement Act (PRIA). 1978. 43 U.S.C. 1901. Public Law 95-514—October 25, 1978.

Ramsey, D. 2005. Population dynamics of brushtail possums subject to fertility control. *J. Appl. Ecol.* 42:348–360.

Ramsey, D. 2007. Effects of fertility control on behavior and disease transmission in brushtail possums. J. Wildl. Manage. 71:109–116.

Ransom, J.I., B.S. Cade, and N.T. Hobbs. 2010. Influences of immunocontraception on time budgets, social behavior, and body condition in feral horses. Applied Animal Behaviour Science 124:51–60.

Ransom, J.I., J.E. Roelle, B.S. Cade, L. Coates-Markle, and A.J. Kane. 2011. Foaling rates in feral horses treated with the immunocontraceptive porcine zona pellucida. Wildlife Society Bulletin 35:343–352.

Ransom, J.I., N.T. Hobbs, and J. Bruemmer. 2013. Contraception can lead to trophic asynchrony between birth pulse and resources. PLoS one, 8(1), p.e54972.

Ransom, J.I., J.G. Powers, N.T. Hobbs, and D.L. Baker. 2014a. Ecological feedbacks can reduce population-level efficacy of wildlife fertility control. Journal of Applied Ecology 51:259–269.

Ransom, J.I., J.G. Powers, H.M. Garbe, M.W. Oehler, T.M. Nett, and D.L. Baker. 2014b. Behavior of feral horses in response to culling and GnRH immunocontraception. Applied Animal Behaviour Science 157:81–92.

Ransom, J.I., L Lagos, H. Hrabar, H. Mowrazi, D. Ushkhjargal, and N. Spasskaya. 2016. Wild and feral equid population dynamics. Pages 68–86 in J.I. Ransom and P. Kaczensky, eds., Wild equids; ecology, management and conservation. Johns Hopkins University Press, Baltimore, Maryland.

Reichler, I.M. 2009. Gonadectomy in Cats and Dogs: A Review of Risks and Benefits. *Reprod. Domest. Anim.* 44:29–35.

Röcken, M., G. Mosel, K. Seyrek-Intas, D. Seyrek-Intas, F. Litzke, J. Verver, and A.B.M. Rijkenhuizen. 2011. Unilateral and bilateral laparoscopic ovariectomy in 157 mares: a retrospective multicenter study. Veterinary Surgery 40:1009–1014.

Rodgerson, D.H., J.K. Belknap, and D.A. Wilson. 2001. Laparoscopic Ovariectomy Using Sequential Electrocoagulation and Sharp Transection of the Equine Mesovarium. Veterinary Surgery, 30:572–579.

Roelle, J.E., F.J. Singer, L.C. Zeigenfuss, J.I. Ransom, F.L. Coates-Markle, and K.A. Schoenecker. 2010. Demography of the Pryor Mountain Wild Horses, 1993–2007. U.S. Geological Survey Scientific Investigations Report 2010–5125.

Roelle, J.E. and S.J. Oyler-McCance. 2015. Potential demographic and genetic effects of a sterilant applied to wild horse mares. US Geological Survey Open-file Report 2015-1045.

Roessner, H.A., K.A. Kurtz, and J.P. Caron. 2015. Laparoscopic ovariectomy diminishes estrus-associated behavioral problems in mares. *J. Equine Vet. Sci.* 35:250–253.

Rowland, A.L., K.G. Glass, S.T. Grady, K.J. Cummings, K. Hinrichs, and A.E. Watts. 2018. Influence of caudal epidural analgesia on cortisol concentrations and pain-related behavioral responses in mares during and after ovariectomy via colpotomy. Veterinary Surgery 2018;00:1–7.

Rubin, C., A.S. Turner, S. Bain, C. Mallinckrodt, and K. McLeod. 2001. Low mechanical signals strengthen long bones. *Nature* 412:603–604.

Rutberg, A., K. Grams, J.W. Turner, and H. Hopkins. 2017. Contraceptive efficacy of priming and boosting doses of controlled-release PZP in wild horses. Wildlife Research: http://dx.doi.org/10.1071/WR16123.

Sacco, A.G. 1977. Antigenic Cross-Reactivity Between Human and Pig Zona Pellucida. Biology of Reproduction 16:164–173.

Salter, R.E. 1979. Biogeography and habitat-use behavior of feral horses in western and northern Canada. in *Symposium on the Ecology and Behaviour of Wild and Feral Equids* 129–141.

Sant, E.D., G.E. Simmonds, R.D. Ramsey, and R.T. Larsen. 2014. Assessment of sagebrush cover using remote sensing at multiple spatial and temporal scales. Ecological Indicators 43:297–305.

Saunders, G. *et al.* 2002. The effects of induced sterility on the territorial behaviour and survival of foxes. J. Appl. Ecol. 39:56–66.

Schemnitz, S.D. (editor). 1980. *Wildlife Management Techniques Manual*. The Wildlife Society, Washington D.C. p. 67.

Schoenecker, K.A. and B.C. Lubow. 2015. Application of a hybrid model to reduce bias and improve precision in population estimates for elk (Cervus elaphus) inhabiting a cold desert ecosystem. Journal of King Saud University – Science, Special Issue on Arid Ecosystems.

Scholz-Ahrens, K.E., G. Delling, P.W. Jungblut, E. Kallweit, and C.A. Barth. 1996. Effect of ovariectomy on bone histology and plasma parameters of bone metabolism in nulliparous and multiparous sows. Z. Ernahrungswiss. 35:13–21.

Science and Conservation Center (SCC). 2015. Materials Safety Data Sheet, ZonaStat-H. Billings, Montana.

Scott, E.A. and D.J. Kunze. 1977. Ovariectomy in the mare: presurgical and postsurgical considerations. J. Equine Med. Surg. 1:5–12.

Seidler, R.G. and E.M. Gese. 2012. Territory fidelity, space use, and survival rates of wild coyotes following surgical sterilization. *J. Ethol.* 30:345–354.

Sigrist, I.M., C. Gerhardt, M. Alini, E. Schneider, and M. Egermann. 2007. The long-term effects of ovariectomy on bone metabolism in sheep. J. Bone Miner. Metab. 25:28–35.

Smith, M.A. 1986. Impacts of feral horse grazing on rangelands: an overview. Journal of Equine Veterinary Science 6:236–239.

Turner, J.W., I.K. Liu, A.T. Rutberg, and J.F. Kirkpatrick. 1997. Immunocontraception limits foal production in free-roaming feral horses in Nevada. Journal of Wildlife Management 61:873–880.

Turner, J.W. Jr., Ph.D. 2014. Progress Report: BLM Wild Horse Fertility Control Project (Cooperative Agreement L10AC20431). January 20, 2015.

Turner, A. Simon, Professor Emeritus (retired). 2015. Department of Clinical Sciences, Colorado State University, August 2011–present. October 29, 2015. Written Communication.

Twigg, L.E. *et al.* 2000. Effects of surgically imposed sterility on free-ranging rabbit populations. J. Appl. Ecol. 37:16–39.

United States Department of Agriculture (USDA). 2012. National Agriculture Statistics Service, Quick Stats. https://quickstats.nass.usda.gov/. Accessed April 6, 2018.

United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). 2018. Ecological Site Description. https://esis.sc.egov.usda.gov/Welcome/pgReportLocation.aspx?type=ESD. Accessed April 24, 2018.

United States Department of the Interior, Bureau of Land Management. 1979. *Warm Springs Equine Herd Management Area Plan*. Burns District.

United States Department of the Interior, Bureau of Land Management. 1980. *Wilderness Inventory, Oregon and Washington: Final Intensive Inventory Decisions*. November 1980.

United States Department of the Interior, Bureau of Land Management. 1980. *West Warm Springs Allotment Management Plan.*

United States Department of the Interior, Bureau of Land Management. 1987. *Warm Springs Wild Horse Herd Management Area Plan – Update.*

United States Department of the Interior, Bureau of Land Management. 1991. *Proposed Three Rivers Resource Management Plan and Environmental Impact Statement*. September 1991. Burns District Office.

United States Department of the Interior, Bureau of Land Management. 1992. *Three Rivers Resource Management Plan, Record of Decision, and Rangeland Program Summary*. Burns District Office.

United States Department of the Interior, Bureau of Land Management. 1993. *East Warm Springs Allotment Management Plan.*

United States Department of the Interior, Bureau of Land Management. 1997. *Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands Administered by the United States Department of the Interior, Bureau of Land Management in the States of Oregon and Washington.*

United States Department of the Interior, Bureau of Land Management and U.S. Geological Survey. 2001. Technical Reference 1730-2, *Biological Soil Crusts: Ecology and Management.*

United States Department of the Interior, Bureau of Land Management. 2008. *National Environmental Policy Act* (NEPA) Handbook, H-1790-1.

United States Department of the Interior, Bureau of Land Management. 2009. Instruction Memorandum (IM) 2009-062, Wild Horse and Burro Genetic Baseline Sample.

United States Department of the Interior, Bureau of Land Management. 2009. IM 2009-085, Managing Gathers Resulting from Escalating Problems and Emergency Situations.

United States Department of the Interior, Bureau of Land Management. 2009. IM 2009-090, Population-Level Fertility Control Field Trials: Herd Management Area Selection, Vaccine Application, Monitoring and Reporting Requirements.

United States Department of Interior, Bureau of Land Management. 2010. *Warm Springs Herd Management Area Plan Update.*

United States Department of the Interior, Bureau of Land Management. 2010. IM 2010-057, Wild Horse and Burro Population Inventory and Estimation.

United States Department of the Interior, Bureau of Land Management. 2010. *Wild Horse and Burro Management Handbook 4700-1.*

United States Department of the Interior, Bureau of Land Management. 2010. *Vegetation Treatment Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Final Environmental Impact Statement and Record of Decision.*

United States Department of the Interior, Bureau of Land Management. 2010. BLM Manual 4720, *Removal.*

United States Department of the Interior, Bureau of Land Management. 2012. BLM Manual 6310, *Conducting Wilderness Characteristics Inventory on BLM Lands.*

United States Department of the Interior, Bureau of Land Management. 2012. BLM Manual 6320, *Considering Lands with Wilderness Characteristics in the BLM Land Use Planning Process.*

United States Department of the Interior, Bureau of Land Management. 2012. Miller Homestead Fire Emergency Stabilization and Rehabilitation Plan Environmental Assessment (EA) (DOI-BLM-OR-B060-2012-0047-EA). BLM Burns District, Hines, Oregon.

United States Department of the Interior, Bureau of Land Management. 2013. IM 2013-058, Wild Horse and Burro Gathers: Public and Media Management.

United States Department of the Interior, Bureau of Land Management. 2013. IM 2013-060, Wild Horse and Burro Gathers: Management by Incident Command System.

United States Department of the Interior, Bureau of Land Management. 2013. IM 2013-146, Exceptions to Policy in BLM Handbook H-4700-1 and Manual 4720.41: Helicopter Gather of Wild Horses and Burros between March 1 and June 30 Due to Emergency Conditions and Escalating Problems.

United States Department of the Interior, Bureau of Land Management. 2014. IM 2018-066, Guidance for the Sale of Excess Wild Horses and Burros.

United States Department of the Interior, Bureau of Land Management. 2015. IM 2015-070, Animal Health, Maintenance, Evaluation and Response.

United States Department of the Interior, Bureau of Land Management. 2015. IM 2015-151, Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers.

United States Department of the Interior, Bureau of Land Management. 2015. *Integrated Invasive Plant Management for the Burns District Revised EA (DOI-BLM-OR-B000-2011-0041-EA) Decision Record.*

United States Department of the Interior, Bureau of Land Management. 2015. *Oregon Greater Sage-Grouse Approved Resource Management Plan Amendment.* September 2015.

United States Department of the Interior, Bureau of Land Management Utah (BLM Utah). 2015. *Population Control Research Wild Horse Gather for the Conger and Frisco Herd Management Areas* (DOI-BLM-UT-W020-2015-0017-EA).

United States Department of the Interior, Bureau of Land Management. 2015. Memorandum regarding - National Research Council's 2015 report to BLM.

United States Department of the Interior, Bureau of Land Management. 2016. Mare sterilization research EA (DOI-BLM-OR-B000-2015-0055-EA). BLM Burns District Office, Hines, Oregon.

United States Department of the Interior, Bureau of Land Management. 2018. *Coyote Fire Emergency Stabilization and Rehabilitation Categorical Exclusion* (DOI-BLM-ORWA-B050-2018-0004-CX). BLM Burns District Office, Hines, Oregon.

United States Department of the Interior, Bureau of Land Management. 2018. *Wild Horse and Burro Quick Facts*. Retrieved from https://www.blm.gov/programs/wild-horse-and-burro/about-the-program/program-data. Accessed April 5, 2018.

United States Department of the Interior, Bureau of Land Management. 2018. *Wild Horse and Burro Program Data*. https://www.blm.gov/programs/wild-horse-and-burro/about-the-program/program-data. Accessed February 12, 2018.

United States Department of the Interior, Bureau of Land Management. 2018. IM 2018-052, Transfer of Excess Wild Horses and Burros to Federal, State, and Local Government Agencies for Use as Work Animals.

United States Department of the Interior, Bureau of Land Management. 2018. Oregon Wild Horse and Burro Corral Facility Access for Visitors (BLM IM-ORB-000-2018-004). Burns District BLM.

United States Department of the Interior, U.S. Fish and Wildlife Service. 2018. Warm Springs Herd Management Area, Scoping Comments (DOI-BLM-ORWA-B050-2018-0016-EA). June 4, 2018.

United States Department of the Interior, U.S. Geological Survey. 2018. Unpublished Data – Statistical analysis for 2018 survey of horse abundance in Liggett Table, Palomino Buttes, and Warm Springs HMAs, Oregon.

Valeix, M., H. Fritz, R. Matsika, F. Matsvimbo, and H. Madzikanda. 2007. The role of water abundance, thermoregulations, perceived predation risk and interference competition in water access by African herbivores. *Afr. J. Ecol*. 46:402–410.

Vavra, M. 2005. Livestock Grazing and Wildlife: Developing Compatibilities. Rangeland Ecology and Management, 58(2):128–134.

Wakefield, S. and O. Attum. 2006. The effects of human visits on the use of a waterhole by endangered ungulates. Journal of Arid Environments 65:668–672.

Western Regional Climate Center. 2018. Recent Climate in the West. https://wrcc.dri.edu/. Accessed June 7, 2018.

White, L. 1980. *A Study of Feral Burros in Butte Valley, Death Valley National Monument*. Cooperative National Park Resources Studies Unit, University of Nevada, Las Vegas.

Whitwell, K.E., 2011. Abortions and Stillbirths: A Pathologist's Overview. In *Equine Reproduction*. A.O. McKinnon, E.E. Squires, W.E. Vaala, and D.D. Varner (Eds.), Blackwell Publishing, pp. 2239–2349.

Wild Free-Roaming Horses and Burros Act (WHB Act) of 1971 (Public Law 92-195), as amended.

Williams, W.L. 1903. *Surgical and Obstetrical Operations*. Ithaca, NY: W.L. Williams, pp. 97–106.

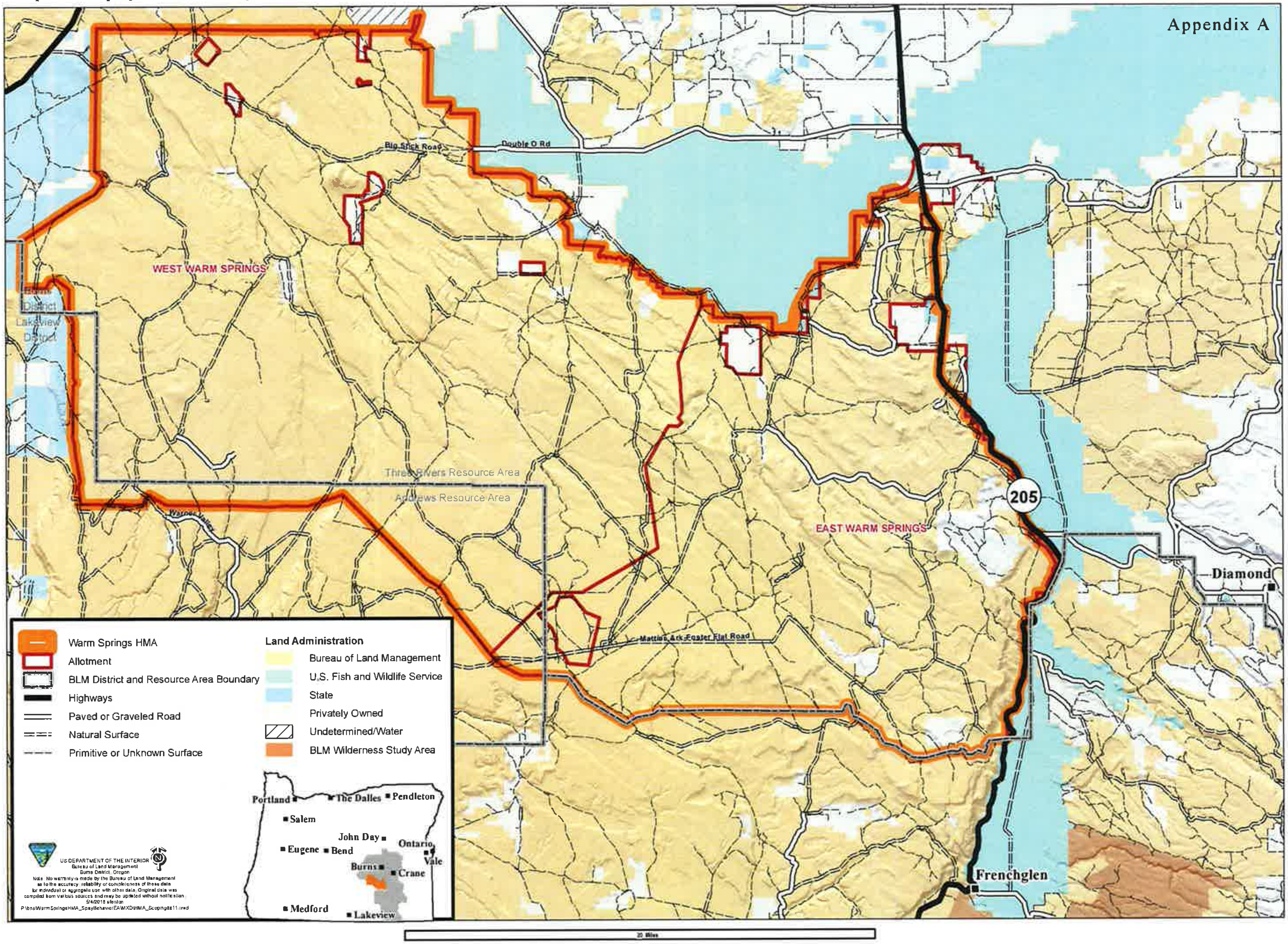
Wright, S. 1931. Evolution in Mendelian populations. Genetics 16:97–159.

Zalba, S.M., and N.C. Cozzani. 2004. The impact of feral horses on grassland bird communities in Argentina. Animal Conservation 7:35–44.

Zeigenfuss, L.C., K.A. Schoenecker, J.I. Ransom, D.A. Ignizio, and T. Mask. 2014. Influence of nonnative and native ungulate biomass and seasonal precipitation on vegetation production in a Great Basin ecosystem. Western North American Naturalist 74(3):286–298.

Zhang, Y., W.P. Lai, P.C. Leung, C.F. Wu, and M.S. Wong. 2007. Short- to Mid-Term Effects of Ovariectomy on Bone Turnover, Bone Mass and Bone Strength in Rats. *Biol. Pharm. Bull.* 30:898–903.

Map A: Spay Feasibility and On-Range Behavioral Outcome Assessment and Warm Springs HMA Population Management Plan



Appendix B

Statement of Research Objectives

BLM seeks a research partner for a "Spay Feasibility and Behavioral Outcomes Assessment" project. Under existing interagency agreement 4500065781, USGS is invited to prepare a proposal addressing the research questions and requirements detailed below. Ovariectomy via colpotomy is the surgical method that BLM seeks to use; this is because BLM anticipates that method could be feasible for management, based on the report from the Bowen et al. (2015) spay panel, and results from the Sheldon NWR (Collins and Kasbohm 2016). BLM is considering supporting a 3-year study that will quantifiably assess the feasibility and outcomes of this method, in the context of on range management. The conceivable timing of such a study would include animal handling in fall 2018, with on-range observations extending through 2020.

Animal Welfare Requirements. Animal handling and surgery must be planned and performed to protect the well-being of the animals. Animal handling will be in conformance with BLM's Instruction Memorandum No. 2015-151 Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers as well as the draft CAWP document applicable to BLM facilities. Documenting animal welfare outcomes will be an important aspect of the project. Additionally, the project will be designed with transparency to maximize, to the extent possible, the public's understanding of the procedure being investigated as potentially useful, future management actions. BLM will work with the researchers to plan for and assure the protection of animal welfare throughout the study, but researchers must plan for an obtain oversight approval for an ACUP from a recognized IACUC, to be included in the proposal. The proposal must include a step-by-step description of the procedure, including sedation and other treatments that may be administered before, during, or after the procedure. The proposal and ACUP would be part of public documents for BLM's NEPA process. The research team is expected to arrange for a veterinary team that includes a practitioner or practitioners experienced with ovariectomy of horses via colpotomy, and with wild horse sedation. Those veterinarians would be identified on ACUP forms. All participants should expect that some members of the public may be allowed to observe the animals, veterinary staff, researchers, and animal-researcher / animal-veterinarian interactions, in some form, before, during, and after surgery, as well as during on-range observations.

The two main research topics to be addressed are I) Surgery Feasibility and Outcomes Assessment and II) On Range Behavior and Outcomes Assessment. Essential sub-questions identified below include italicized notes about the specific questions that BLM wants assessed. These sub-questions include notes on data forms, protocols, or other items that should be included in the proposal. The proposal must also address what statistical methods will be used to answer research questions.

BLM would expect that the sub-questions indicated with an asterisk will be addressed in a report or publication within 9 months after the surgeries.

I. Surgery Feasibility and Outcomes Assessment.

1) * Sub-question: What are the stages of pregnancy for treated and non-treated mares in the pool of available animals? *The proposal and associated ACUP will need to identify what veterinary method will be used to quantify the stage of each mare's pregnancy, and what the expertise is of the practitioner who will make that assessment.* BLM anticipates that the defined pregnancy stages would be open, early term (i.e., <120 days), mid-term (i.e., 120 to 250? days) and late term (i.e. >~250 days), but *the proposal must identify the definitions of the approximate cutoffs between stages that will be used in the study, and what cues will be used to differentiate the stages*, (perhaps such as formation of endometrial cups, when the fetus drops over the pelvic brim, or other criteria). The anticipated sample size will be largest in open mares, early term pregnancies, and mid-term pregnancies. Few late term pregnancies would be expected during a fall gather. *The proposal should include an example of the data form that will be used to record the pregnancy stage for each mare that is examined.*
2) * Sub-question: What are the immediate outcomes of surgery, in terms of quantitative measures of surgery feasibility and success? *The proposal should include an example of the data form that will be used for each treated mare to record for each mare whether it is or is not deemed suitable for surgery, any difficulties encountered during surgery, surgery duration, amount of sedation required, and surgical success.*
3) * Sub-question: What are the immediate outcomes of surgery, in terms of morbidity (including signs of abdominal pain), and mortality? *The proposal should specify: the veterinary practitioner who will perform the surgeries and that person's expertise with ovariectomy via colpotomy; the veterinary expert in animal sedation that will be used, and that person's expertise with wild horses; the specific schedule and data sheet, for recording quantitative data on morbidity, and the specific measures that will be recorded to measure all immediate health outcomes for treated mares in the immediate (i.e., 0- ~10 days) period after surgery, what the expertise is of the veterinarian who will make those assessments; and details from a power analysis in support of the sample size necessary for the quantification of mortality rates. The approved ACUP for surgeries and veterinary care must be included with the proposal. The proposal should include the schedule and protocol for pre-surgical care (i.e. feed/water), post-surgical assessments, and an example of the data form that will be used to record post-surgical measures of morbidity and mortality for treated and untreated mares.*
4) *Sub-question: What are the animal welfare impacts of the treatment on treated mares (e.g., in comparison to non-treated mares)? *The proposal should identify a few basic measures of animal welfare that will be recorded and quantified (for example, moving to feed, moving to water, interactions with peers, etc.).* Sub-question: What is the pregnancy outcome (birth rate, and apparent post-partem foal health condition, and foal one-year survival rate) for pregnant mares that undergo surgery, as compared to the pregnancy outcome of untreated mares? *The proposal must identify the study design elements that will allow for this comparison.*

5) Sub-question: Are there measurable differences in annual mortality rate for treated vs. non-treated mares, as measured for the first 2 years after surgery? *The proposal must identify the study design elements that will allow for this comparison.*

II. On-Range Behavior and Outcomes Assessment. We expect that spayed mares will have changes in on-range behavior and outcomes, compared to non-spayed mares, but we seek a quantification of those changes.

1) Sub-question: Do spayed mares differ in body condition scores, compared to non-treated mares? *The proposal must include data forms for on-range observations, and an intended schedule for on-range welfare check observations.*
2) Sub-question: Are spayed mares part of harem bands? *For this, and all other on-range sub-questions, the proposal should include protocols and data sheets to be used for behavioral observations, explanation of the adequacy of the proposed study design and methods for answering the sub-question (including results from a power analysis), and include details about intended analyses.*
3) Sub-question: Do band fidelity rates differ for treated mares, compared to non-treated mares?
4) Sub-question: Are there quantifiable differences in attention and breeding attempts that spayed mares receive from stallions, compared with that received by non-spayed mares?
5) Sub-question: Are there quantifiable differences in social interactions (e.g., fighting, harem tending, etc.) as a function of the proportion of spayed mares in his harem?
6) Sub-question: Does habitat selection and home range size of treated mares differ from that of non-treated mares? *Proposal should present intended data collection methods and analyses for both habitat use and movement, and comment on the study design elements that will allow for this comparison.*

5a FOR BLM USE ONLY, DATE RECEIVED ____________

5b FOR BLM USE ONLY, PROPOSAL # ____________ (MM-YY-####)

BLM Research Proposal Format

A. COVER PAGE

US Department of Interior
Bureau of Land Management
Wild Horse and Burro Program

Proposal for Research Effort

1a Monitoring responses of wild horse behavior and demography to BLM management treatment
TITLE OF PROPOSAL (90 Character Maximum)

1b. [redacted]
INVESTIGATORS (Principal-Investigator LAST NAME, FIRST NAME; Co-Investigators LAST NAME, FIRST NAME)

2a [redacted]
NAME OF PRINCIPAL INVESTIGATOR (PI)

2b. [redacted]
EMAIL

2c PhD Ecologist
POSITION TITLE

2d ____________
EMAIL

2e USGS, [redacted]
INSTITUTION AND DEPARTMENT

2f,g. [redacted]
PHONE

[redacted]
FAX

2h. ADDRESS [redacted]

3a THIS PROPOSAL IS A: (Mark one only) X__ NEW APPLICATION ___ CONTINUATION ___ UNPLANNED EXTENSION

3b FOR COMPLETION, A FUNDING REQUEST IS:

	INCLUDED and REQUIRED	INCLUDED but NOT REQUIRED	NOT INCLUDED
3b FOR COMPLETION, A FUNDING REQUEST IS:	X		

	FIRST YEAR	SECOND YEAR	THIRD YEAR
3c AMOUNT OF FUNDING REQUESTED:	$362,201	$268,222	$268,222

	START	END	
3d,e DATES OF PROPOSED STUDY	10/2018	05/2022	Total Request: $898,645

AGREEMENT: It is understood and agreed by the undersigned if this proposal / application is approved, whether or not a grant is made, it will be according to the terms of the proposal and the stipulations set forth in the accompanying instructions. In addition, a written agreement appropriate for the nature of the proposed work (e.g., Memorandum of Understanding, Assistance Agreement, Task Order, letter of agreement) will be required to outline the obligations of the researchers and the BLM in the conduct of the study

PRINCIPAL INVESTIGATOR ASSURANCE: I agree to accept responsibility for the conduct, completion and reporting of the study proposed here and to provide the agreed upon progress and final reports.

4a SIGNATURE OF PRINCIPAL INVESTIGATOR [redacted] DATE [redacted]

CERTIFICATION AND ACCEPTANCE: I certify that the statements made in this application are true and complete to the best of our knowledge, and I accept the obligation to comply with the above agreement. I understand that the Principal Investigator and his/her department will be responsible for any expenses incurred by this project which exceed the approved funding amount.

4b OFFICIAL SIGNING FOR ORGANIZATION [redacted] DATE [redacted]

4c. ADDRESS USGS [redacted]

4d [redacted]
EMAIL

4e,f. [redacted]
PHONE FAX

B. RESEARCH OBJECTIVES

BLM Wild Horse and Burro Program
Proposal for Collaborative Research Effort
Privileged Communication

Name and Address of Applicant or Applicant Organization:

USGS [redacted]

Title of Project: Monitoring responses of wild horse behavior and demography to BLM management treatment

ABSTRACT:
Wild horses are a revered and iconic species that roam the American west. They are protected by the Wild Free-Roaming Horses and Burros Act of 1971, which has led to the successful recovery of their numbers on public lands, and greater animal welfare and humane treatment protections. Their successful recovery has been to such a degree that they now exceed their numerical capacity on western landscapes and compete with other wildlife in areas where there is not enough water or forage to sustain healthy herds. To date the primary management tool for controlling overpopulation on public rangelands has been removal of wild horses to holding facilities in which animals are made available for public adoption. Contraception treatment has been unsuccessful in making a large-scale impact to control herd over-abundance because horses need to be handled annually to inject a vaccine booster. This leads to over-handling of animals and is not a feasible solution in larger more vast-ranging herds. Darting to inject boosters is not feasible in most herds because horses are not approachable. It is also not economically sustainable. Thus, alternative management tools to removals or short-term contraception are needed to moderate population growth. From 2008-2014 a study was conducted that included spaying wild horse mares (Collins and Kasbohm 2017) and evaluating their group associations and survival. The Collins and Kasbohm (2017) study reported reductions in foaling rates, but did not measure individual band fidelity or any changes in habitat selection of treated mares or their cohorts. We propose to examine the impact of management actions conducted by the Bureau of Land Management (BLM) on mares. We will measure mare behavior and band fidelity, demography (birth and survival rates), and spatial ecology (using radio collars and radio tags). We will also evaluate the population-level effects of BLM management by comparing the managed population to an unmanaged control within the same habitat. We will conduct our study in a Herd Management Area (HMA) that has an intact fence dividing the HMA into two segments. Each segment will have ~100 wild horses with natural age classes and even sex ratios. Both herd segments will be allowed to grow without removals or other management actions for the duration of the study after the initial gather and release is conducted.

Name, official title, department, project responsibilities and time commitment (% of annual work effort) of all professional personnel engaged in project:

[redacted] USGS: Project PI, field project oversight, study design, data analysis, data interpretation, publication (30%)

C. RESEARCH PROPOSAL

1. Goals / Objectives / Hypotheses:

Goals:

Our goal is to monitor the demography and behavior of wild horses that are managed by BLM to determine differences between spayed and non-spayed mares, and to measure the effect on herd growth rate

Objectives:

1. To evaluate effects of spaying free-roaming mares on aspects of their social behavior, reproductive behavior, band membership, and band fidelity.
2. To determine longer-term physiological side effects (if any) of spaying free-roaming mares on general health, body condition, and survival (up to 3 years).
3. To determine effects of spaying on the spatial distribution of individuals and bands, habitat selection, movement rates, and overall spatial ecology of the herd.
4. To determine effects of spaying on population growth.

Hypotheses:

H_1: Free-roaming spayed females will continue to exhibit estrus behaviors (e.g., Asa et al. 1980a, Crabtree 2016), but will exhibit a lower rate of reproductive behaviors than non-spayed mares.

This hypothesis will be tested by comparing behavior of spayed and non-spayed mares within the same herd segment, as well as compared to mares in the control herd segment.

H_2: Similar to data collected on contracepted mares (e.g., Nunez et al. 2009), spayed females will have lower band fidelity than non-spayed, but will remain in a band with other females and band stallion(s).

This hypothesis will be tested by comparing band composition and fidelity of spayed and non-spayed mares within the same herd segment, as well as compared to mares in the control herd segment.

H_3: Spaying will not affect short-term survival of mares because this parameter was not affected in contracepted mares (Kirkpatrick and Turner 2008), nor in studies of wild rabbits or possums (Twigg et al. 2000, Ramsey 2005).

H_4: Spayed free-roaming mares will remain in better body condition than non-spayed due to being freed from the costs of parturition and lactation, similar to non-reproducing mares (Ransom et al. 2010, 2014).

These hypotheses will be tested by comparing survival and body condition of spayed and non-spayed mares within the same herd segment, as well as compared to mares in the control herd segment.

H_5: We expect there will be no difference in habitat use between spayed mares and non-spayed mares, based on similarities in habitat use between contracepted and non-contracepted mares (Ransom et al. 2014).

This will be tested by comparing GPS location data and movement rates from collared individuals in the treatment and control herd segments.

H_6: Similar to studies in which contraceptives have temporarily rendered females infertile (Ransom et al. 2011), population growth will be lower in the population with spayed mares. *This will be tested by comparing annual growth rate in spayed and non-spayed herd segments, using data from foal counts and aerial population surveys.*

2. Specific Aims:

a) Our first aim is to measure rates of social and reproductive behavior and group cohesion in free roaming male and female wild horses evaluating individuals within and between treatment and control HMA segments and comparing their behavior.
b) Our second aim is to record any changes in body condition, morbidity, or mortality of females and their foals in both treatment and control herd segments, to determine if these factors are affected by spaying.
c) Our third aim is to determine spatial ecology of horses within spayed and non-spayed herd segments of the population, by monitoring the GPS locations every 2 hours throughout the year of 20 treatment-herd females, 20 control-herd females, and 12 stallions from each herd segment.
d) Our final aim is to measure annual population size in both spayed and non-spayed herd segments by monitoring foaling rates, natural mortality, and by conducting aerial surveys 1-2x annually to examine population growth.

3. Background and Significance:

Free-roaming wild horses on public lands in the USA are protected by the Wild Free-Roaming Horses and Burros Act of 1971. Except in the rare places where they are controlled by predation, horses have the potential for rapid population growth: rates of 20–25% have been recorded (Eberhardt et al. 1982, Berger 1986, Garrott et al. 1991, Greger and Romney 1999, Goodloe et al. 2000). The primary management tool for BLM managers has been removal of horses from public rangelands once their numbers are over Appropriate Management Level (AML). Wild horses are gathered and moved to holding facilities where they are available for adoption by the public. If not adopted, they can remain in holding for the remainder of their lives. Maintenance of these facilities is costly (~$50M/year), and currently they are approaching or at capacity, resulting in a significant decline in the number of gathers/removals that can take place. Leaving too many wild horses on public rangeland causes habitat degradation and significant negative impacts to wildlife (Beever et al. 2008, Beever and Herrick 2006, Beever and Brussard 2004, Boyd et al. 2017, Gooch et al. 2017, Hall et al. 2016,). Thus, alternative management tools and strategies are needed to effectively and humanely reduce the population growth rate of wild horses.

Over the past 20 years substantial effort was invested developing an immunocontraceptive vaccine for females (Gray and Cameron 2010). One of these, porcine zona pellucida vaccine (pZP) has proven to be fairly effective over the short-term (for about one year; Kirkpatrick and Turner 2008), and other vaccines such as GonaCon and SpayVac® are still being tested (Gray et al. 2010, Ransom et al. 2014). All of these vaccines require repeat applications to maintain their effectiveness (Hall, 2017). This can be costly and time-intensive as it requires either gathering horses to administer the vaccine, or darting them, which has its own set of field logistical complications, problems, and outright failures.

According to the Wild Free-Roaming Horses and Burros Act of 1971 (Public Law 92-195) some HMAs may be managed for non-reproducing wild horses as a means of controlling population numbers (Bureau of Land Management 2010), but this tool has not been applied as a routine management action to date. By replacing a proportion of the breeding population of females with spayed mares fewer foals will be produced each year, resulting in slower population growth.

In wildlife species considered pests, such as rabbits (*Oryctolagus cuniculus*) and coyotes (*Canis latrans*), sterilization has been used as a more palatable alternative to lethal culling, but with variable effects (Seidler et al. 2014, Twigg et al. 2000). It would be expected that the greater the number of animals treated the larger the reduction in population growth rate, with most pronounced effects at highest treatment levels (Garrott 1995). In ungulates it is expected that at least 50% of fertile females would need to be sterilized to reduce population density (Hobbs et al. 2000). A model for white tailed deer (*Odocoileus virginianus*) predicted that a population could be reduced by 30-60% in 4-10 years if 25-50% of females are sterilized annually (Merrill et al. 2006). However, in a real-world open population of white tailed deer where 93 females were sterilized, while the number of females and fawns detected in camera traps decreased over the short-term, there was no overall reduction of deer numbers within 6 years due to immigration, particularly of males (Boulanger and Curtis, 2016). Two studies investigated the effects of sterilizing different proportions of females in populations of possums and rabbits, from 0% to 80%, and were also affected by the limitations of working in an open population (Twigg et al. 2000, Ramsey 2005). For brushtail possums (*Trichosaurus vulpecula*) the rate of breeding was similar among treatments, but there was no downward trend in population abundance due to increased births and immigration into highly sterilized groups (Ramsey 2005). Similarly, the annual rate of increase was comparable across groups of proportionally sterilized rabbits, also due to immigration and higher survival and recruitment of young in highly sterilized groups, despite lower production (Twigg et al. 2000). While immigration will not be an issue in many HMAs because they are closed populations, the compensatory demographic mechanisms of animals living longer and greater survival of offspring which reduced the effect of sterility in rabbits (Twigg et al. 2000) may play a role in wild horse populations.

While animals in previous sterilization studies have different social systems than horses, results at the individual level are likely to be similar. A common trend has been higher survival of sterilized females (Twigg et al. 2000, Saunders et al. 2002, Ramsey 2005, Jacob et al. 2008, Seidler and Gese 2012), and in rabbits sterilized females were also heavier and had greater longevity (Twigg et al. 2000). Sterilization affected predation rates in coyotes (Seidler et al. 2014) in which their prey preferences changed when they did not need to provision pups (Bromley and Gese 2001). Being free from the costs of reproduction will likely lead to mares remaining in better condition, and there is a possibility it will affect their habitat use.

Horses are anovulatory during the short days of late fall and early winter, beginning to ovulate as days lengthen and then cycling roughly every 21 days, with about 5 days of estrous (Asa et al. 1979, Crowell-Davis 2007). Estrus in mares is shown by increased frequency of proceptive behaviors: approaching and following the stallion, urinating, presenting her rear end, clitoral winking, and raising the tail towards the stallion (Asa et al. 1979, Crowell-Davis 2007). In most mammal species outside primates, estrus behavior is not shown during the anovulatory period, and reproductive behavior is considered extinguished following spaying. However, mares have been shown to continue to demonstrate estrus behavior during the anovulatory period, and even when ovariectomized (Asa et al. 1980a, Roessner et al. 2015, Crabtree 2016). This is due to non-endocrine support of estrous behavior in horses, specifically steroids from the adrenal cortex, and has the function of maintaining social cohesion within a group even outside the breeding season (Asa et al. 1980b, Asa et al. 1984).

Any action taken to alter the reproductive capacity of an individual has the potential to affect hormone production and therefore behavioral interactions and ultimately population dynamics in unforeseen ways (Ransom and Powers 2014); any research applying new techniques therefore must carefully record these effects. While no research has been conducted on the behavior of spayed mares in wild populations, anecdotal reports have suggested that they behave much like senescent mares ([redacted] USFWS, personal communication), and it would be expected that individual and population level responses may be similar to those seen in contracepted populations. At the individual level most studies of contracepted mares have found no change in activity budget, with minimal impact on home range size or movements (Gray and Cameron 2010), however group behavioral differences have been observed (Nuñez et al. 2009), and individuals receiving fertility control often have reduced mortality and increased longevity (Kirkpatrick and Turner 2008).

Radio collars have been widely used on ungulates to mark individuals and conduct research on their spatial ecology. We will use radio collars on wild horses to locate and monitor individuals and gain an understanding of their home range and habitat use. Previous habitat studies were conducted about 30 years ago (e.g., Miller 1983). Not only did none use GPS technology, but also the landscape has changed in that time due to differing agriculture practices and climate change (Parmesan and Galbraith 2004). Radio collars are also important for locating animals to conduct behavioral observations and to record data on fertility and fecundity. It is unlikely that spayed females will have changes in their spatial ecology, but being emancipated from constraints of lactation may mean they can spend more time away from water sources and increase their home range size. Lactating mares need to drink every day, but during the winter when snow can fulfill water needs or when not lactating, horses can traverse a wider area (Feist and McCullough 1976, Salter 1979).

4. Experimental Approach: (Not to exceed 5 pages)

Study Area

Warm Springs HMA covers 475,460 acres in eastern Oregon. The terrain consists of rolling hills and valleys which is optimal for radio telemetry tracking. The habitat consists primarily of sagebrush, and water sources are found across the HMA. For behavioral observations we need to be able to mark animals with radio collars or radio tags to locate them, and the horses in the population need to be somewhat accustomed to people so they would not have a severe flight distance (so behavioral observations and data collection would be possible). The herd must be undisturbed (no removals) for the duration of the study (3 years).

Gather and Radio Collaring/Tagging

After requirements for the National Environmental Policy Act (NEPA) are approved, wild horses will be gathered at Warm Springs HMA and brought to the BLM Oregon Wild Horse Corrals facility. Horses gathered from the two segments of the HMA will be kept separate at the facility and returned to the same area from where they were gathered. Two hundred horses will be returned to the HMA (100 in each herd segment), with a 50:50 sex ratio and a population structure representing all age classes. Mares with foals that are due to be released to the range will be kept together in the facility and released together. This sample size, and the methods used to monitor the on-range welfare, body condition, group fidelity and behavior of the horses, replicates an ongoing study in Utah of wild horse ecology and demography, and a study on the effect of gelding a proportion of stallions on wild horse behavior, ecology, and demography.

While horses are at the BLM facility we will collect hair follicles from all individuals that will be returned to the range. Also, annual fecal samples of new foals (and individuals that were not captured during the gather) will be collected throughout the study. These samples will be analyzed genetically to form a pedigree of both herd segments, enabling us to assess paternity of foals born during the study and to understand kinship between mares. Should spaying lead to lower group fidelity of mares these data will show whether or not they move with more closely related individuals, and whether spayed individuals within the population influences foal paternity by non-harem stallions. It will also allow us to quantify the sneak mating rate of non-harem holding stallions, and determine age of first reproduction for mares. These parameters will be used in modeling population growth.

Following BLM management protocol, animals to be turned out to the range will be given a freeze mark on their neck with a unique BLM identifier using the International Alpha Angle System, and the last four digits of this identifier will be freeze-marked on their left hip for field identification. The majority of horses in both populations will be fitted with radio collars (females ≥3 yrs only) or radio tags (stallions and 1-2 yr olds). A candidate pool of horses that can be returned to the range will be selected by BLM; the remainder (above AML) will not be returned to Warm Springs HMA. Of the candidate pool, researchers will randomly select based on age (to include all age classes), and sex. We acknowledge that not all animals may be collected during the gather. This will not affect our demography study design because we are focusing on a subset of the population and because we will be able to document any unmarked horses in the population once field crews are on the ground monitoring the population full time.

At the BLM facility we will fit horses with global positioning system (GPS) and very high frequency (VHF) radio collars or radio tags ([redacted]nstitutional Animal Care and Use Committee Approval 2015-10). Following the results of a preliminary captive trial at the BLM Pauls Valley adoption facility in Oklahoma ([redacted]et al. 2018, *in prep*) we will only be placing radio collars on females ≥3 years old (based on tooth wear estimation; McMullan 1983). In an ongoing study of free-roaming mares wearing radio collars, we have observed some minor rubbing abrasions from collars, and 6 of 129 collars were removed via remote drop off due to collars going over the ears of the mare. For this reason, we continue to monitor the welfare of collared individuals on a regular basis (1-2X per month).

Stallions will be radio tracked with GPS and/or VHF tags that will be braided in to their tails and secured to the hair with cable ties and a low temperature curing epoxy resin. GPS or VHF radio collars will be placed on 30 females per herd segment (60 total) that have a Henneke body condition score of 4 or greater (i.e., "moderately thin" and fatter; Henneke et al. 1983), stratified by adult age class (3-5, 6-10, 11-15, >16 years old). This is considered a normal level of body condition for horses that are at athletic fitness or living in wild conditions. Animals that are "thin" (Henneke score of ≤3), deformed, or who have any apparent neck problems will not be fitted with a collar. As tags are small (<75g) and are not worn around the neck they are considered insignificant or minimal burden to the animal, and therefore could potentially be worn by animals in lower body condition. Forty stallions (20 per herd segment; 12 per segment to be GPS transmitters) to be fitted with tail tags will be selected randomly but stratified by age. Only biologists experienced with fitting radio collars and tags on wild horses will be permitted to place them on animals. Placing radio collars and radio tags on horses at Warm Springs HMA will be part of a field test of radio collars in wild as opposed to captive conditions.

To monitor horse welfare effects of collars, all animals wearing a collar will be visually observed at least once a month during winter (October to March), and twice a month during spring/summer (April to September). This welfare monitoring is to assure collars remain in proper position on the animals' necks and do not cause any unforeseen problems for mares. Each radio collar will be equipped with a remote emergency release mechanism in case it needs to be removed.

A sample size of 20 males and 30 females per herd segment will result in a robust sample of the adult population being monitored with GPS and/or VHF radio locations. Collars or tags with GPS will be set to collect a fix (location) every 2 hours. VHF collars or tags will be used to locate animals to record behavior, births and deaths, body condition (following Henneke et al. 1983), and group composition throughout the year.

On-range behavioral observations

On-range behavioral observations will be conducted during the breeding season (March to September) each year, beginning the March after animals are returned to the range. We will need to allow time (~3 months) for social groups to re-establish over the winter after gather and release is completed. Individual horses will be referred to by the last four digits of their unique BLM numeric identifier or collar/tag frequency (not named). We will conduct behavioral observations on focal animals and their social groups, using focal animals to determine groups observed rather than selecting focal groups, as horses are likely to change groups during the study. In the treatment segment we will have 8 spayed and 8 non-spayed focal collared mares, and 16 non-spayed collared mares in the control segment, with 4 focal tagged stallions in each segment. As there are normally approximately 4 adults in a band (Linklater 2000), this means that although our number of focal animals is relatively small we will be gathering data on a larger number of individuals overall, including a greater number of males than the focal four as they are generally associated with females. Focal females will be distributed across adult age classes, and focal males will include stallions that are bachelors and harem stallions at the start of behavioral observations. Focal animals will determine which bands are observed, but otherwise behavior of all animals within a social group will be recorded. It is possible that more than one focal animal may be in a social group; this would not lead to pseudo-replication, but instead would result in more data gathered per individual in that group. If a focal animal changes groups then all members of the new group will be recorded. The same focal individuals will be followed throughout the study, so that we can compare treated animals with un-treated controls in the same population. Observers will be blind to treatment and control animals to the extent possible.

Due to the logistics of travel around the HMA we will stratify groups in to areas for observations, and then randomize focal animals within that area, ensuring that all focal animals are observed evenly but randomly. Horses spend over 50% of their time feeding and 20% of their time resting (Duncan 1979), with social interactions being rare. Therefore, many hours of observation are required to provide enough data for meaningful statistical analyses. With a crew of four field technicians we aim to gather 1600 to 1800 hours of observations per field season, which will be sufficient for statistical analyses. Examining 20 horses and their social associates represents coverage of the majority of the horses within each segment of the HMA. Our sample sizes are comparable to other equid studies; up to 19 radio collars were used to examine the ecology of wild equids (Kaczensky et al. 2011), although not all simultaneously, with most studies only having collars on four to ten individuals (Goodloe et al. 2000, Fischhoff et al. 2007, Girard et al. 2013, Owen-Smith and Goodall 2014). While some equid studies have conducted population-wide observations, such as those at the Pryor Mountains, Wyoming (Roelle et al. 2010) and the Granite Range, Nevada (Berger 1986), the number of focal animals we propose are comparable to most fine behavior studies (ranging from Bourjade et al. (2009) n=9, to Krueger et al. (2014) n=55).

Every 10 minutes during a 1-hour observation session the basic state of each individual (i.e., feeding, standing, moving, lying down) within a social group and the identity of their nearest neighbor will be recorded. These data will show whether treatment affects time budget and associations between individuals. All-occurrence sampling (Altmann 1974) will be used to record individuals involved in incidents of social behaviors such as agonistic behavior (e.g., bites, kicks) and affiliative behavior (e.g., mutual grooming, touch), and reproductive behavior (e.g., estrus behavior, mating and mating attempts, and scent marking behavior), as well as other behaviors such as nursing and vocalizations; detailed data will be taken at each event. These data will be used to examine if spaying affects social behavior of treated mares and the animals they associate with.

Population level effects
Aerial surveys for population estimation will take place in both herd segments before the initial gather, and then 1-2x annually for the remainder of the study. Population estimation will follow set guidelines for counting wild horses using published population estimation techniques, primarily double observer surveys (Lubow and Ransom 2016, Schoenecker and Lubow 2015). Foaling rates in both herd segments will be determined by visually observing mares wearing collars approximately twice a month between March and September. Foal survival will be determined by monitoring these same animals monthly during the rest of the year.

Table 1. Schedule
Preparation Period (Feb 2018 – Sep 2018)
a) Purchase/order radio collars and other equipment.
b) June 2018 conduct pre-gather aerial survey.

Year 1 (Oct 2018-Sep 2019)

a) October 2018 BLM conducts a gather of Warm Springs HMA.
b) Assess age of all females. Place radio tags on 20 adult males and radio collars on 30 adult females in spay herd segment, and the same number in non-spay herd segment. Collect tail hair samples from every individual (200 total) for genetic analyses.
c) BLM conducts management treatments of some mares.
d) BLM returns animals to the HMA,
e) USGS initiates field study: begin testing radio collars, locating radioed individuals 1-2x/month to check collars or tags, body condition, and presence of foals. Throughout winter 2018/2019 assess body condition and record social associations of radio marked horses.
f) Winter 2018/2019 fly aerial surveys in both spay and non-spay segments of the HMA.
g) March to September 2019 - collect data on social behavior, reproductive behavior, and band membership and fidelity using radio marks to locate focal individuals for observation.

Year 2 (Oct 2019-Sep 2020)

a) Winter 2019/2020 fly aerial surveys in both spay and non-spay segments of the HMA.
b) Continue the field study; field test of radio collared individuals by locating them 1-2x/month to check collars, body condition survival, and record presence of foals.
c) March to September 2020 - collect data on social behavior, reproductive behavior, and band membership and fidelity using radio marks to locate focal individuals for observation.

Year 3 (Oct 2020-Sep 2021)

a) Winter 2020/2021 fly aerial surveys in both spay and non-spay segments of the HMA.
b) Continue the field study; field test of radio collared individuals by locating them 1-2x/month to check collars, body condition, survival, and record presence of foals.
c) March to September 2021 - collect data on social behavior, reproductive behavior, and band membership and fidelity using radio marks to locate focal individuals for observation.

Year 4 (Oct 2021-Aug 2022)

a) Conduct data analyses and write/publish peer-reviewed papers.

5. Statistical Methods: (Not to exceed 1 page)

Population Estimation: Aerial survey data will be analyzed using current standards for all BLM surveys that collect data using simultaneous double observer with sightability covariates (Lubow and Ransom 2016).

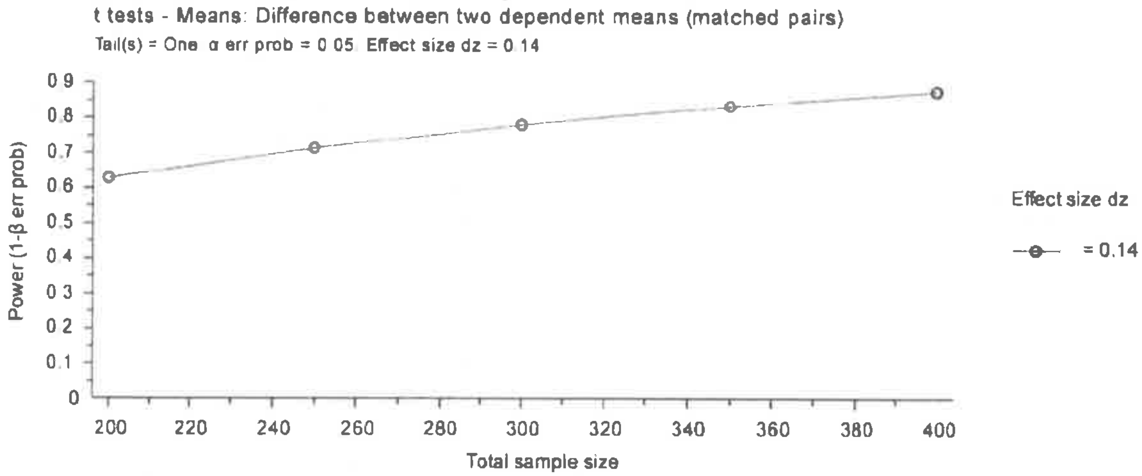
Population Growth: Annual population growth (of individuals ≥ 1 year old) will be calculated using the equation $\lambda_t = N_t / (N_{t-1})$, where λ_t is the growth multiplier from year $t - 1$ to year t, N is the population size. In this formulation, λ represents the apparent growth rate of the population (as used in Garrott and Taylor 1990). We will use known fate models for survival, based on observations of collared animals conducted 1-2x/month throughout the year (we assume foals of collared mares will be reliably detected at the same time as their mothers if alive). This will allow us to assess survival of adults and foals on a seasonal scale.

Body Condition: We will model body condition using mixed-effect regression with individual horse as a random effect on the intercept term to account for the repeated observations of individuals over time. We will model body condition response as a function of treatment, band stallion or bachelor status, age, and climate (temperature and precipitation). Climate data will be obtained from the National Climatic Data Center (http://www.ncdc.noaa.gov/oa/ncdc.html). Climate variables will be used in the model as a proxy for vegetation condition.

Herd Genetics: Genetic analyses of tail hair follicles and fecal samples will illustrate how relatedness may influence mare movements between groups, and reproductive success of stallions. In addition, it will provide information about parentage, age of first breeding, and episodes of sneak mating to be used in the new WinEquus II model (ongoing USGS project). All of these parameters will enable improved calibration of population models. Genotypes derived from tail hair and fecal samples will be analyzed using GenAlEx software (Peakall and Smouse 2006, 2012) or similar, to provide details about inbreeding coefficients and heterozygosity, and to form as complete a pedigree of the population as possible. The pedigree in combination with genotypes of known stallions will be used to assess the frequency of sneak matings and whether mares move to or with more closely related individuals when they disperse or change bands.

Behavior: Behavioral analyses will follow the analytical methodology of Ransom et al. (2010) and King (2002). On-range observations of each focal horse will be expressed as frequency of behavior (count/total hours observed per year). By weighting frequency of behavior per observational hour, unforeseen difficulties in obtaining an equal number of observations per individual will not negatively affect the model. We will model behavior as a function of age, sex, group size, time of day, month, and treatment. We are expecting to gather 320 to 360 hours of observation data per focal animal. A power test conducted in G*Power 3.1 (Faul et al. 2007) indicates that with a sample size of 300 observation hours, an alpha error probability of 0.05 and for a power of 0.8 we will achieve an effect size of dz = 0.14. Extrapolated, this gives us a power of 0.625 at 200 hours to 0.875 at 400 hours of observations per focal animal (Figure 1).

Figure 1. Power test of the number of observation hours per focal animal, based on an effect size at 300 observation hours (conducted in G*Power 3.1 (Faul et al. 2007)).



Movements and Spatial Ecology: Spatial data from both HMAs will be analyzed in ArcGIS following methods similar to King and Gurnell (2005). Utilization curves will be used to establish core range areas for each individual, and 90% and 95% kernel density estimates will be used to estimate home range size (Silverman 1986). We will use state-space models (e.g. Patterson et al. 2008) to examine differences in movement patterns between control and treated animals, and will assess any differences in movement rates (distance over time), home ranges, and minimum, maximum, and average distance to water.

6. Pitfalls and Limitations: (Not to exceed 1 page)

Use of radio collars and radio tags in this study will save a great deal of time locating focal animals and allow for 24-hour recording of movements and habitat use. However, a potential limitation is technological failure. GPS locations are dependent on the unit functioning correctly and the antenna having a clear view of the sky. We have tried to supplement the radio marked sample in in our study to account for some attrition.

Due to problems experienced previously when stallions were radio collared (National Research Council 1991) and some issues seen in the recent captive study at the BLM Pauls Valley adoption facility ([redacted] et al. *In prep*), we will not use radio collars on stallions, but will use radio tags instead. These have a greater attrition rate than collars because tail hair grows out and eventually expels the radio tag. No effects of collars on mares were found in the Pauls Valley study, thus we are now testing radio collars on free-roaming mares as part of this study. There have been several cases of a collar going over the ears of a mare in a test of free-roaming mares wearing radio collars (ongoing research). As such, we monitor the collar-wearers regularly. While every effort is being made to develop a collar that is safe and comfortable, and experienced personnel will fit them, we cannot rule out the possibility of an accident, complication, or mortality of a horse wearing a collar as part of research; although in the past 3 years USGS researchers have reported only some minor rubbing abrasions from collars and the few that went over the ears were removed. We are mitigating any potential mishap by affixing an emergency drop off mechanism on every collar, and by visually checking each collar 1-2x/month. All radio collared horses are closely monitored.

Another limitation may be if not all the horses are sufficiently habituated to observers to allow fine-scale behavioral data to be collected. While it is likely that animals will become habituated to observers over the course of the study, from the outset it is desirable to be able to approach within 50 m in order that subtle behaviors can be observed. If this is not possible we will use spotting scopes until the horses are accustomed to our presence.

7. Anticipated effects:

Gather

The gather will be conducted by the BLM following their established guidelines and policy (BLM IM 2015-151`). We anticipate that gathers will be carried out calmly and at as slow a speed as possible to minimize stress and injury, however it is possible that small injuries (e.g. abrasions) may occur. Due to the removal of animals after the gather to bring the population to AML, we expect mixing of the social bands, and individuals may not return to the same social group in which they were found before the gather. To assure this mixing does not affect the study, we will not conduct behavioral observations until at least 3 months after the animals have been returned to the range and settled into their bands.

Radio Collars and Tags

Based on other studies that have used GPS or VHF radio collars to study the ecology of wild ungulates we expect these devices to have minimal effects on the animals wearing them. However, the following effects are possible:

1. Collar going over the ear: In other equids this has been observed to happen in males (G. Collins, USFWS and P. Kaczensky NINA, per. commun.), which will therefore be fitted with tags rather than collars in this study. All animals wearing collars and tags will be observed at least once a month throughout the year. Should the collar go over the ear of mares the remote-release (also known as the drop-off mechanism) will be deployed remotely (by radio-tracking the individual and walking to within 200m of it). If this fails we expect that the collar will be removed after capturing the animal with helicopter drive trapping, bait or water traps or darting, depending on what options are best in the specific situation, and in keeping with BLM policy.
2. Neck abrasion/sores: Rubbing and sores have not been reported in other studies where equids have been collared (e.g., Collins et al. 2014), and were not seen in mares during the first 5 months of our collar test at Pauls Valley adoption facility, Oklahoma. We therefore do not anticipate a problem. All horses will be visually checked at least 1-2X monthly, and this check includes looking for rubbing or sores. Horses in the wild are susceptible to wounds, most of which heal relatively quickly. If sores caused by a collar have not healed within 4 weeks of when it was sighted, that individual will have its collar remotely triggered to drop off, or will be captured with bait or water traps or darting, depending on what options are best in the specific situation and according to BLM policy.
3. Collar too tight: Every effort will be made to put collars on at the correct tightness, which for horses means snug when the head is raised and looser when the head is lowered.

Should an individual put on an unusually large amount of weight it is conceivable that the collar may become too tight. In this case the collar will be removed with the remote release mechanism. If that fails we expect the collar will be removed after capturing the animal with helicopter drive trapping, bait or water trapping or darting, depending on what options are best in the specific situation, and in keeping with BLM policy.

4. Tags: We do not expect any effects of the tags. However, it is possible that they may form an irritation to individuals should vegetation get tangled in the tail. In this case we expect that the tag will ultimately rip out of the hair (leaving no injury) as the horse rubs it.

Aerial surveys

Flying population estimation surveys is part of established management for wild horses, but not typically conducted every year. It can cause stress to individuals, in which they flee, using energy resources in their flight response from the helicopter.

Individual behavior

We expect minimal effects of this project on individual behavior. Focal animal observations will necessarily be carried out at a distance such that they do not influence behavior.

Other

We anticipate some mortality and injuries due to the rigors of life in the wild, and specifically expect mortality of juveniles in early spring. These are natural processes. Quantifying survival (and therefore mortality events) is one of the aims of our study.

8. References:

Altmann, J. 1974. Observational study of behavior: sampling methods. Behaviour 49:227–267.

Asa, C. S., D. A. Goldfoot, and O. J. Ginther. 1979. Sociosexual behavior and the ovulatory cycle of ponies (*Equus caballus*) observed in harem groups. Hormones and Behavior 13:49–65.

Asa, C., D. A. Goldfoot, M. C. Garcia, and O. J. Ginther. 1980a. Sexual behavior in ovariectomized and seasonally anovulatory pony mares (*Equus caballus*). Hormones and Behavior 14:46–54.

Asa, C. S., D. A. Goldfoot, M. C. Garcia, and O. J. Ginther. 1980b. Dexamethasone suppression of sexual behavior in the ovariectomized mare. Hormones and Behavior.

Asa, C., D. Goldfoot, M. Garcia, and O. Ginther. 1984. The effect of estradiol and progesterone on the sexual behavior of ovariectomized mares. Physiology and Behavior 33:681–686.

Asa, C. S., J. E. Bauman, E. W. Houston, M. T. Fischer, B. Read, C. M. Brownfield, and J. F. Roser. 2001. Patterns of excretion of fecal estradiol and progesterone and urinary chorionic gonadotropin in Grevy's zebras (*Equus grevyi*): Ovulatory cycles and pregnancy. Zoo Biology 20:185–195.

Beever, E.A., R.J. Tausch, and W.E. Thogmartin. 2008. Multi-scale responses of vegetation to removal of horse grazing from Great Basin (USA) mountain ranges. Plant Ecology 196:163–184.

Beever E.A. and P.F. Brussard. 2004. Community- and landscape-level responses of reptiles and small mammals to feral-horse grazing in the Great Basin. Journal of Arid Environments 59:271–297.

Beever, E.A. and J.E. Herrick. 2006. Effects of feral horses in Great Basin landscapes on soils and ants: Direct and indirect mechanisms. Journal of Arid Environments 66:96–112.

Berger, J. 19 86. Wild horses of the Great Basin. University of Chicago Press, Chicago.

Boulanger, J. R., and P. D. Curtis. 2016. Efficacy of surgical sterilization for managing overabundant suburban white-tailed deer. Wildlife Society Bulletin 40:727–735.

Bourjade, M., L. Tatin, S. R. B. King, and C. Feh. 2009. Early reproductive success, preceding bachelor ranks and their behavioural correlates in young Przewalski's stallions. Ethology Ecology and Evolution 21:1–14.

Boyd, C.S., K.W. Davies, and G.H. Collins. 2017. Impacts of feral horse use on herbaceous riparian vegetation within a sagebrush steppe ecosystem. Rangeland Ecology and Management, 70(4):411-417.

Bromley, C., and E. M. Gese. 2001. Surgical sterilization as a method of reducing coyote predation on domestic sheep. The Journal of Wildlife Management 65:510–519.

Brooks, C. J., M. C. Bonyongo, and S. Harris. 2008. Effects of global positioning system collar weight on zebra behavior and location error. Journal of Wildlife Management 72:527–534.

Bureau of Land Management. 2010. 4710 - Management Considerations Manual. United States Department of the Interior.

Bussières, G., C. Jacques, O. Lainay, G. Beauchamp, A. Leblond, J. L. Cadoré, L. M. Desmaizières, S. G. Cuvelliez, and E. Troncy. 2008. Development of a composite orthopaedic pain scale in horses. Research in Veterinary Science 85:294–306.

Collins, G. H., S. L. Petersen, C. A. Carr, and L. Pielstick. 2014. Testing VHF/GPS collar design and safety in the study of free-roaming horses. PLoS ONE 9:e103189.

Collins, G.H. and J.W. Kasbohm. 2017. Population dynamics and fertility control of feral horses. Journal of Wildlife Management 81: 289-296.

Committee on Wild Horse and Burro Research. 1991. Wild Horse Populations: Field Studies in Genetics and Fertility. National Academy Press, Washington, D.C.

Crabtree, J. R. 2016. Can ovariectomy be justified on grounds of behaviour? Equine Veterinary Education 28:58–59.Crowell-Davis, S. L. 2007. Sexual behavior of mares. Hormones and Behavior 52:12–17.

Eberhardt, L. L., A. K. Majorowicz, and J. A. Wilcox. 1982. Apparent rates of increase for two feral horse herds. Journal of Wildlife Management 46:367–374.

Faul, F., E. Erdfelder, A.-G., Lang, and A. Buchner. 2007. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods 39: 175-191.

Feist, J. D., and D. R. McCullough. 1976. Behavior patterns and communication in feral horses. Zietschrift für Tierpsychologie 41:337–371.

Fischhoff, I. R., S. R. Sundaresan, J. E. Cordingley, and D. I. Rubenstein. 2007. Habitat use and movements of plains zebra (*Equus burchelli*) in response to predation danger from lions. Behavioral Ecology 18:725–729.

Garrott, R. A. 1995. Effective management of free-ranging ungulate populations using contraception. Wildlife Society Bulletin 23:445–452.

Garrott, R. A., and L. Taylor. 1990. Dynamics of a feral horse population in Montana. Journal of Wildlife Management 54:603–612.

Garrott, R. A., D. B. Siniff, and L. L. Eberhardt. 1991. Growth rates of feral horse populations. Journal of Wildlife Management 55:641–648.

Girard, T. L., E. W. Bork, S. E. Nielsen, and M. J. Alexander. 2013. Seasonal variation in habitat

selection by free-ranging feral horses within Alberta's Forest Reserve. Rangeland Ecology & Management 66:428–437.
Gleerup, K. B., and C. Lindegaard. 2016. Recognition and quantification of pain in horses: A tutorial review. Equine Veterinary Education 28:47–57.
Gleerup, K. B., B. Forkman, C. Lindegaard, and P. H. Andersen. 2015. An equine pain face. Veterinary Anaesthesia and Analgesia 42:103–114.
Gooch, A.M.J., S.L. Petersen, G.H. Collins, T.S. Smith, B.R. McMillan, and D.L. Eggett. 2017. The impact of feral horses on pronghorn behavior at water sources. Journal of Arid Environments 138:38-43.
Goodloe, R. B., R. J. Warren, D. A. Osborn, and C. Hall. 2000. Population characteristics of feral horses on Cumberland Island, Georgia and their management implications. Journal of Wildlife Management 64:114–121.
Gray, M. E., and E. Z. Cameron. 2010. Does contraceptive treatment in wildlife result in side effects? A review of quantitative and anecdotal evidence. Reproduction 139:45–55.
Gray, M. E., D. S. Thain, E. Z. Cameron, and L. A. Miller. 2010. Multi-year fertility reduction in free-roaming feral horses with single-injection immunocontraceptive formulations. Wildlife Research 37:475–481.
Greger, P. D., and E. M. Romney. 1999. High foal mortality limits growth of a desert feral horse population in Nevada. Great Basin Naturalist 59:374–379.
Hall, L.K., R.T. Larsen, M.D. Westover, C.C. Day, R.N. Knight, and B.R. McMillan. 2016. Influence of exotic horses on the use of water by communities of native wildlife in a semi-arid environment. Journal of Arid Environments 127:100-105.
Hall, S. E., B. Nixon, and R. J. Aitken. 2017. Non-surgical sterilisation methods may offer a sustainable solution to feral horse (*Equus caballus*) overpopulation. Reproduction, Fertility and Development 29:1655–1666.
Henneke, D. R., G. D. Potter, J. L. Kreider, and B. F. Yeates. 1983. Relationship between condition score, physical measurements and body fat percentage in mares. Equine Veterinary Journal 15:371–372.
Hobbs, N. T., D. C. Bowden, and D. L. Baker. 2000. Effects of fertility control on populations of ungulates: general, stage-structured models. Journal of Wildlife Management 64:473–491.
Hooper, R. N., T. S. Taylor, D. D. Varner, and T. L. Blanchard. 1993. Effects of bilateral ovariectomy via colpotomy in mares: 23 cases (1984-1990). Journal of the American Veterinary Medical Association. 203:1043-1046.
Jacob, J., G. R. Singleton, and L. A. Hinds. 2008. Fertility control of rodent pests. Wildlife Research 35:487.
Kaczensky, P., R. Kuehn, B. Lhagvasuren, S. Pietsch, W. Yang, and C. Walzer. 2011. Connectivity of the Asiatic wild ass population in the Mongolian Gobi. Biological Conservation 144:920–929.
Kahn, V.W. and W. Leidl. 1987. Die ultraschall-biometric von pferdefeten in utero und die sonographische darstellung ihrer organe (The ultrasound biometry of horse fetuses in utero and the sonographic representation of their organs; article written in German). Deutsche Tierarztliche Wochenschrift 94:497-540.
Killian, G., D. S. Thain, N. K. Diehl, J. Rhyan, and L. A. Miller. 2008. Four-year contraception rates of mares treated with single-injection porcine zona pellucida and GnRH vaccines and intrauterine devices. Wildlife Research 35:531.
King, S. R. B. 2002. Behavioural ecology of Przewalski horses (*Equus przewalskii*) reintroduced

to Hustai National Park, Mongolia. Queen Mary, University of London, London.

King, S. R. B., and J. Gurnell. 2005. Habitat use and spatial dynamics of takhi reintroduced to Hustai National Park, Mongolia. Biological Conservation 124:277–290.

King, S. R. B., and J. Gurnell. 2006. Scent-marking behaviour by stallions: an assessment of function in a reintroduced population of Przewalski horses (*Equus ferus przewalskii*). Journal of Zoology 272:30–36.

Kirkpatrick, J. F., and A. Turner. 2008. Achieving population goals in a long-lived wildlife species (*Equus caballus*) with contraception. Wildlife Research 35:513.

Krueger, K., B. Flauger, K. Farmer, and C. K. Hemelrijk. 2014. Movement initiation in groups of feral horses. Behavioural Processes 103:91–101.

Linklater, W. L. 2000. Adaptive explanation in socio-ecology: lessons from the Equidae. Biological Reviews 75:1–20.

Loesch, D. A., and D. H. Rodgerson. 2003. Surgical approaches to ovariectomy in mares. Continuing Education for Veterinarians 25:862–871.

Lubow, B.C. and J.I, Ransom. 2016. Practical bias correction in aerial surveys of large mammals: validation of hybrid double-observer with sightability method against known abundance of feral horse (*Equus caballus*) populations. PLoS ONE 11(5): e0154902. doi:10.1371/journal.pone.0154902

McMullan, W. C. 1983. Dental criteria for estimating age in the horse. Equine Practitioner 5:36-43.

Merrill, J. A., E. G. Cooch, and P. D. Curtis. 2006. Managing an overabundant deer population by sterilization: effects of immigration, stochasticity and the capture process. The Journal of Wildlife Management 70:268-277.

Miller, R. 1981. Male aggression, dominance and breeding behaviour in Red Desert feral horses. Zietschrift für Tierpsychologie 57:340–351.

Miller, R. 1983. Seasonal movements and home ranges of feral horse bands in Wyoming's Red Desert. Journal of Range Management 36:199–201.

Nuñez, C. M. V., J. S. Adelman, and C. Mason. 2009. Immunocontraception decreases group fidelity in a feral horse population during the non-breeding season. Applied Animal Behaviour Science 117:74–83.

Owen-Smith, N., and V. Goodall. 2014. Coping with savanna seasonality: comparative daily activity patterns of African ungulates as revealed by GPS telemetry. Journal of Zoology 293:181–191.

Pader, K., L. J. Freeman, P. D. Constable, C. C. Wu, P. W. Snyder, and T. B. Lescun. 2011. Comparison of Transvaginal Natural Orifice Transluminal Endoscopic Surgery (NOTES{®}) and Laparoscopy for Elective Bilateral Ovariectomy in Standing Mares. Veterinary Surgery 40:998–1008.

Parmesan, C., and H. Galbraith. 2004. Observed impacts of global climate change in the U.S. Pew Center on Global Climate Change.

Patterson, T. A., L. Thomas, C. Wilcox, O. Ovaskainen, and J. Matthiopoulos. 2008. State-space models of individual animal movement. Trends in Ecology and Evolution 23:87–94.

Peakall, R., and P. E. Smouse. 2006. GENALEX 6: Genetic analysis in Excel. Population genetic software for teaching and research. Molecular Ecology Notes 6:288–295.

Peakall, R., and P. E. Smouse. 2012. GenALEx 6.5: Genetic analysis in Excel. Population genetic software for teaching and research-an update. Bioinformatics 28:2537–2539.

Pollari, F. L., and B. N. Bennett. 1996. Evaluation of postoperative complications following elective surgeries of dogs and cats at private practices using computer records. The Canadian Veterinary Journal 37:672–678.

Prado, T., and J. Schumacher. 2017. How to perform ovariectomy through a colpotomy. Equine Veterinary Education 1–5.

Price, J., S. Catriona, E. M. Welsh, and N. K. Waran. 2003. Preliminary evaluation of a behaviour-based system for assessment of post-operative pain in horses following arthroscopic surgery. Veterinary anaesthesia and analgesia 30:124–137. Association of Veterinary Anaesthetists and American College of Veterinary Anesthesia and Analgesia.

Pritchett, L. C., C. Ulibarri, M. C. Roberts, R. K. Schneider, and D. C. Sellon. 2003. Identification of potential physiological and behavioral indicators of postoperative pain in horses after exploratory celiotomy for colic. Applied Animal Behaviour Science 80:31–43.

Ramsey, D. 2005. Population dynamics of brushtail possums subject to fertility control. Journal of Applied Ecology 42:348–360.

Ransom, J. I., and J. G. Powers. 2014. Ecological feedbacks can reduce population□level efficacy of wildlife fertility control. Journal of Applied Ecology 51:259–269.

Ransom, J. I., B. S. Cade, and N. T. Hobbs. 2010. Influences of immunocontraception on time budgets, social behavior, and body condition in feral horses. Applied Animal Behaviour Science 124:51–60.

Ransom, J. I., J. E. Roelle, B. S. Cade, L. Coates-Markle, and A. J. Kane. 2011. Foaling rates in feral horses treated with the immunocontraceptive porcine zona pellucida. Wildlife Society Bulletin 35:343–352.

Ransom, J. I., J. G. Powers, H. M. Garbe, M. W. Oehler Sr., T. M. Nett, and D. L. Baker. 2014. Behavior of feral horses in response to culling and GnRH immunocontraception. Applied Animal Behaviour Science 157:81–92.

Röcken, M., G. Mosel, K. Seyrek-Intas, D. Seyrek-Intas, F. Litzke, J. Verver, and A. B. M. Rijkenhuizen. 2011. Unilateral and bilateral laparoscopic ovariectomy in 157 mares: a retrospective multicenter study. Veterinary Surgery 40:1009–1014

Rocky Mountain CESU. 2014. Cooperative joint venture agreement between U.S. Department of Interior, Bureau of Land Management, U.S. Geological Survey; and Colorado State University. USGS No. G14AC00138, Article II, Section A, No. 7.

Roelle, J. E., F. J. Singer, L. C. Zeigenfuss, J. I. Ransom, L. Coates-Markle, and K. A. Schoenecker. 2010. Demography of the Pryor Mountain Wild Horses, 1993–2007. pubs.usgs.gov. U.S. Geological Survey Scientific Investigations Report 2010-5125.

Roessner, H. A., K. A. Kurtz, and J. P. Caron. 2015. Laparoscopic ovariectomy diminishes estrus-associated behavioral problems in mares. Journal of Equine Veterinary Science 35:250–253. Elsevier Ltd.

Salter, R. E. 1979. Biogeography and habitat-use behavior of feral horses in western and northern Canada. Pages 129–141 *in*. Symposium on the Ecology and Behaviour of Wild and Feral Equids, University of Wyoming, Laramie.

Sanborn, L. J. 2007. Long-Term Health Risks and Benefits Associated with Spay / Neuter in Dogs.

Saunders, G., J. McIlroy, M. Berghout, B. Kay, E. Gifford, R. Perry, and R. van de Ven. 2002. The effects of induced sterility on the territorial behaviour and survival of foxes. Journal of Applied Ecology 39:56–66.

Schoenecker, K.A., and B.C. Lubow. 2015. Application of a hybrid model to reduce bias and improve precision in population estimates for elk (*Cervus elaphus*) inhabiting a cold desert ecosystem. Journal of King Saud University Science, Special Issue on Arid Ecosystems.

Seidler, R. G., and E. M. Gese. 2012. Territory fidelity, space use, and survival rates of wild coyotes following surgical sterilization. Journal of Ethology 30:345–354.

Seidler, R. G., E. M. Gese, and M. M. Conner. 2014. Using sterilization to change predation rates of wild coyotes: a test case involving pronghorn fawns. Applied Animal Behaviour Science 154:83-92.

Silverman, B. W., 1986, Density Estimation for Statistics and Data Analysis: London, Chapman and Hall.

Spain, C. V., J. M. Scarlett, and K. A. Houpt. 2004. Long-term risks and benefits of early-age gonadectomy in dogs. Journal of the American Veterinary Medical Association 224:380–387.

Turner, R.M., S.M. McDonnell, E.M. Feit, E.H. Grogan, and R. Foglia. 2006. How to determine gestational age of an equine pregnancy in the field using transrectal ultrasonographic measurement of the fetal eye. Proceedings of the American Association of Equine Practitioners 52:250-255.

Twigg, L. E., T. J. Lowe, G. R. Martin, A. G. Wheeler, G. S. Gray, S. L. Griffin, C. M. O'Reilly, D. J. Robinson, and P. H. Hubach. 2000. Effects of surgically imposed sterility on free-ranging rabbit populations. Journal of Applied Ecology 37:16–39.

Wagner, A. E. 2010. Effects of Stress on Pain in Horses and Incorporating Pain Scales for Equine Practice. Veterinary Clinics of North America - Equine Practice 26:481–492.

E. FACILITIES STATEMENT

BLM Wild Horse and Burro Program
Proposal for Collaborative Research Effort

Privileged Communication

Describe the facilities, equipment, assays etc. available for use in this project. (not to exceed 1 single-spaced page)

USGS [redacted] will provide office space, information technology resources, vehicle and field trailer rental, and administrative support. Laboratory space and equipment for genetic analyses will be provided by the USGS [redacted] Equipment necessary for extracting and amplifying DNA is already purchased and available; overhead costs for this study help to support genetics lab maintenance [redacted]

F. DETAILED BUDGET FOR EACH 12 MONTH PERIOD

YEAR 1: Oct 2018 to Sep 2019

Salary & Wages (Describe % effort or hours for each person)

Item	USGS In-kind	BLM in-kind	Project Cost
[redacted]	10,000		
GS 7/9 Crew Leader (20% time)			13,600
Sr. field tech, Mar-Sep			34,432
Field tech control herd, Mar-Sep			28,720
Field tech spay herd (Sr.), Mar-Sep			34,432
Field tech spay herd, Mar-Sep			28,720
Student hourly data entry and proofing (summer; 4 months)	8001		
Subtotal	18,001		139,904

Equipment & Supplies

Item	USGS Direct	BLM in-kind	Project Cost
Radio collars (24 Vectronic GPS @ $2200/collar= $52,800; and 20 Vertex Survey collars @$850/collar=$17,000	17,000		52,800
20 new plus 16 replacement emergency drop-off mechanisms @$500 each			18,000
Radio tags (24 GPS tags @ $1,200 each)			28,800
Radios/walkie talkies (4 @ $80 each)	320		
4 Telemetry Receivers (@ $795), antennas x4 (@ $75)	3,480		
Binoculars x4 @$280 each; scopes x2 @485 each	2,090		
Misc. supplies or equipment for trailer or other	500		
Subtotal	23,390		99,600

Animal Costs (Including board and maintenance)

Item	USGS Direct	BLM in-kind	Project Cost
BLM gather in Aug 2018 to bring herd to AML and deploy collars/tags ($700K); Emergency capture[1]($20K)		$720,000	0
Subtotal		$720,000	0

Miscellaneous Costs– Itemize

Item	USGS Direct	BLM in-kind	Project Cost
Lab analysis genetic samples, 240 samples @$80 each	19,200		
Trailer site rental in Oregon ($525/month x 12 months)			6,300
Aerial survey pre gather June 2018		10,000	
Aerial survey post gather winter 2018/2019		10,000	
Travel: pre gather Aerial survey; 1 USGS observer for 3 nights @ $135/night= $405 , vehicle rental= $350; airport parking= $41; airfare= $300			1096
Travel: post gather Aerial survey; 1 USGS observer for 3 nights @ $135/night= $405 , vehicle rental= $350; airport parking= $41; airfare= $300			1096
Travel: 2 GOVs for field crew ; 7 mos (Mar-Sep) @ $1K/month/GOV			14,000
Travel to field site in 2019	1,500		2,800
Subtotal	20,700		25,292

[1] Emergency capture will only be necessary in the event a collar remote release mechanism fails. Emergency capture will consist of water or bait trapping and/or darting.

	USGS	BLM	Project
Total	62091	740,000	264,796

Indirect Costs: $ 97,405
TOTAL: $ 362,201
AMOUNT REQUESTED OF BLM: $ 362,201

YEAR 2: Oct 2019 to Sep 2020

Salary & Wages

Item	USGS In-kind	BLM in-kind	Project Cost
[redacted]	10,000		
GS 7/9 Technician/crew leader (20% time)			13,600
Non-student hourly cntrl herd (senior field tech), Mar-Sep			34,432
Non-student hourly control herd, Mar-Sep			28,720
Non-student hourly spay herd (Senior field tech), Mar-Sep			34,432
Non-student hourly spay herd, Mar-Sep			28,720
Winter field tech Oct 2019-Feb 2020 (5 months)			23,790
Student hourly data entry, proofing (summer; 4 months)	9,001		
Subtotal	34,001		163,694

Equipment & Supplies

Item	USGS Direct	BLM in-kind	Project Cost
Replacement equipment	600		
Subtotal	600		0

Animal Costs (Including board and maintenance)

Item	USGS Direct	BLM in-kind	Project Cost
Emergency capture if needed[2]		20,000	0
Subtotal	0	20,000	0

Miscellaneous Costs– Itemize

Item	USGS Direct	BLM in-kind	Project Cost
Lab analysis fecal samples. 40 foal samples @$80 each			3,200
Trailer site rental in Oregon ($525/month x 12 months)			6,300
Annual aerial population survey and foal count		10,000	
Travel: annual Aerial survey; 1 USGS observer for 3 nights @ $135/night= $405 , vehicle rental= $350; airport parking= $41; airfare= $300			1096
GOVs for 2 field crews Mar-Sep; 2K/month x 7 months			14,000
1 GOV for winter fieldwork $1K/month for 5 months			5,000
Travel to field sites in 2020	1,500		2,800
Subtotal	1,500	10,000	32,396
Total	**36,101**	**10,000**	**196,090**

Project Total: $196,090
Indirect Costs: $ 72,132
TOTAL: $268,222
AMOUNT REQUESTED OF BLM: $268,222

[2] Emergency capture will only be necessary in the event a collar remote release mechanism fails. Emergency capture will consist of water or bait trapping and/or darting.

YEAR 3: Oct 2020 to Sep 2021

Salary & Wages

Item	USGS In-kind	BLM in-kind	Project Cost
[redacted]	10,000		
GS 7/9 Technician/crew leader (20% time)			13,600
Non-student hourly contrl herd (senior field tech), Mar-Sep			34,432
Non-student hourly control herd, Mar-Sep			28,720
Non-student hourly spay herd (Senior field tech), Mar-Sep			34,432
Non-student hourly spay herd, Mar-Sep			28,720
Winter field tech Oct 2019-Feb 2020 (5 months)			23,790
Student hourly data entry, proofing (summer; 4 months)	9,001		
Subtotal	34,001		163,694

Equipment & Supplies

Item	USGS In-kind	BLM in-kind	Project Cost
Replacement Equipment	800		0
Subtotal	800		0

Animal Costs (Including board and maintenance)

Item	USGS In-kind	BLM in-kind	Project Cost
No gathers, except for emergency capture if needed[3]		20,000	0
Subtotal		20,000	0

Miscellaneous Costs– Itemize

Item	USGS In-kind	BLM in-kind	Project Cost
Lab analysis fecal samples, 40 foal samples @$80 each			3,200
Trailer site rental in Oregon ($525/month x 12 months)			6,300
Annual aerial population survey and foal count		10,000	
Travel: annual Aerial survey; 1 USGS observer for 3 nights @ $135/night= $405 , vehicle rental= $350; airport parking= $41; airfare= $300			1096
GOVs for 2 field crews Mar-Sep; 2K/month x 7 months			14,000
1 GOV for winter field work $1K/month for 5 months			5,000
Travel to field sites in 2021	1,500		2,800
Subtotal		10,000	
			32,396
Total	**36,301**	**10,000**	**196,090**

Project Total: $196,090
Indirect Costs: $ 72,132
TOTAL: $268,222
AMOUNT REQUESTED OF BLM: $268,222

[3] Emergency capture will only be necessary in the event a collar remote release mechanism fails. Emergency capture will consist of water or bait trapping and/or darting.

YEAR 4: Oct 2021 to June 2022

Salary & Wages

Item	USGS Direct	BLM in-kind	Project Cost
Data Analyst (tbd)	25,000		0
[redacted]	21,000		0
Subtotal	46,000		0

Equipment & Supplies

Item	USGS Direct	BLM in-kind	Project Cost
None			0
Subtotal			0

Animal Costs (Including board and maintenance)

Item	USGS Direct	BLM in-kind	Project Cost
			0
Subtotal			0

Miscellaneous Costs– Itemize

Item	USGS Direct	BLM in-kind	Project Cost
Funding for data analyses support	40,000		0
Publication charges $1,400 x 3	4,200		0
Subtotal	44,200		0
Total	**90,200**	**0**	**0**

Indirect Costs: $0
TOTAL: **$0**
AMOUNT REQUESTED OF BLM: $0

G. HUMANE CARE AND USE OF ANIMALS

BLM Wild Horse and Burro Program
Proposal for Collaborative Research Effort / Grant Application

This study will require restraining wild horses within a padded squeeze panel for the fitting of collars. We will not use chemical immobilization for radio collaring or tail tagging.
No other direct contact will be made with living animals. Collars will be designed to drop off at the end of the study period and will be fitted with remote release mechanisms for earlier release if needed. All procedures will follow protocols approved by USGS Animal Care and Use Committee.

Protocol number: [redacted]***/ACUC 2015-10***

Title of proposal: Field use and testing of radio telemetry collars and radio tags on free-roaming wild horses and burros in the Western United States.

Investigators: [redacted]

Pursuant to procedures established by the Bureau of Land Management, Wild Horse and Burro Research Program, I certify that the above described protocol follows guidelines set forth in the National Institutes of Health "Guide for the Care and Use of Laboratory Animals" (#85-23) and the "Animal Welfare Act of 1966" (PL 89-544) as amended.

Signature: ___*(Please see attached signature page)*_ Date __7-13-2015___

Name: ___[redacted]___
Chair, Institutional Animal Care and Use Committee

Name of Institution: ___U.S. Geological Survey [redacted]_

NOTE: This completed form must be in receipt of the BLM WH&B Research Coordinator before the initiation of funding or collaborative work can commence. Private individuals must seek local/regional institutional approval.

G. HUMANE CARE AND USE OF ANIMALS

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

[redacted]

July 13, 2015

To: [redacted]

From: [redacted] IACUC Chair

Re: [redacted] IACUC Approval of Study Plan entitled "Field use and testing of radio telemetry collars and radio tags on free-roaming wild horses and burros in the Western United States."([redacted] IACUC Approval 2015-10).

After completion of preliminary review of your submission (6/17/15), PI review and resubmission (7/7/15), your [redacted] IACUC document has been approved ([redacted] IACUC Approval 2015-10). This approval is good for 3 years, at which time the PI will need to request an extension and report on the current progress of this project.

Just a reminder that the [redacted] IACUC has a minimum of 10 working days to complete their preliminary review. With committee review, PI review, and resubmission of amended document, this review process can take up to 20 working days (1 month), so please plan accordingly. PIs cannot start their field or laboratory research with animals until the [redacted] IACUC approval has been given.

Sincerely,

[redacted]

[redacted] IACUC Chair

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
[redacted]

March 13, 2018

To: [redacted]

From: [redacted] IACUC Chair

Re: [redacted] IACUC Amendment Extension Request for [redacted] IACUC Approval 2015-10 "Field use and testing of radio telemetry collars and radio tags on free-roaming wild horses and burros in the Western United States."([redacted] IACUC Approval 2015-10).

The PIs original approval and amendment request detailing additional field trapping methods were last approved on 11/17/15, due for 3 year review on 11/17/18. On 3/10/18, the PIs requested an extension of these approved protocols through 11/17/21. Given that all the animal care and use methods will be the same as the approved [redacted] IACUC 2015-10, this extension amendment is approved.

These protocols/amendment approvals are good for 3 years (until 11/17/2021), at which time the PIs will need to inform the [redacted] IACUC of project continuation or completion.

If you have any additional questions, feel free to contact me.

Sincerely,

[redacted]

[redacted] IACUC Chair

FOR BLM USE ONLY, DATE RECEIVED ____________

FOR BLM USE ONLY, PROPOSAL # ____________
(MM-YY####)

USGS [redacted]
Proposal of Live Animal Use for Research

Section I. Background

1. Study Plan Title
   Field use and testing of radio telemetry collars and radio tags on free-roaming wild horses and burros in the Western United States.

2. Principal Investigator(s)
   [redacted]

   a. Contact telephone number(s)
      [redacted]

3. Other Personnel
   Bureau of Land Management (BLM) Wild Horse and Burro Program staff and contractors involved in animal gathers. Other USGS and Colorado State University employees or field technicians will be involved for data collection and tracking individuals.

4. Consulting Veterinarian (**REQUIRED).** The Consulting Veterinarian's duty is to review your IACUC form for any procedures that may cause pain and distress in animals, animal medical care suggestions, and to make themselves available for consultation on animal care emergencies that may occur during your project. If you are having problems finding a Consulting Veterinarian, please contact the [redacted] ACUC Chair for assistance.

   a. DVM contact telephone numbers
      The following individuals will serve as consulting veterinarians for study areas located in their specific state and HMA or facility:

<u>Utah:</u>
Axtell Facility: [redacted]
Delta Facility: [redacted]
Cedar City Corrals: [redacted]
Price/San Rafael Area: [redacted]

<u>Wyoming:</u>
[redacted]

Arizona:

[redacted]

Oregon:

[redacted]

Other locations:

[redacted].

5. Project Timeline

   a. Proposed starting date

      We will deploy radio telemetry collars and/or tags potentially starting fall/winter 2015/2016 (between September 2015 and March 2016), and fall/winter 2016/1017. The exact date will be determined pending BLM staff availability and gather dates. Additional gathers to re-deploy collars with new batteries will take place in fall/winter 2017/2018 and 2018/2019, pending BLM staff schedules and gather dates.

6. Duration

   Collars will be deployed no more than five years on any single individual, during which time animals will be observed in the field (to check collars) ≥ 1 x/month. We will request an extension to our IACUC after 3 years, and provide a short report with our extension request.

Section II. Species Information

1. Species to be used (scientific and common names)

   Equus ferus caballus feral horse, and *Equus asinus* burro (i.e., feral donkey).

2. Species Status (please make sure you have the proper federal and state permits)

   a. Is this species protected?

      Yes.

   b. If so, how and where?

      Feral horses and burros are protected by the Wild and Free-Roaming Horses and Burros Act of 1971 (92 P.L. 195) on lands where they occurred at the time the Act was passed, and other areas where they are managed by the BLM.

   c. If so, do you have or applied for appropriate permits? Provide permit numbers and source.

The formal written approval of our proposal by BLM serves as the permit for this study, although an approved IACUC petition is necessary to receive this written approval. BLM will complete a NEPA document and any necessary Environmental Assessments for each population in which we deploy radio collars or radio tags.

3. Quantity, sex and age of animals to be used in study.
   We will put radio collars or tags on up to 300 individual wild horses (mares and stallions) and up to 100 individual wild burros (jennies only) in multiple herd management areas. We will radio collar only adult age classes (animals ≥3 years old), and radio tags may be used on yearlings or foals (braided into the mane or tail).

4. Source of animals.
   Research animals will be within free-ranging horse and burro populations in Herd Management Areas in the western United States (Utah, Arizona, Wyoming, Nevada, California, Oregon, Colorado). Exact study sites (HMAs) are still being finalized by BLM, but [redacted] have been approved.

Section III. Rationale for and appropriateness of the species and numbers of animals used. A rationale for the appropriateness of the species and numbers of animals used is required (e.g., is it the right species for project? are there alternatives (models, lab animal models) that could be used instead? are the sample sizes adequate to address the issue?). It is recommended that statistical information, e.g., a power analysis of your sample size, or a literature review of similar studies regarding appropriate sample sizes, be included in this section.

In early 2015 we conducted a three-month trial of four different models of radio collars and two different models of radio tags on captive wild horses and burros at the Bureau of Land Management (BLM) Pauls Valley holding facility in Oklahoma (under [redacted] IACUC 2014-07 and [redacted] IACUC 2014-14). The results of this study [redacted] showed minimal effects of collar wear on individuals. Therefore we now wish to conduct field testing by deploying radio collars on free-roaming wild horses and burros. Our goal is to deploy radio collars in multiple HMAs and observe collared individuals ≥1x/month to determine the safety, longevity, and percent of calamities, accidents, or mortalities due to the use of radio collars on free roaming wild equids. Similar to other North American ungulates that have been radio collared, we expect some small percent of mortality from capture, handling, or radio collars. The effects of capture operations and radio collars vary among species, but in general studies that quantify the effects of tags on their bearers are rare with only10.4% of 836 studies directly assessing the effect of radio tags on their bearers in a 2003 review (Godfrey and Bryant 2003). In wild mountain goats radio collars had no effect on kid production or female dominance status and did not affect survival, foraging efficiency, or time spent alert for either sex (Armeno et al. 2006). One wild equid mortality due to a radio collar was reported by colleagues in Mongolia (and 70 collars without incident; [redacted], University Vienna, pers. commun. 2015). Research on root vole survival relative to radio collars reported no difference in mortality between animals wearing collars compared to those that did not wear collars (Johannesen et al. 1997), but little to no research has been conducted on free-roaming wild horses and burros.

In addition to field testing radio collars and tags on free-roaming wild horses and burros, we seek to deploy radio collars in multiple HMAs to answer a variety of research questions, including: examining demography of wild horse and wild burro populations (using collars or tags to locate specific age and sex classes for survival and recruitment), determining seasonal movements and spatial ecology with GPS collar locations, evaluating the behavioral effects of gelding stallions and spaying mares (using collars or tags to locate focal animals for collecting behavior data), improving burro census techniques (using collars for mark-resight model), and habitat selection studies (using high-fix-rate GPS collars to record habitat selection). Radio collars that can store GPS locations have been used to examine spatial ecology of most wild ungulates in North America. We aim to deploy radio collars on free-roaming wild horses and burros to gather the same data that has been available for other ungulates but is not yet available for wild equids.

Our total sample size will be ≤ 300 individual wild horses and up to 100 individual jennies (female burros) in HMAs in the western United States. We currently have 4 wild horse HMAs and 2 burro HMAs that have been approved for research using radio collars, with the potential to add additional sites. Each study area that has been selected so far has a population size of about 100 animals; we will collar up to 30 mature individuals (≥3 years old) in each HMA, with an additional ≤ 40 radio tags braided into the mane or tail of adults, yearlings, and/or foals. One HMA will have mostly mares radio collared, while another will [redacted] deploy radio tags on males. Collaring studies examining the social ecology of wild equids have deployed up to 19 collars (Kaczensky et al. 2011), with most studies on social ecology only having collars on four to ten individuals (Goodloe et al. 2000, Fischhoff et al. 2007, Girard et al. 2013, Owen-Smith and Goodall 2014). The small sample sizes used in these studies on social ecology are not robust enough for demography studies. The general rule-of-thumb for ungulate studies is 1/3 of the adult population should be radio-collared for spatial ecology and demography studies. We are also expecting and accounting for some attrition in our collar sample.

Section IV. Written narrative for alternatives to painful procedures. As required by AWA Section 13(a)(3)(B)9 CFR, Part 2, Section 2.31 (d)(1)(ii) provide a narrative of databases searched, sources consulted and alternatives considered so that no other sources of animals or techniques were available to prevent a painful or distressful procedure. Include in this section:

1. A literature review should include animal care and use methods, alternatives to painful procedures, as well as an assurance that no alternatives to the use of these live animals are available. Literature reviews may include online databases searches (e.g., Google search with keywords used) and animal care and use manuals for your specific taxa. Acceptable guidelines for animal use have been provided by professional societies e.g., the American Society of Mammalogists, American Society of Ichthyologists and Herpetologists, American

Fisheries Society, The Wildlife Society, Society for the Study of Amphibians and Reptiles, American Ornithologists' Union.

2. Information demonstrating that this research does not unnecessarily duplicate research that has already been published or taken place.
3. Also include information on what length of time may the animal suffer from stress or pain.

This application to radio collar free-roaming wild horses and burros is a field test of radio collars and radio tags that were developed in a previous study of captive wild horses and wild burros ([redacted] IACUC 2014-07 and [redacted] IACUC 2014-14). The field test will occur in multiple HMAs, and will also include studies of demography and spatial ecology, evaluation of the behavioral effects of gelding stallions and spaying mares, improving burro census techniques, and habitat selection studies. There are surprisingly few scientific studies on the home range and habitat use of wild horses and burros in the American west, with almost all being published more than 30 years ago, and none from the United States within the last 10 years. Because there is such a lack of recent literature on the ecology of wild horses and especially burros, the studies we are proposing will provide important and novel data.

The main invasive and/or stressful procedures required for the radio collar and tag field test is gathering the animals at the start of the study to deploy the collars and tags, and at the end of Year 2 to replace radio collar batteries. On some individuals, particularly yearlings and foals in which radio collars were not tested in the captive trial and may be unsafe, we will braid a radio tag in to the mane or tail in place of a collar. While gathered we will collect tail hairs for genetic analyses, which is minimally invasive. Prior experience collecting this genetic material from bison showed that most animals did not react when a few tail hairs were pulled. In addition, pulling tail hairs for genetic analysis has been standard practice in BLM gathers in some herds for at least 5 years.

In order to identify individual burros that are not wearing radio collars, we will rely on BLM's standard procedure of freeze-marking individuals on the rump (i.e., this proposed USGS study will use existing freeze-marked burros, and BLM will be conducting additional freeze-marking as part of their management activities, and we may utilize these individuals as well.) Horses are identifiable by their unique pelage markings, but burros are identical to one another. Individual identification is vital for recording accurate demographic data. The BLM routinely freeze-marks animals that they remove from the range. This technique is not only commonly used for marking ownership of domestic livestock, but is an accepted way of marking wild animals (Sikes et al. 2011). Behavioral observations will be non-intrusive, and will be specifically conducted at a distance beyond which the observer causes any reaction from the focal individuals.

Gathers that are conducted to radio collar and radio tag wild equids will be carried out by Bureau of Land Management (BLM) personnel, conducted following BLM guidelines and methods (BLM IM 2013-059). In gathers, helicopters are used to move animals slowly to corrals. BLM procedure sometimes involves the use of men on horses to rope burros that do not enter corrals. BLM may use this procedure if there is no other alternative. In some HMAs BLM will use bait traps to capture wild equids using water, hay, or mineral blocks as bait. These low-intensity methods will be used whenever possible. Water traps consist of a fence placed around a water source, with other water sources closed for up to 72 hours, in order to encourage wild horses or burros to enter.

Once gathered, all animals are held in corrals and adults are separated into a chute system, ending in a padded fly chute or hydraulic squeeze where they can be restrained for radio collar or tag application. During the previous study to test different models of radio collars in captive conditions ([redacted] IACUC 2014-07 and [redacted] IACUC 2014-14) it took between 4 and 17 minutes to fit a collar on mares, stallions, and burros (average of 21 collars was 9 minutes). Braiding radio tags into the mane and tail (2 people working simultaneously) took between 3 and 18 minutes. We expect free roaming horses to be more anxious than the wild horses at Paul's Valley Adoption Facility that were getting somewhat accustomed to people. Thus we anticipate it will take longer, even up to 25 minutes, to deploy radio collars. Individual wild equids will also be aged through dental wear by an experienced veterinarian, which should take 1-2 minutes. Thus wild horses may be restrained in the padded fly chute or padded squeeze chute for up to 27 minutes. Wild burros just stand still, so no squeeze chute is required or used. Burros will come through the chute or simply through narrow fencing that can be closed at both ends so the burro can't move out. We will record capture times and squeeze/restraint times during our collaring and tagging for each individual.

Experienced BLM personnel will herd animals through the chutes. Collars and tags will be put in place by experienced USGS and CSU personnel, using experience gained from the previous captive collar study ([redacted] IACUC 2014-07 and [redacted] IACUC 2014-14). These procedures should not cause any pain to the animal, but being in close proximity to humans is not natural for wild horses or burros and will cause stress. We will work to reduce the stress on animals by working as quickly and efficiently as possible, and using quiet voices and low tones. Collars will only be placed on adults (≥3 years old) that are in good body condition. Recent studies that have collared equids have not reported any injuries or deaths despite using chemical restraint (etorphine hydrochloride and the reversal drug was diprenorphine hydrochloride, see Bartlam-Brooks et al. 2013 for further details), and we had no injuries while applying collars in our previous study. In the winter of Year 2 or Year 3 a second gather will take place following the same methods as in Year 1. During this gather batteries will be replaced in collars as necessary. Animals will be kept in corrals for no longer than 24 hours. If corral facilities at the HMA are not sufficient we will transport animals to a BLM holding facility. In this case animals may be held in corrals for up to 3 weeks, although we don't think this will be necessary for radio collaring.

Section V. Care and Housing

1. Where and how will the animals be housed?
   Animals will be gathered into corrals for fitting collars. Corrals used at the HMA will be either existing facilities used by BLM for previous gathers, or will be built specifically for this project. If facilities at the HMA are not sufficient for applying radio collars or tags we will transport animals to a nearby BLM short-term holding facility (for example,

the Delta Wild Horse and Burro Holding Facility in Utah, or the Rock Springs Adoption Facility in Wyoming).

2. Do other IACUC protocols apply through other facilities or organizations? (If so provide a copy.)
   No other protocols apply for the field testing of radio collars and tags. However, two previously-approved ACUC protocols are relevant to this application:
   [redacted] *IACUC 2014-07* and [redacted] *IACUC 2014-14*

3. Length of time of housing?
   When gathered for the application of collars animals will be held in a corral for no more than 24 hours.

4. Purpose of housing? (ie. holding, breeding, etc.)
   Animals will be kept only as long as necessary for applying collars or braiding mane/tail tags, assuring proper fit, and any routine processing that is conducted by BLM at their gathers.

5. Describe any abnormal behavioral or physical conditions the animal may be exposed to.
   During gathers, animals are exposed to stress as they are moved towards the corrals via helicopter. They are held in corrals and may be briefly separated from their social groups. Animals will be subject to restraint in a padded squeeze-chute.

6. How will the animals be housed? Type of caging, number of animals to a cage, size of caging and any restraints.
   Animals will be gathered into corrals, and physically separated from other horses, although usually not visually. The size and dimensions of the corrals will be determined by BLM, and will follow guidelines they have established (BLM IM 2013-059). The animals will not be restrained except for when in a squeeze chute. No cages will be involved.

7. Describe the type of food and food source.
   While retained in corrals grass hay will be provided to wild horses and burros, and fresh water.

8. Describe method, quantity and frequency of feeding.
   Grass hay will be provided in corrals in sufficient quantity to provide, in combination, 2–3% of body weight per day, per individual.

9. Describe frequency and method of cleaning, including any chemicals used, individual cleaning tools, etc.
   Because corrals for gathers are temporary, fecal material in corrals is allowed to decompose naturally; thus, no cleaning is required. Water tanks in corrals will be cleaned after each gather with a handheld brush and household chlorine bleach, followed by

thorough rinsing with clean water, then stored dry. In more permanent Adoption or Holding Facility corrals automatic waterers are provided.

Section VI. Capture and Handling

1. Describe any capture or handling method.
Experienced BLM personnel will gather horse groups into corrals following BLM IM 2013-059, using either helicopters or bait traps. If these methods are not sufficient animals near the corrals may be gently roped by men on horses, following the BLM Standard Operating Procedure (BLM IM 2013-059). Once gathered, animals are coaxed towards a separate corral and alley leading to a padded fly chute or hydraulic squeeze chute. Horses will be encouraged to move through the chutes by BLM personnel using flags and/or shaker paddles to provide visual and auditory stimuli. Animals will be individually restrained in the chute for collar or tag application. All movements by humans will be conducted in a calm and quiet manner. Once all handling has been conducted and all personnel are clear, the animal will be released from the chute to the corrals, and then released back to the wild.

2. How often are traps checked or animals handled?
If bait or water traps are used they will be monitored consistently until the horses are inside, at which time gates will be shut to contain them. Each animal will be handled twice: when the collar is initially put in place during the first gather in year 1, and a second time in year 2 or 3 to replace batteries in the collar. Animals are not likely to be handled a third time for removal of collars because collars will have a remote drop-off mechanism. However, if the remote drop-offs fail, study animals may need to be handled a third time to remove collars.

   Behavioral observations of a subset of animals and their groups will be conducted at least bi-weekly between May and September, and all collared animals will be checked monthly the rest of the year. This will not require handling of animals.

3. Describe any injuries that may occur from this method.
Horses and burros may receive bumps, bruises, and minor cuts when moving through chutes. More serious injuries such as lacerations or fractures of the head, neck, or limbs can also occur if animals collide with panels or gates. These serious injuries are very rare in BLM facilities, affecting less than one half of one percent of horses even during the initial capture process when wild equids are not accustomed to moving through chutes. By using low-stress methods and creating a low-stress environment, we aim to minimize any injury.

4. Describe other methods considered and why they were rejected.
Wild horses are not amenable to being fitted with radio collars or having their tails braided without any form of restraint, so 'no restraint' was eliminated from consideration. Burros are much more docile and are unlikely to be "squeezed" in the chute. Burros tend to stand still, and simply having them in a small space should be sufficient to apply radio

collars. Bait and water traps will be used whenever possible in both burro and wild horse HMAs. Darting is not efficient, and impossible in most HMAs due to the size of the landscape (typically 350K-500K acres) and the flight distance of wild horses, where they remain outside of dart range. Aerial netgunning, which is common for other wild ungulates, is too dangerous for wild horses as they are large bodied and when running at top speeds can easily break their necks when they fall after being netted. BLM has a tremendous amount of experience handling horses over the past 40+ years since the WH&B Act was passed, and we are relying on their humane judgement about the best methods to capture and restrain wild horses and burros for collar and tag application.

5. What types of manipulations are required during handling? Describe all methods of restraint used, including catch poles, straps, anesthetics etc.
   The only restraint used will be the padded squeeze chute or fly chute, or on rare occasions a lasso or lead rope. The only manipulations required will be access to the neck or tail of a horse for application of a radio collar or mane tag or tail tag, and access to the neck or rump of a burro for application of a radio collar

6. How long will the animals be restrained?
   Affixing the collars or tags should take ≤ 25 minutes. No collared animal will be restrained for more than 30 minutes. We will have a stopwatch or timer on hand to mark our time and we will record these data on a datasheet.

7. How will the animal be monitored to prevent overt risk or stress?
   All handling will be done by BLM personnel experienced in working with and handling wild horses. A veterinarian with experience working with wild horses will be present to evaluate the health of each individual, and all personnel will be experienced at observing equids. Animals will be monitored for signs of stress such as eye-rolling, extended nostrils, and sudden sweating. Experienced personnel will monitor the overall condition and well-being of the animals.

   Typically for other ungulates researchers monitor their temperature with a rectal thermometer and release the wild ungulate once it reaches a certain temperature indicative of stress. We have found this to be ineffective for wild horses because they really don't overheat like ungulates subjected to capture myopathy, and the most important variable seems to be monitoring their breathing and watching for any coughing. In the captive trial at Pauls Valley, we occasionally unsqueezed individuals to adjust them in the chute, or if they were coughing and there was indication that they were struggling. We had no injuries in the squeeze chute during the captive trial.

Section VII. Invasive Procedures (this includes any tissue sampling, use of syringes/injections, or anesthesia other than normal capture, handling, and marking of animal).

1. Does the procedure expect survival or non-survival?

Survival.

2. If surgery is involved, describe the reason for the procedure.
   No surgery is required for the field test of radio collars or tags.

3. Describe any surgical procedure.
   N/A

4. Describe any anesthetic used or injections given including proposed dosages.
   N/A

5. How will the anesthetic be administered?
   N/A

6. Who will be in charge or the surgery and anesthetic?
   N/A

7. What of type training have they received in this method?
   N/A.

8. What type of pre and post-surgical care will be provided?
   N/A

9. Describe other procedures, drugs, frequency, etc. that may be used during the study.
   A small number of hairs (10-20) including the follicle will be pulled from the tail of each animal for genetic analyses.

Section VIII. Transportation

1. What is the purpose of transporting the animal?
   Animals will be transported to nearby BLM holding facilities if the corrals at the HMA are not sufficient or safe for applying radio collars or radio tags (although we think this is unlikely to be needed due to the availability of a fly chute at both wild horse research locations in Utah and Wyoming).

2. What method of transportation will be used?
   The BLM will provide any transport of animals, and it will therefore follow their guidelines of being a stock-type trailer with rear swing gates and a covered top, with the floor covered with a non-skid material.

3. What type of restraint, caging etc. will be used during transportation?
   None. Animals will be free to move within the trailer.

4. How will the animal be monitored during transportation?

It is not safe for a human observer to travel in the truck with wild horses so they will not be observed directly during transportation.

5. What safeguards have been provided to prevent escape, injury or overt stress?
Trailers will have no protruding or sharp edges which can cause injury and are designed to carry livestock and prevent their escape. Overt stress will be minimized by not transporting animals in temperatures over 82°F.

Section IX. Marking (banding, tagging, radio collaring, etc.)

1. What is the purpose of marking the animal?
Use of a VHF collar or tag will enable animals to be located quickly and efficiently for behavioral observations thus maximizing the amount of data that can be collected, and enabling a more robust study design that incorporates randomness into selecting individuals for collecting behavior data. Collars or tags will also be used to locate animals to gather data on group composition and individual body condition, and demographic parameters. Spatial data gathered by GPS collars will provide information on home range and habitat use of feral horses and burros. Additionally the collars will be used to conduct mark-resight population estimation. Marking also enables individual identification of each of the study animal for herd demographic parameters.

2. What alternative methods were considered?
Marking of animals with some kind of radio-collar or tag is the only feasible way to obtain data on spatial ecology and habitat use when horses are in the wild, due to the need for fixes every 20 minutes. Although direct observations could be conducted, it would require intensive personnel time with unreasonable labor costs to be a realistic alternative. Radio collars are the most common means of tagging wild ungulates.

3. Is the marking technique potentially hazardous?
One published study showed an effect on zebra movements from a marginally heavier collar (Brooks et al. 2008), and if they do not fit correctly, collars may cause abrasions to the neck or cheek, and could lead to development of an abscess under the jaw. We will use a collar that has been determined through experimental testing to be appropriate for equids (see [redacted] IACUC 2014-07 and [redacted] IACUC 2014-14), and we will be monitoring individuals intensively. However, in the event that an animal is in distress due to a collar, we are planning to use radio collars equipped with a remotely operated release mechanism that can be engaged to remove the collar.

This project constitutes the first field trial of radio collars developed in the previous study. Once in the wild it is possible that horses will be involved in situations that were not available in a captive setting, and we therefore cannot rule out mortality or injury of collared animals.

4. Is restraint or anesthetics required?

Yes. Animals will be restrained in a padded squeeze chute or fly chute for radio collars and tags to be affixed.

Section X. Disposition of Animals After the Study and Euthanasia

1. **What will be done with the animals upon completion of the study?**
   All animals will continue to be free-roaming on their respective HMA, as managed by the BLM.

2. **If euthanasia is considered, provide the method to be used including any drugs, personnel, training in the technique, etc.**
   No euthanasia will be required as an endpoint of the study. If required for emergency veterinary reasons, euthanasia will be guided by BLM policy. If required, the procedure would be performed by trained BLM personnel or the attending veterinarian using a method approved by BLM and the American Veterinary Medical Association: either gunshot to the brain or a lethal intravenous overdose of barbiturate (sodium pentobarbital 390 mg + sodium phenytoin 50 mg/ml administered at a rate of 1ml/10 lbs). BLM personnel who perform euthanasia by gunshot are trained in doing so by a veterinarian.

3. **How and where will dead animals be disposed of? Will permits be required?**
   If deaths occur while free-roaming carcasses will be left for natural processes and scavengers. If they occur during gathers, carcasses will be buried on site in accordance with local sanitation requirements. Permits are not required.

Literature cited

Arnemo, J. M., P. Ahlqvist, R. Andersen, F. Berntsen, G. Ericsson, J. Odden, S. Brunberg, P. Segerström, and J. E. Swenson. 2006. Risk of capture-related mortality in large free-ranging mammals: experiences from Scandinavia. Wildlife Biology 12:109–113.

Bartlam-Brooks, H. L. A., P. S. A. Beck, G. Bohrer, and S. Harris. 2013. In search of greener pastures: Using satellite images to predict the effects of environmental change on zebra migration. Journal of Geophysical Research: Biogeosciences 118:1427–1437.

Brooks, C. J., M. C. Bonyongo, and S. Harris. 2008. Effects of global positioning system collar weight on zebra behavior and location error. Journal of Wildlife Management 72:527–534.

Fischhoff, I. R., S. R. Sundaresan, J. E. Cordingley, and D. I. Rubenstein. 2007. Habitat use and movements of plains zebra (*Equus burchelli*) in response to predation danger from lions. Behavioral Ecology 18:725–729.

Girard, T. L., E. W. Bork, S. E. Nielsen, and M. J. Alexander. 2013. Seasonal variation in habitat selection by free-ranging feral horses within Alberta's Forest Reserve. Rangeland Ecology & Management 66:428–437.

Godfrey, J.D., and D.M. Bryant. 2003. Effects of radio transmitters: Review of recent radio-tracking studies. Pp. 83-95 *in*: Williams, M. (Comp.) 2003: Conservation applications of measuring energy expenditure of New Zealand birds: Assessing habitat quality and costs of carrying radio transmitters. *Science for Conservation 214*. 95p.

Goodloe, R. B., R. J. Warren, D. A. Osborn, and C. Hall. 2000. Population characteristics of feral horses on Cumberland Island, Georgia and their management implications. Journal of Wildlife Management 64:114–121.

Internal Memo (IM) 2013-059. 2013. Wild horse and burro gathers comprehensive animal welfare policy. US DOI, Bureau of Land Management. 3pp.

Johannesen, E., H.P. Andreassen, and H. Steen. 1997. Effect of radio collars on survival of root voles. Journal of Mammalogy 78:638-642.

Kaczensky, P., R. Kuehn, B. Lhagvasuren, S. Pietsch, W. Yang, and C. Walzer. 2011. Connectivity of the Asiatic wild ass population in the Mongolian Gobi. Biological Conservation 144:920–929.

Owen-Smith, N., and V. Goodall. 2014. Coping with savanna seasonality: comparative daily activity patterns of African ungulates as revealed by GPS telemetry. Journal of Zoology 293:181–191.

Sikes, R. S., W. L. Gannon, Animal Care and Use Committee of the American Society of Mammalogists. 2011. Guidelines of the American Society of Mammalogists for the use of wild mammals in research. Journal of Mammalogy 92:235–253.

The Use of Radio Collars on Wild Horse Mares and Burro Jennies

The study of animal behavior and ecology requires understanding the daily life of the focal species (King 2013). It is common to use radio collars fitted with VHF transmitters, GPS recorders, or satellite transmitters to obtain and record data on movement and other activities of individuals in a population. While most radio collars are considered to be minimally invasive, they can impose a cost on the animal carrying them. Thus guidelines have been developed for a weight ratio (that is, a collar should not exceed 5% of the animal's body weight) and best practice in their use (Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee 1998, Sikes et al. 2011). Collars have the potential to cause injury to the animal wearing them. However when the collar is fitted correctly and monitored regularly it can provide invaluable data without any impact on the study animal.

Telemetry collars have been used extensively on carnivores (Germain et al. 2008, Creel and Christianson 2009, Hunter et al. 2010, e.g. Broekhuis et al. 2013, Cozzi et al. 2013, Dellinger et al. 2013), rodents (Chambers et al. 2000, Solomon et al. 2001, Koprowski et al. 2007), and some ungulates (Johnson et al. 2000, Creel et al. 2005, Ito et al. 2005, Allred et al. 2013, Buuveibaatar et al. 2013, Latombe et al. 2013), however they have not been commonly used on equids. A few studies have used this tool to examine habitat use, movements, and behavior of zebra (Fischhoff et al. 2007, Sundaresan et al. 2007, Brooks and Harris 2008) and Asiatic wild asses (Kaczensky et al. 2006, 2008, 2011). Even fewer published studies have used telemetry collars on feral horses (Committee on Wild Horse and Burro Research 1991, Asa 1999, Goodloe et al. 2000, Hampson et al. 2010).

Although some research has been conducted on wild horse use of vegetation and habitat (e.g. Beever and Brussard 2000), little has been done recently, and long-term, fine-scale data on habitat use has never been gathered. Yet it is important that resource managers have a scientifically-based understanding of wild equid seasonal habitat use and movements on public lands. Due to the scale of some of the Herd Management Areas (HMAs) it is logistically challenging to collect habitat use data via direct observation. Utilization of GPS and VHF collars for marking and locating individuals can provide fine-scale data about where wild equids spend their time and how they use habitat.

Radio collars consist of a 2-inch wide strap/belt made of soft pliable plastic-like material (Figure 1). Some are oval shaped with adjustments on both sides of the collar, and others are teardrop shaped with adjustments at the top of the collar so it can be fitted to different neck sizes. This is the most optimal shape for the neck of equids. Attached to the belt of the collar is a battery pack and transmitter module. These may either be combined in the same unit, or placed at the top and bottom of the collar to counterbalance each other. The size of the battery is determined by the amount of power needed, both in terms of length of deployment, and how much data will be recorded by the collar.

Fitting of the collar

Fitting a collar on an equid requires an understanding of the neck circumference and shape; that is, when the head of the animal is raised the collar should be tight, and when the head is down grazing the collar will become looser (Figures 2, 3). The collar should rest just behind the ears of the equid and be tight enough so it does not slip down the neck, yet loose enough that it does not interfere with movement when the neck is flexed. The collar must fit snugly to minimize rubbing. USGS researchers use 0-1 finger between collar and neck, depending on season collar is deployed to give consideration to the potential for weight gain. Other studies (e.g. Committee on Wild Horse and Burro Research 1991) have had problems with the fitting of collars due to animals gaining weight in spring, or losing weight in winter, causing collars to become too tight or too loose. Whenever collars are deployed they should be fitted by experienced personnel who can attach the collar quickly but proficiently to minimize handling stress on the animal, and should be monitored at least 1x/month in the field. Collars can be placed on horses' necks when wild horses are in a padded squeeze chute during a gather. It takes between 7 and 12 minutes to fit a collar on the animal.

Figure 1. Two collar designs that are appropriate for wild horses and burros; one is teardrop shaped, and the other is oval shaped from Collins et al. (2014).

Figure 2. Burro jenny fitted with a radio collar showing appropriate placement higher on the neck, behind ears, and snugly fit when head is up.

Figure 3.Wild horse mare fitted with a radio collar illustrating head up and head down, and showing appropriate placement of collars higher on the neck just behind the ears.

References

Allred, B. W., S. D. Fuhlendorf, T. J. Hovick, R. Dwayne Elmore, D. M. Engle, and A. Joern. 2013. Conservation implications of native and introduced ungulates in a changing climate. Global Change Biology 19:1875–1883.

Asa, C. S. 1999. Male reproductive success in free-ranging feral horses. Behavioural Ecology and Sociobiology 47:89–93.

Beever, E. A., and P. F. Brussard. 2000. Examining ecological consequences of feral horse grazing using exclosures. Western North American Naturalist 60:236–254.

Broekhuis, F., G. Cozzi, M. Valeix, J. W. McNutt, and D. W. Macdonald. 2013. Risk avoidance in sympatric large carnivores: reactive or predictive? J. Fryxell, editor. Journal of Animal Ecology 82:1098–1105.

Brooks, C. J., and S. Harris. 2008. Directed movement and orientation across a large natural landscape by zebras, *Equus burchelli antiquorum*. Animal Behaviour 76:277–285.

Buuveibaatar, B., T. K. Fuller, A. E. Fine, B. Chimeddorj, J. K. Young, and J. Berger. 2013. Changes in grouping patterns of saiga antelope in relation to intrinsic and environmental factors in Mongolia. Journal of Zoology 291:51–58.

Committee on Wild Horse and Burro Research. 1991. Wild Horse Populations: Field Studies in Genetics and Fertility. nap.edu. National Academy Press, Washington, D.C.

Collins et al. 2014.

Creel, S., and D. Christianson. 2009. Wolf presence and increased willow consumption by Yellowstone elk: implications for trophic cascades. Ecology 90:2454–2466.

Creel, S., J. Winnie Jr, B. Maxwell, K. Hamlin, and M. Creel. 2005. Elk alter habitat selection as an antipredator response to wolves. Ecology 86:3387–3397.

Fischhoff, I. R., S. R. Sundaresan, J. Cordingley, and D. Rubenstein. 2007. Habitat use and movements of plains zebra (*Equus burchelli*) in response to predation danger from lions. Behavioral Ecology 18:725–729.

Germain, E., S. Benhamou, and M. L. Poulle. 2008. Spatio-temporal sharing between the European wildcat, the domestic cat and their hybrids. Journal of Zoology 276:195–203.

Goodloe, R. B., R. J. Warren, D. A. Osborn, and C. Hall. 2000. Population characteristics of feral horses on Cumberland Island, Georgia and their management implications. Journal of Wildlife Management 64:114–121.

Hampson, B. A., M. A. de Laat, P. C. Mills, and C. C. Pollitt. 2010. Distances travelled by feral horses in "outback" Australia. Equine Veterinary Journal 42:582–586. <http://eutils.ncbi.nlm.nih.gov/entrez/eutils/elink.fcgi?dbfrom=pubmed&id=21059064&retmode=ref&cmd=prlinks>.

Hunter, C. M., H. Caswell, M. C. Runge, E. V. Regehr, S. C. Amstrup, and I. Stirling. 2010. Climate change threatens polar bear populations: a stochastic demographic analysis. Ecology 91:2883–2897.

Ito, T. Y., N. Miura, B. Lhagvasuren, D. Enkhbileg, S. Takatsuki, A. Tsunekawa, and Z. Jiang. 2005. Satellite tracking of Mongolian gazelles (*Procapra gutturosa*) and habitat shifts in their seasonal ranges. Journal of Zoology 269:291–298.

Johnson, B. K., J. W. Kern, M. J. Wisdom, S. L. Findholt, and J. G. Kie. 2000. Resource selection and spatial separation of mule deer and elk during spring. Journal of Wildlife Management 64:685–697.

Kaczensky, P., D. P. Sheehy, C. Walzer, D. E. Johnson, D. Lhkagvasuren, and C. M. Sheehy. 2006. Room to Roam? The Threat to Khulan (Wild Ass) from Human Intrusion. Mongolia Discussion Papers, East Asia and Pacific Environment and Social Development Department. Washington, D.C.: World Bank.

Kaczensky, P., O. Ganbaatar, H. von Wehrden, and C. Walzer. 2008. Resource selection by sympatric wild equids in the Mongolian Gobi. Journal of Applied Ecology 45:1762–1769.

Kaczensky, P., R. Kuehn, B. Lhagvasuren, S. Pietsch, W. Yang, and C. Walzer. 2011. Connectivity of the Asiatic wild ass population in the Mongolian Gobi. Biological Conservation 144:920–929.

King, S. R. B. 2013. Przewalski's Horses and Red Wolves. Importance of Behavioral Research for Species Brought Back from the Brink of Extinction. Pages 153–158 *in* M. Bekoff, editor. Ignoring Nature No More. University of Chicago Press, Chicago.

Koprowski, J. L., S. R. B. King, and M. J. Merrick. 2007. Expanded home ranges in a peripheral population: space use by endangered Mt. Graham red squirrels. Endangered Species Research 3:105–110.

Latombe, G., D. Fortin, and L. Parrott. 2013. Spatio-temporal dynamics in the response of woodland caribou and moose to the passage of grey wolf. Journal of Animal Ecology.

Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee. 1998. Wildlife Radio-telemetry. Second edition.

Sikes, R. S., W. L. Gannon, Animal Care and Use Committee of the American Society of Mammalogists. 2011. Guidelines of the American Society of Mammalogists for the use of wild mammals in research. Journal of Mammalogy 92:235–253.

Sundaresan, S. R., I. R. Fischhoff, and D. I. Rubenstein. 2007. Male harassment influences female movements and associations in Grevy's zebra (*Equus grevyi*). Behavioral Ecology 18:860–865. <http://www.beheco.oxfordjournals.org/cgi/doi/10.1093/beheco/arm055>.

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Welfare Monitoring Datasheet

Date: ____/____/____ *Observer/s*: __________

Time: ____:____ *Obs UTM:* *Obs distance to animals*: _____m

BLM ID #: _________ *Sex (circle)*: Male Female

Body condition (circle): 1 2 3 4 5 6 7 8 9 (see over for description)

Foal at foot? N/A No Yes - Foal ID_____

Telemetry type (circle): Collar Tag *VHF frequency*: ___________

View of (circle): left head/neck right head/neck gullet

Collar/tag marks/wear? YES NO *Additional description/comments*:

Other individuals with the collared/tagged animal:

BLM ID#:	Sex:	Age:	Color/markings (if no BLM ID#)

Data written on reverse? Y N

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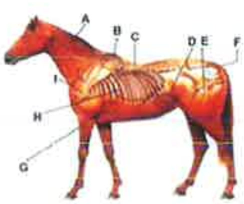
science for a changing world

Welfare Monitoring Datasheet

Other comments:

Kentucky Equine Research

BODY CONDITION SCORING CHART



Areas of Emphasis for Body Condition Scoring

- A: Thickening of the neck
- B: Fat covering the withers
- C: Fat deposits along backbone
- D: Fat deposit on flanks
- E: Fat deposits on inner thigh
- F: Fat deposits around tailhead
- G: Fat deposit behind shoulder
- H: Fat covering ribs
- I: Shoulder blends into neck

1 *Poor*

Animal extremely emaciated; spinous processes, ribs, tailhead, tuber coxae, and tuber ischii projecting prominently; bone structure of withers, shoulders, and neck easily noticeable; no fatty tissue can be felt.

2 *Very Thin*

Animal emaciated; slight fat covering over base of spinous processes; transverse processes of lumbar vertebrae feel rounded; spinous processes, ribs, tailhead, tuber coxae, and tuber ischii prominent; withers, shoulders, and neck structure faintly discernable.

3 *Thin*

Fat buildup about halfway on spinous processes; transverse processes cannot be felt; slight fat cover over ribs; spinous processes and ribs easily discernable; tailhead prominent, but individual vertebrae cannot be identified visually; tuber coxae appear rounded but easily discernable; tuber ischii not distinguishable; withers, shoulders, and neck accentuated.

4 *Moderately Thin*

Slight ridge along back; faint outline of ribs discernable; tailhead prominence depends on conformation, fat can be felt around it; tuber coxae not discernable; withers, shoulders, and net not obviously thin.

5 *Moderate*

Back is flat (no crease or ridge); ribs not visually distinguishable but easily felt; fat around tailhead beginning to feel spongy; withers appear rounded over spinous processes; shoulders and neck blend smoothly into body.

6 *Moderately Fleshy*

May have slight crease down back; fat over ribs fleshy/spongy; fat around tailhead soft; fat beginning to be deposited along sides of withers, behind shoulders, and along sides of neck.

7 *Fleshy*

May have crease down back; individual ribs can be felt, but noticeable filling between ribs with fat; fat around tailhead soft; fat deposited along withers, behind shoulders, and along neck.

8 *Fat*

Crease down back; dificult to feel ribs; fat around tailhead very soft; area along withers filled with fat; area behind shoulder filled with fat; noticeable thickening of neck; fat deposited along inner thighs.

9 *Extremely Fat*

Obvious crease down back; patchy fat appearing.

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Henneke et al. 1983

Illustrations by Japan Racing Association

Data written on reverse? Y N

Date: ___/___/___ *Observer/s*: _________

Start time: ____:____ *UTM*: ____________________ *Distance to animals*: _____m

Focal indiv BLM ID# _______

☐ + ☐ + ☐ + ☐ = ☐

Adult males + # Adult females + # yearlings + # foals = Total in group

Temperature: Below freezing / Cold / Cool / Warm / Hot

Precipitation: None / Mist / Light rain / Heavy rain / Snow/ice

Cloud cover: None / Partly cloudy / Mostly cloudy / Overcast

Wind: Still / Light wind / Gusty / Very windy

5 minute instantaneous scan samples: *Record behavior and nearest neighbor of each individual every 5 minutes*

	BLM ID#:		BLM ID#:		BLM ID#:		BLM ID#:		BLM ID#:		BLM ID#:	
Scan time	Activity	NN	Activity	NN	Activity	NN	Activity	NN	Activity	NN	Activity	NN
5												
10												
15												
20												
25												
30												
35												
40												
45												
50												
55												
60												

Add data here if the group is larger than 6 individuals

	BLM ID#:		BLM ID#:		BLM ID#:		BLM ID#:		BLM ID#:		BLM ID#:	
Scan time	Activity	NN	Activity	NN	Activity	NN	Activity	NN	Activity	NN	Activity	NN
5												
10												
15												
20												
25												
30												
35												
40												
45												
50												
55												
60												

Notes:

Focal indiv BLM ID#_______ Date: ___/___/___ Start time: _____ Observer: _______

All occurrence sampling:

Time start	Time stop	Actor ID:	Recipient ID:	Behavior

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240-0036
http://www.blm.gov

September 25, 2015

In Reply Refer To:
4720 (260) P

EMS TRANSMISSION 09/29/2015
Instruction Memorandum No. 2015-151
Expires: 09/30/2018

To: All Field Office Officials (except Alaska)

From: Assistant Director, Resources and Planning

Subject: Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers

Program Area: Wild Horse and Burro (WH&B) Program

Purpose: The purpose of this Instruction Memorandum (IM) is to establish policy for the Wild Horse and Burro (WH&B) Gather component of the Comprehensive Animal Welfare Program (CAWP). It defines standards, training and monitoring for conducting safe, efficient and successful WH&B gather operations while ensuring humane care and handling of animals gathered.

Policy/Action: The Bureau of Land Management (BLM) is committed to the well-being and responsible care of WH&B we manage. At all times, the care and treatment provided by the BLM and its contractors will be characterized by *compassion and concern* for WH&B well-being and welfare needs.

All State, District and Field Offices are required to comply with the CAWP policy for all gathers within their jurisdiction. The CAWP for WH&B gathers includes three components:

1. Comprehensive Animal Welfare Program Standards for Wild Horse and Burro Gathers (Attachment 1): 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.

2. Training: All Incident Commanders (IC), Contracting Officer Representatives (COR), Project Inspectors (PI) and contractors must complete a mandatory training course. The training is available online via DOI Learn: Course Title: BLM's Comprehensive Animal Welfare Program (CAWP) – gathers; Course Number: 4700-13.

3. CAWP Gather Assessment Tool (Attachment 2): The Gather Assessment Tool will be used during FY2016 for evaluating the effectiveness of mandatory training and adequacy of the Standards for CAWP for WH&B Gathers. The WO-260 Division is responsible for overseeing implementation of assessments as well as providing the necessary access to the assessment tool for those gathers selected for internal assessment during FY2016.

4. Starting in FY2017, the Assessment Tool will be used to evaluate compliance by the BLM and its contractors with the Standards for CAWP for WH&B Gathers. The WO-260 Division will oversee the completion of all assessments as well as providing the necessary access to the assessment tool for those gathers identified for both internal and external assessment by internal and external personnel during FY2017.

This IM supersedes Interim IM No. 2013-059, Wild Horse and Burro Gathers: Comprehensive Animal Welfare Policy which was issued as part of a package of IMs covering various aspects of the management of WH&B gathers, including:

- IM No. 2013-058, Wild Horse and Burro Gathers: Public and Media Management.
- IM No. 2013-060, Wild Horse and Burro Gathers: Management by Incident Command System
- IM No. 2013-061, Wild Horse and Burro Gathers: Internal and External Communicating and Reporting

The goal of this IM 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 Bureau'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, standard operating procedures and contract requirements. The CAWP and its associated components will be reviewed regularly and modified as necessary to enhance its transparency and effectiveness in assuring the humane care and treatment of the WH&Bs.

The Lead COR is the primary party responsible for promptly addressing any actions that are inconsistent with the Standards set forth in the CAWP. The Lead COR may delegate responsibility to an alternate COR. The Lead COR will promptly notify the contractor if any improper or unsafe actions are observed and will ensure that they are promptly rectified. If issues are left unresolved or immediate action is required, the Lead COR has the authority to suspend gather operations. Through coordination with the Contracting Officer, the Lead COR shall, if necessary, ensure that corrective measures have been taken to prevent such actions from reoccurring and all follow-up and corrective measures shall be reported as a component of the Lead COR's daily reports.

Timeframe: All portions of this policy are effective as of October 1st, 2015.

Budget Impact: This IM is implementing new policy and guidance with additional training and reporting requirements for personnel and contractors. The cost for the required training is about $250 per person. CAWP program implementation, oversight, data compilation and reporting requirements will require an additional 12 to 15 work months per year.

Background: The authority for a Comprehensive Animal Welfare Program for WH&B Gathers is provided by Public Law 92-195, Wild Free-Roaming Horses and Burros Act of 1971 (as amended) and 43 CFR 4700.0-2.

The Comprehensive Animal Welfare Program for WH&B gathers consolidates and highlights the BLM's policies, procedures and ongoing commitment to protect animal welfare; provide training for employees and contractors on animal care and handling; and implement a gather assessment tool which will be used to evaluate the agency's and contractor's adherence to standards for the handling and care of animals during gather operations.

Manual/Handbook Sections Affected: None

Coordination: This IM was coordinated among WO-100, WO-200, WO-260, WO-600, WH&B State Leads and WH&B Specialists.

Contact: Bryan Fuell, On-Range Branch Chief, Wild Horse and Burro Program, at 775-861-6611.

Signed by:
Michael H. Tupper
Acting, Assistant Director
Resources and Planning

Authenticated by:
Robert M. Williams
Division of IRM Governance, WO-860

2 Attachments
1 - Comprehensive Animal Welfare Program Standards for Wild Horse and Burro Gathers (20 pp)
2 - CAWP Gather Assessment Tool screen shots (26 pp)

ATTACHMENT 1: COMPREHENSIVE ANIMAL WELFARE PROGRAM FOR WILD HORSE AND BURRO GATHERS

STANDARDS

Developed by

The Bureau of Land Management
Wild Horse and Burro Program

in collaboration with

Carolyn L. Stull, PhD
Kathryn E. Holcomb, PhD
University of California, Davis
School of Veterinary Medicine

June 30, 2015

WELFARE ASSESSMENT STANDARDS for GATHERS

CONTENTS

STANDARDS

Standard Definitions

Major Standard: Impacts the health or welfare of WH&Bs. Relates to an alterable equipment or facility standard or procedure. Appropriate wording is "must," "unacceptable," "prohibited."

Minor Standard: unlikely to affect WH&Bs health or welfare or involves an uncontrollable situation. Appropriate wording is "should."

Lead COR = Lead Contracting Officer's Representative

COR = Contracting Officer's Representative

PI = Project Inspector

WH&Bs = Wild horses and burros

I. FACILITY DESIGN

A. Trap Site and Temporary Holding Facility

1. The trap site and temporary holding facility must be constructed of stout materials and must be maintained in proper working condition, including gates that swing freely and latch or tie easily. **(major)**
2. The trap site should be moved close to WH&B locations whenever possible to minimize the distance the animals need to travel.(minor)
3. If jute is hung on the fence posts of an existing wire fence in the trap wing, the wire should be 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 Lead COR/COR/PI. (minor)
4. Fence panels in pens and alleys must be not less than 6 feet high for horses, 5 feet high for burros, and the bottom rail must not be more than 12 inches from ground level. **(major)**

5. The temporary holding facility must have a sufficient number of pens available to sort WH&Bs according to gender, age, number, temperament, or physical condition. **(major)**
   a. All pens must be assembled with capability for expansion. **(major)**
   b. Alternate pens must be made available for the following: **(major)**
      1) WH&Bs that are weak or debilitated
      2) Mares/jennies with dependent foals
   c. WH&Bs in pens at the temporary holding facility should be maintained at a proper stocking density such that when at rest all WH&Bs occupy no more than half the pen area. (minor)
6. An appropriate chute designed for restraining WH&Bs must be available for necessary procedures at the temporary holding facility. This does not apply to bait trapping operations unless directed by the Lead COR/COR/PI. **(major)**
7. 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. **(major)**
8. Padding must be installed on the overhead bars of all gates and chutes used in single file alleys. **(major)**
9. 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. **(major)**
10. Finger gates (one-way funnel gates) used in bait trapping must be constructed of materials approved by the Lead COR/COR/PI. Finger gates must not be constructed of materials that have sharp ends that may cause injuries to WH&Bs, such as "T" posts, sharpened willows, etc. **(major)**
11. Water must be provided at a minimum rate of ten gallons per 1000 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). Water must be refilled at least every morning and evening. **(major)**
12. The design of pens at the trap site and temporary holding facility should be constructed with rounded corners. (minor)

13. All gates and panels in the animal holding and handling pens and alleys of the trap site must be covered with materials such as plywood, snow fence, tarps, burlap, etc. approximately 48" in height to provide a visual barrier for the animals. All materials must be secured in place.**(major)**

These guidelines apply:

a. For exterior fences, material covering panels and gates must extend from the top of the panel or gate toward the ground.**(major)**
b. For alleys and small internal handling pens, material covering panels and gates should 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. (minor)
c. The initial capture pen may be left uncovered as necessary to encourage animals to enter the first pen of the trap. (minor)

14. Non-essential personnel and equipment must be located to minimize disturbance of WH&Bs. **(major)**
15. Trash, debris, and reflective or noisy objects should be eliminated from the trap site and temporary holding facility. (minor)

B. Loading and Unloading Areas

1. Facilities in areas for loading and unloading WH&Bs 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. **(major)**
2. 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. **(major)**
3. 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. **(major)**
4. All gates and doors must open and close easily and latch securely. **(major)**

5. 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. **(major)**
6. 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. **(major)**
7. Stock trailers should 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. (minor)

II. CAPTURE TECHNIQUE

A. Capture Techniques

1. WH&Bs gathered on a routine basis for removal or return to range must be captured by the following approved procedures under direction of the Lead COR/COR/PI. **(major)**
   a. Helicopter
   b. Bait trapping
2. WH&Bs must not be captured by snares or net gunning. **(major)**
3. Chemical immobilization must only be used for capture under exceptional circumstances and under the direct supervision of an on-site veterinarian experienced with the technique. **(major)**

B. Helicopter Drive Trapping

1. The helicopter must be operated using pressure and release methods to herd the animals in a desired direction and should not repeatedly evoke erratic behavior in the WH&Bs causing injury or exhaustion. Animals must not be pursued to a point of exhaustion; the on-site veterinarian must examine WH&Bs for signs of exhaustion. **(major)**

2. The rate of movement and distance the animals travel must not exceed limitations set by the Lead COR/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. **(major)**
   a. WH&Bs that are weak or debilitated must be identified by BLM staff or the contractors. Appropriate gather and handling methods should be used according to the direction of the Lead COR/COR/PI. **(major)**
   b. The appropriate herding distance and rate of movement must be determined 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. **(major)**
   c. Rate of movement and distance travelled must not result in exhaustion at the trap site, with the exception of animals requiring capture that have an existing severely compromised condition prior to gather. Where compromised animals cannot be left on the range or where doing so would only serve to prolong their suffering, euthanasia will be performed in accordance with BLM policy. **(major)**
3. WH&Bs must not be pursued repeatedly by the helicopter such that the rate of movement and distance travelled exceeds the limitation set by the Lead COR/COR/PI. Abandoning the pursuit or alternative capture methods may be considered by the Lead COR/COR/PI in these cases. **(major)**
4. When WH&Bs are herded through a fence line en route to the trap, the Lead COR/COR/PI must be notified by the contractor. The Lead COR/COR/PI must determine the appropriate width of the opening that the fence is let down to allow for safe passage through the opening. The Lead COR/COR/PI must decide if existing fence lines require marking to increase visibility to WH&Bs. **(major)**
5. The helicopter must not come into physical contact with any WH&B. The physical contact of any WH&B by helicopter must be documented by Lead COR/COR/PI along with the circumstances. **(major)**
6. WH&Bs 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 must be evaluated by the Lead COR/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.(**major**)

7. Horse captures must not be conducted when ambient temperature at the trap site is below 10°F or above 95°F without approval of the Lead COR/COR/PI. Burro captures must not be conducted when ambient temperature is below 10°F or above 100°F without approval of the Lead COR/COR/PI. The Lead COR/COR/PI will not approve captures when the ambient temperature exceeds 105 °F. (**major**)

C. Roping

1. The roping of any WH&B must be approved prior to the procedure by the Lead COR/COR/PI. (**major**).
2. The roping of any WH&B must be documented by the Lead COR/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 environmentally sensitive designation; and public and animal safety or legal mandates for removal. (**major**)
3. Ropers should dally the rope to their saddle horn such that animals can be brought to a stop as slowly as possible and must not tie the rope hard and fast to the saddle so as to intentionally jerk animals off their feet. (**major**)
4. 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. (**major**)
5. WH&Bs that are roped and tied down in recumbency must be untied within 30 minutes. (**major**)
6. 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. (**major**)
7. Sleds, slide boards, or slip sheets must be placed underneath the animal's body to move and/or load recumbent WH&Bs. (**major**)

8. Halters and ropes tied to a WH&B may be used to roll, turn, 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. **(major)**
9. Animals captured by roping must be evaluated by the on-site/on-call veterinarian within four hours after capture, marked for identification at the trap site, and be re-evaluated periodically as deemed necessary by the on-site/on-call veterinarian. **(major)**

D. Bait Trapping

1. WH&Bs may be lured into a temporary trap using bait (feed, mineral supplement, water) or sexual attractants (mares/jennies in heat) with the following requirements:
   a. The period of time water sources other than in the trap site are inaccessible must not adversely affect the wellbeing of WH&Bs, wildlife or livestock, as determined by the Lead COR/COR/PI. **(major)**
   b. Unattended traps must not be left unobserved for more than 12 hours. **(major)**
   c. Mares/jennies and their dependent foals must not be separated unless for safe transport. **(major)**
   d. WH&Bs held for more than 12 hours must be provided with accessible clean water at a minimum rate of ten gallons per 1000 pound animal per day, adjusted accordingly for larger or smaller horses, burros and foals and environmental conditions. **(major)**
   e. WH&Bs held for more than 12 hours must be provided good quality hay at a minimum rate of 20 pounds per 1000 pound adult animal per day, adjusted accordingly for larger or smaller horses, burros and foals. **(major)**
      1) Hay must not contain poisonous weeds, debris, or toxic substances. **(major)**
      2) Hay placement must allow all WH&Bs to eat simultaneously. **(major)**

III. WILD HORSE AND BURRO CARE

A. Veterinarian

1. On-site veterinary support must be provided for all helicopter gathers and on-site or on-call support must be provided for bait trapping. **(major)**

2. Veterinary support must be under the direction of the Lead COR/COR/PI. The on-site/on-call veterinarian will provide consultation on matters related to WH&B health, handling, welfare, and euthanasia at the request of the Lead COR/COR/PI. All decisions regarding medical treatment or euthanasia will be made by the on-site Lead COR/COR/PI. **(major)**

B. Care

1. 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 with water available at all times other than when animals are being sorted or worked. **(major)**
   b. Water must be provided at a minimum rate of ten gallons per 1000 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). . **(major)**
   c. Good quality hay must be fed at a minimum rate of 20 pounds per 1000 pound adult animal per day, adjusted accordingly for larger or smaller horses, burros and foals. **(major)**
      i. Hay must not contain poisonous weeds or toxic substances. **(major)**
      ii. Hay placement must allow all WH&Bs to eat simultaneously. **(major)**
   d. When water or feed deprivation conditions exist on the range prior to the gather, the Lead COR/COR/PI should adjust the watering and feeding arrangements in consultation with the onsite veterinarian as necessary to provide for the needs of the animals. (minor)
2. Dust abatement
   a. Dust abatement by spraying the ground with water must be employed when necessary at the trap site and temporary holding facility. **(major)**

3. Trap Site
    a. Dependent foals or weak/debilitated animals 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 Lead COR/COR/PI authorizes a longer time or a decision is made to wean the foals. **(major)**
4. Temporary Holding Facility
    a. All WH&Bs in confinement must be observed at least once daily to identify sick or injured WH&Bs and ensure adequate food and water. **(major)**
    b. Foals must be reunited with their mares/jennies at the temporary holding facility within four hours of capture unless the Lead COR/COR/PI authorizes a longer time or foals are old enough to be weaned during the gather. **(major)**
    c. Non-ambulatory WH&Bs must be located in a pen separate from the general population and must be examined by the BLM horse specialist and/or on-call or on-site veterinarian as soon as possible, no more than four hours after recumbency is observed. Unless otherwise directed by a veterinarian, hay and water must be accessible to an animal within six hours after recumbency.**(major)**
    d. Alternate pens must be made available for the following: **(major)**
        1) WH&Bs that are weak or debilitated
        2) Mares/jennies with dependent foals
    e. Aggressive WH&Bs causing serious injury to other animals should be identified and relocated into alternate pens when possible. (minor)
    f. WH&Bs in pens at the temporary holding facility should be maintained at a proper stocking density such that when at rest all WH&Bs occupy no more than half the pen area. (minor)

C. Biosecurity

1. Health records for all saddle and pilot horses used on WH&B gathers must be provided to the Lead COR/COR/PI prior to joining a gather, including: **(major)**
   a. Certificate of Veterinary Inspection (Health Certificate, within 30 days).
   b. Proof of:
      1) A negative test for equine infectious anemia (Coggins or EIA ELISA test) within 12 months.
      2) Vaccination for tetanus, eastern and western equine encephalomyelitis, West Nile virus, equine herpes virus, influenza, *Streptococcus equi*, and rabies within 12 months.
2. Saddle horses, pilot horses and mares used for bait trapping lures 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 Examination is obtained after three weeks and prior to returning to the gather. **(major)**
3. WH&Bs, saddle horses, and pilot horses showing signs of infectious disease must be examined by the on-site/on-call veterinarian. **(major)**
   a. 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. **(major)**
   b. Groups of WH&Bs showing signs of infectious disease should not be mixed with groups of healthy WH&Bs at the temporary holding facility, or during transport. (minor)
4. Horses not involved with gather operations should remain at least 300 yards from WH&Bs, saddle horses, and pilot horses being actively used on a gather. (minor)

IV. HANDLING

A. Willful Acts of Abuse

1. Hitting, kicking, striking, or beating any WH&B in an abusive manner is prohibited. **(major)**
2. Dragging a recumbent WH&B without a sled, slide board or slip sheet is prohibited. 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 II. C. 8. **(major)**
3. There should be no deliberate driving of WH&Bs into other animals, closed gates, panels, or other equipment. (minor)
4. There should be no deliberate slamming of gates and doors on WH&Bs. (minor)
5. There should be no excessive noise (e.g., constant yelling) or sudden activity causing WH&Bs to become unnecessarily flighty, disturbed or agitated. (minor)

B. General Handling

1. All sorting, loading or unloading of WH&Bs during gathers must be performed during daylight hours except when unforeseen circumstances develop and the Lead COR/CO/PI approves the use of supplemental light. **(major)**
2. WH&Bs should be handled to enter runways or chutes in a forward direction. (minor)
3. WH&Bs should not remain in single-file alleyways, runways, or chutes longer than 30 minutes. (minor)
4. Equipment except for helicopters should be operated and located in a manner to minimize flighty behavior . (minor)

C. Handling Aids

1. Handling aids such as flags and shaker paddles must be the primary tools for driving and moving WH&Bs during handling and transport procedures. Contact of the flag or paddle end of primary handling aids 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. **(major)**

2. Electric prods must not be used routinely as a driving aid or handling tool. Electric prods may be used in limited circumstances only if the following guidelines are followed:
   a. 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. **(major)**
   b. The electric prod device must never be disguised or concealed. **(major)**
   c. 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. **(major)**
   d. Electric prods must only be picked up when intended to deliver a stimulus; these devices must not be constantly carried by the handlers. **(major)**
   e. Space in front of an animal must be available to move the WH&B forward prior to application of the electric prod. **(major)**
   f. Electric prods must never be applied to the face, genitals, anus, or underside of the tail of a WH&B. **(major)**
   g. 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 Lead COR/COR/PI. Each exception must be approved at the time by the Lead COR/COR/PI. **(major)**
   h. Any electric prod use that may be necessary must be documented daily by the Lead COR/COR/PI including time of day, circumstances, handler, location (trap site or temporary holding facility), and any injuries (to WH&B or human). **(major)**

V. 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 Lead COR/CO/PI approves the use of supplemental light. **(major)**

2. WH&Bs identified for removal should be shipped from the temporary holding facility to a BLM facility within 48 hours. (minor)
   a. Shipping delays for animals that are being held for release to range or potential on-site adoption must be approved by the Lead COR/COR/PI. **(major)**
3. Shipping should occur in the following order of priority; 1) debilitated animals, 2) pairs, 3) weanlings, 4) dry mares and 5) studs. (minor)
4. Planned
5. transport time to the BLM preparation facility from the trap site or temporary holding facility must not exceed 10 hours. **(major)**
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. (minor)

B. Vehicles

1. Straight-deck trailers and stock trailers must be used for transporting WH&Bs. **(major)**
   a. Two-tiered or double deck trailers are prohibited. **(major)**
   b. Transport vehicles for WH&Bs must have a covered roof or overhead bars containing them such that WH&Bs cannot escape. **(major)**
2. WH&Bs 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. **(major)**
3. The width and height of all gates and doors must allow WH&Bs to move through freely. **(major)**
4. All gates and doors must open and close easily and be able to be secured in a closed position. **(major)**
5. The rear door(s) of the trailers must be capable of opening the full width of the trailer. **(major)**
6. Loading and unloading ramps must have a non-slip surface and be maintained in proper working condition to prevent slips and falls. **(major)**

7. Transport vehicles more than 18 feet and less than 40 feet in length must have a minimum of one partition gate providing two compartments; transport vehicles 40 feet or longer must have at least two partition gates to provide a minimum of three compartments. **(major)**
8. All partitions and panels inside of trailers must be free of sharp edges or holes that could cause injury to WH&Bs. **(major)**
9. The inner lining of all trailers must be strong enough to withstand failure by kicking that would lead to injuries. **(major)**
10. Partition gates in transport vehicles should be used to distribute the load into compartments during travel. (minor)
11. Surfaces and floors of trailers must be cleaned of dirt, manure and other organic matter prior to the beginning of a gather. **(major)**

C. Care of WH&Bs during Transport Procedures

1. WH&Bs that are loaded and transported from the temporary holding facility to the BLM preparation facility must be fit to endure travel. **(major)**
   a. WH&Bs 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. **(major)**
   b. WH&Bs that are weak or debilitated must not be transported without approval of the Lead COR/COR/PI in consultation with the on-site veterinarian. Appropriate actions for their care during transport must be taken according to direction of the Lead COR/COR/PI. **(major)**
2. WH&Bs should be sorted prior to transport to ensure compatibility and minimize aggressive behavior that may cause injury. (minor)
3. Trailers must be loaded using the minimum space allowance in all compartments as follows: **(major)**
   a. 12 square feet per adult horse.
   b. 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.

4. The Lead COR/COR/PI in consultation with the receiving Facility Manager must document any WH&B that is recumbent or dead upon arrival at the destination. **(major)**
   a. Non-ambulatory or recumbent WH&Bs must be evaluated on the trailer and either euthanized or removed from the trailers using a sled, slide board or slip sheet. **(major)**
5. Saddle horses must not be transported in the same compartment with WH&Bs. **(major)**

VI. EUTHANASIA OR DEATH

A. 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. **(major)**
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. **(major)**
3. The decision to euthanize and method of euthanasia must be directed by the Authorized Officer or their Authorized Representative(s) that include but are not limited to the Lead COR/COR/PI who must be on site and may consult with the on-site/on-call veterinarian. **(major)**
4. Photos needed to document an animal's condition should be taken prior to the animal being euthanized. No photos of animals that have been euthanized should be taken. An exception is when a veterinarian or the Lead COR/COR/PI may want to document certain findings discovered during a postmortem examination or necropsy. (minor)
5. Any WH&B that dies or is euthanized must be documented by the Lead COR/COR/PI including time of day, circumstances, euthanasia method, location, a

description of the age, gender, and color of the animal and the reason the animal was euthanized. **(major)**

6. The on-site/on-call veterinarian should review the history and conduct a postmortem physical examination of any WH&B that dies or is euthanized during the gather operation. A necropsy should be performed whenever feasible if the cause of death is unknown. (minor)

B. Carcass Disposal

1. The Lead COR/COR/PI must ensure that appropriate equipment is available for the timely disposal of carcasses when necessary on the range, at the trap site, and temporary holding facility. **(major)**
2. Disposal of carcasses must be in accordance with state and local laws. **(major)**
3. WH&Bs euthanized with a barbiturate euthanasia agent must be buried or otherwise disposed of properly. **(major)**
4. 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. (minor)

CAWP

REQUIRED DOCUMENTATION AND RESPONSIBILITIES OF LEAD COR/COR/PI

Required Documentation

Section	Documentation
II.B.5	Helicopter contact with any WH&B.
II.C.2	Roping of any WH&B.
III.B.3.a and III.B.4.b	Reason for allowing longer than four hours to reunite foals with mares/jennies. Does not apply if foals are being weaned.
III.C.1	Health status of all saddle and pilot horses.
IV.C.2.h	All uses of electric prod.
V.C.4	Any WH&B that is recumbent or dead upon arrival at destination following transport.
VI.A.5	Any WH&B that dies or is euthanized during gather operation.

Responsibilities

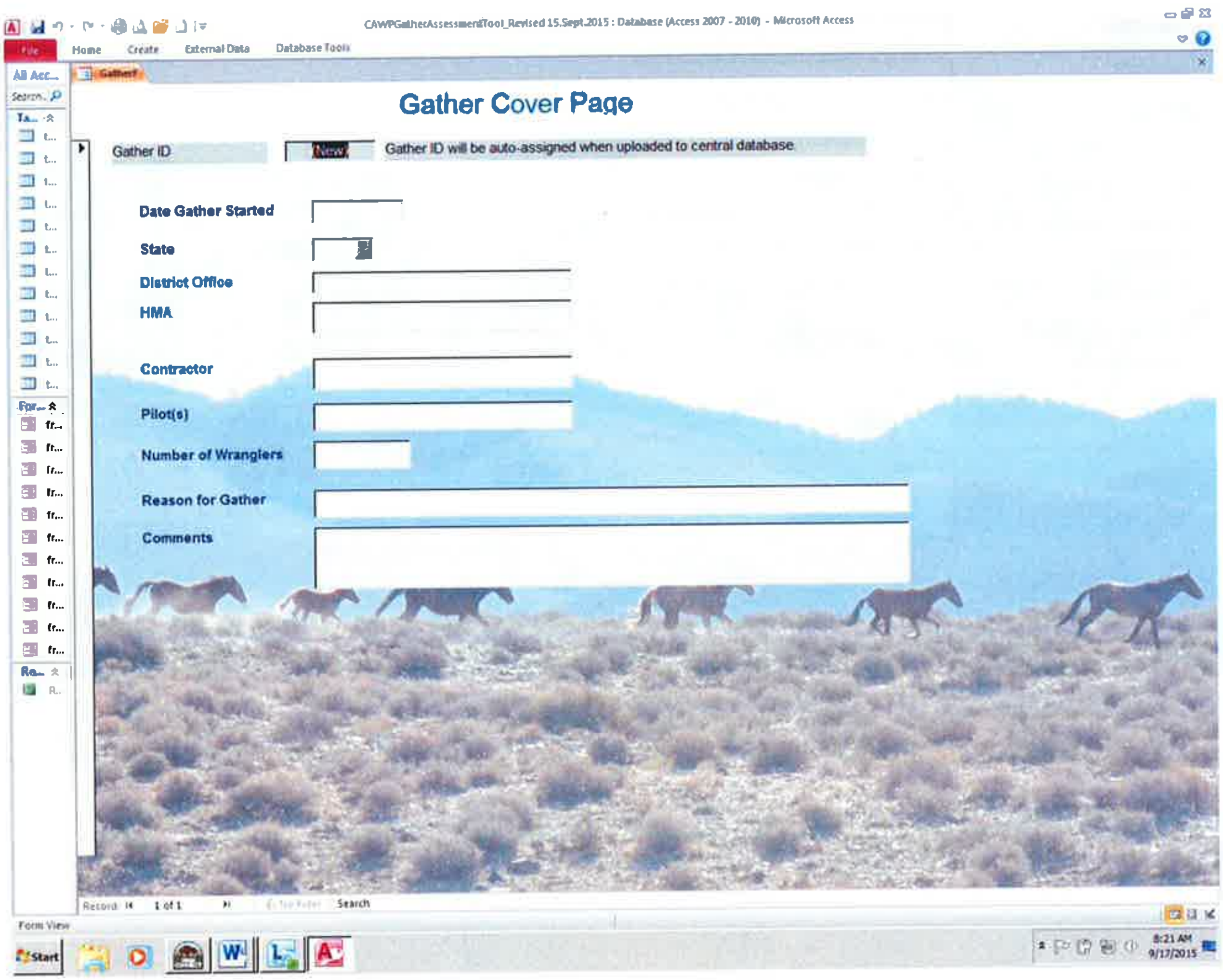
Section	Responsibility
I.A.10	Approve materials used in construction of finger gates in bait trapping
II.A.1	Direct gather procedures using approved gather technique.
II.B. 2	Determine rate of movement and distance limitations for WH&B helicopter gather.
II.B.2.a	Direct appropriate gather/handling methods for weak or debilitated WH&B.
II.B.3	Determine whether to abandon pursuit or use other capture method in order to avoid repeated pursuit of WH&B.
II.B.4	Determine width and need for visibility marking when using opening in fence en route to trap.
II.B.6	Determine number of attempts that can be made to capture the missing half of a mare/foal pair that has become separated.
II.B.7	Determine whether to proceed with gather when ambient temperature is outside the range of 10°F to 95°F for horses or 10°F to 100°F for burros.
II.C.1	Approve roping of any WH&B.
II.D.1.a	Determine period of time that water outside a bait trap is inaccessible such that wellbeing of WH&Bs, wildlife, or livestock is not adversely affected.
III.A.2	Direct and consult with on-site/on-call veterinarian on any matters related to WH&B health, handling, welfare and euthanasia.

III.B.1.e	Adjust feed/water as necessary, in consultation with onsite/on call veterinarian, to provide for needs of animals when water or feed deprivation conditions exist on range.
III.B.4.c	Determine provision of water and hay to non-ambulatory animals.
IV.C.2.g	Approve use of electric prod more than three times, for exceptional cases only.
V.A.1	Approve sorting, loading, or unloading at night with use of supplemental light.
V.A.2.a	Approve shipping delays of greater than 48 hours from temporary holding facility to BLM facility.
V.C.1.b	Approve of transport and care during transport for weak or debilitated WH&B.
VI.A.3	Direct decision regarding euthanasia and method of euthanasia for any WH&B; may consult with on-site/on-call veterinarian.
VI.B.1	Ensure that appropriate equipment is available for carcass disposal.

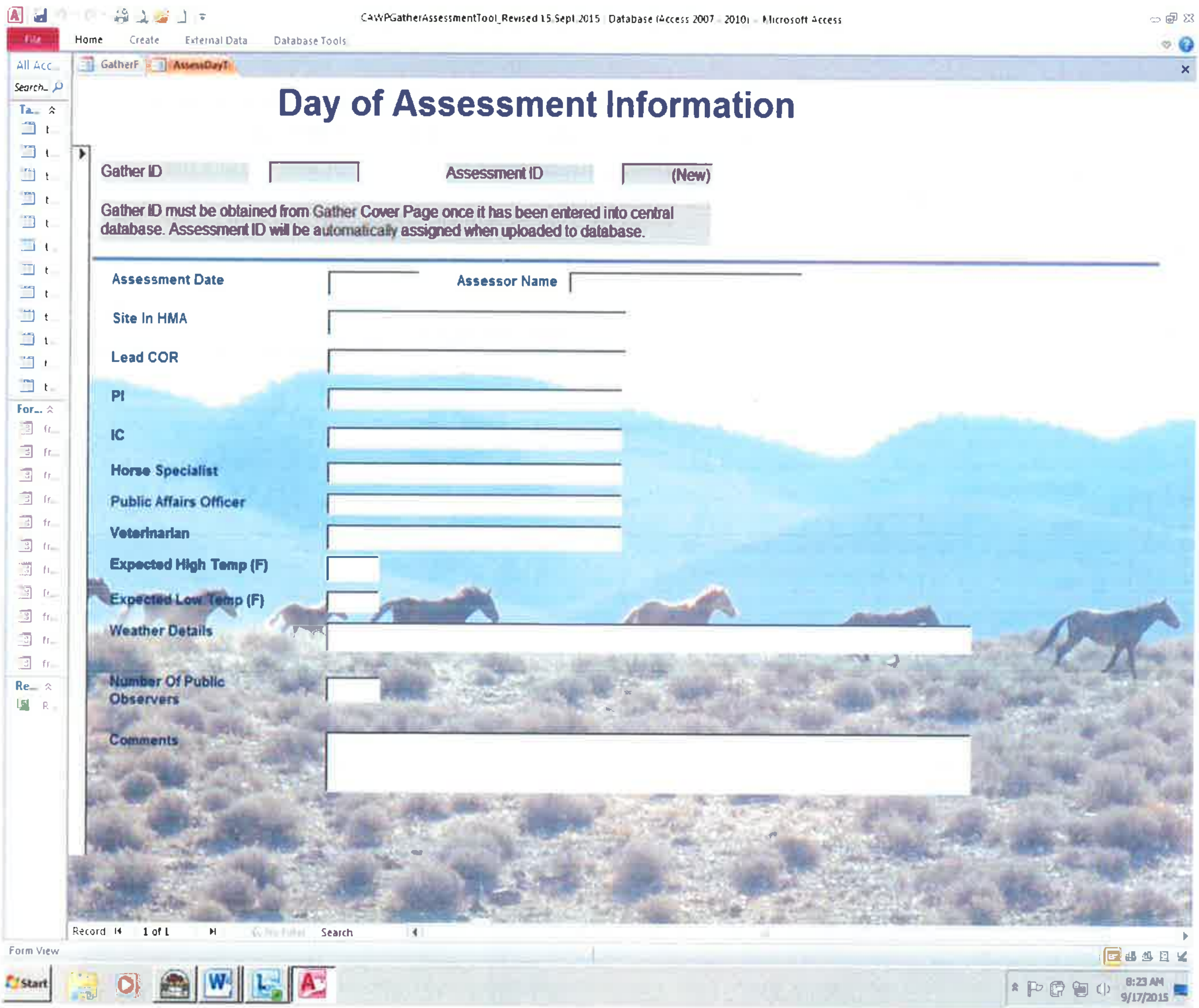
Attachment 2: Comprehensive Animal Welfare Policy Gather Assessment Tool

Summary: The Comprehensive Animal Welfare Policy (CAWP) Gather Assessment Tool is a MS Access database that has been developed as a means to assess, standardize, and track CAWP compliance. The following document contains screen shots of the standardized forms from the tool and details the information that will be collected during a gather assessment.

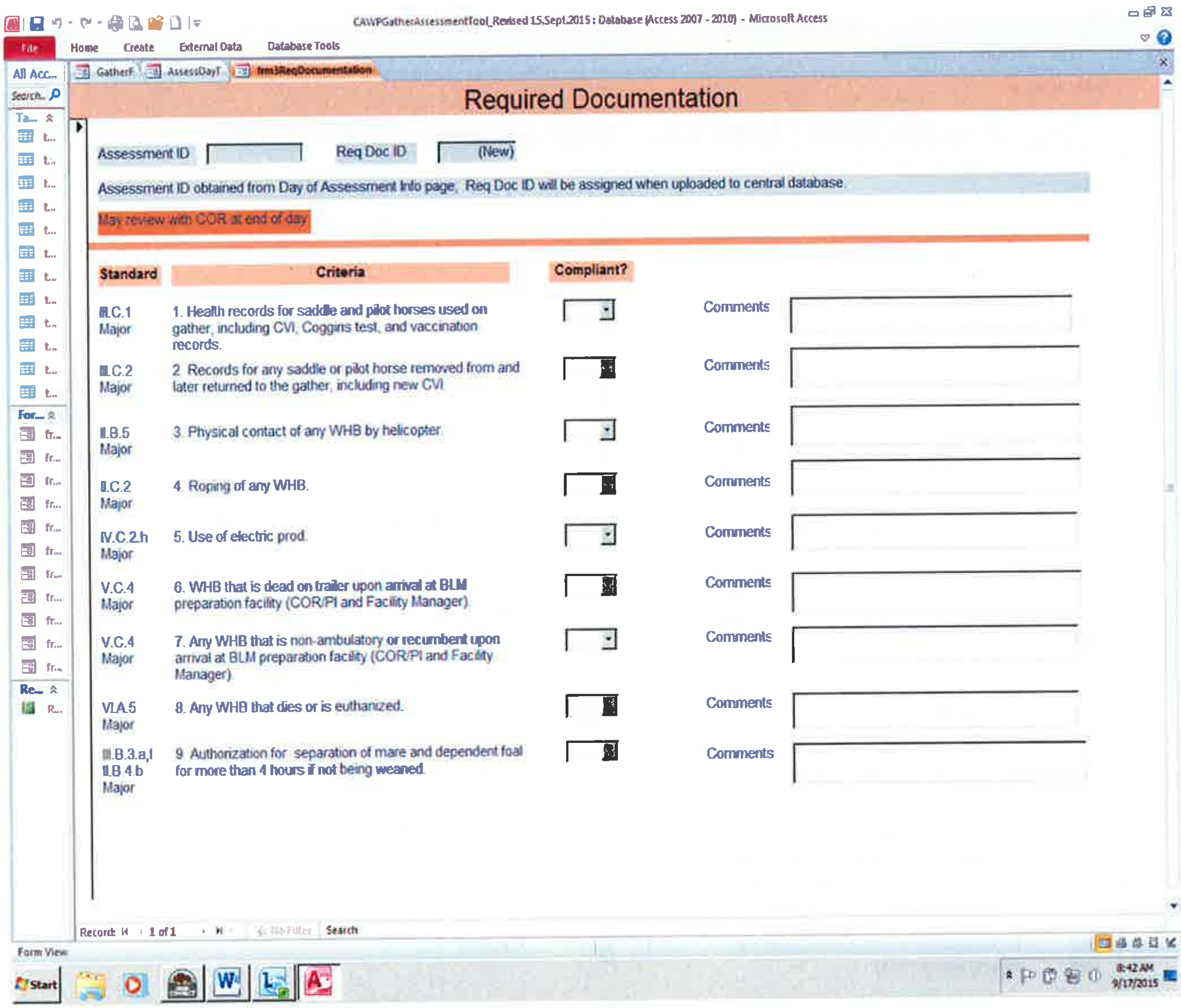
Form #1: Gather Cover Page



Form #2: Day of Assessment Information



Form #3: Required Documentation



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File | Home | Create | External Data | Database Tools

GatherF | AssessDayT | frm3ReqDocumentation

Required Documentation

Assessment ID [ ] Req Doc ID (New)

Assessment ID obtained from Day of Assessment Info page. Req Doc ID will be assigned when uploaded to central database.

May review with COR at end of day

Standard	Criteria	Compliant?	
II.C.1 Major	1. Health records for saddle and pilot horses used on gather, including CVI, Coggins test, and vaccination records.		Comments
II.C.2 Major	2. Records for any saddle or pilot horse removed from and later returned to the gather, including new CVI		Comments
II.B.5 Major	3. Physical contact of any WHB by helicopter.		Comments
II.C.2 Major	4. Roping of any WHB.		Comments
IV.C.2.h Major	5. Use of electric prod.		Comments
V.C.4 Major	6. WHB that is dead on trailer upon arrival at BLM preparation facility (COR/PI and Facility Manager).		Comments
V.C.4 Major	7. Any WHB that is non-ambulatory or recumbent upon arrival at BLM preparation facility (COR/PI and Facility Manager)		Comments
VI.A.5 Major	8. Any WHB that dies or is euthanized.		Comments
III.B.3.a,I II.B.4.b Major	9. Authorization for separation of mare and dependent foal for more than 4 hours if not being weaned.		Comments

Record: 1 of 1 | No Filter | Search

Form View

Form #4a: Trap Site: Facility Design, Care Provisions, and Biosecurity Assessment – Facility Design

CAWPGatherAssessmentTool_Revised 15.Sept.2015 : Database (Access 2007 - 2010) - Microsoft Access

File Home Create External Data Database Tools

frm4TrapSiteFacilities

Trap Site: Facility Design, Care Provisions, and Biosecurity Assessment

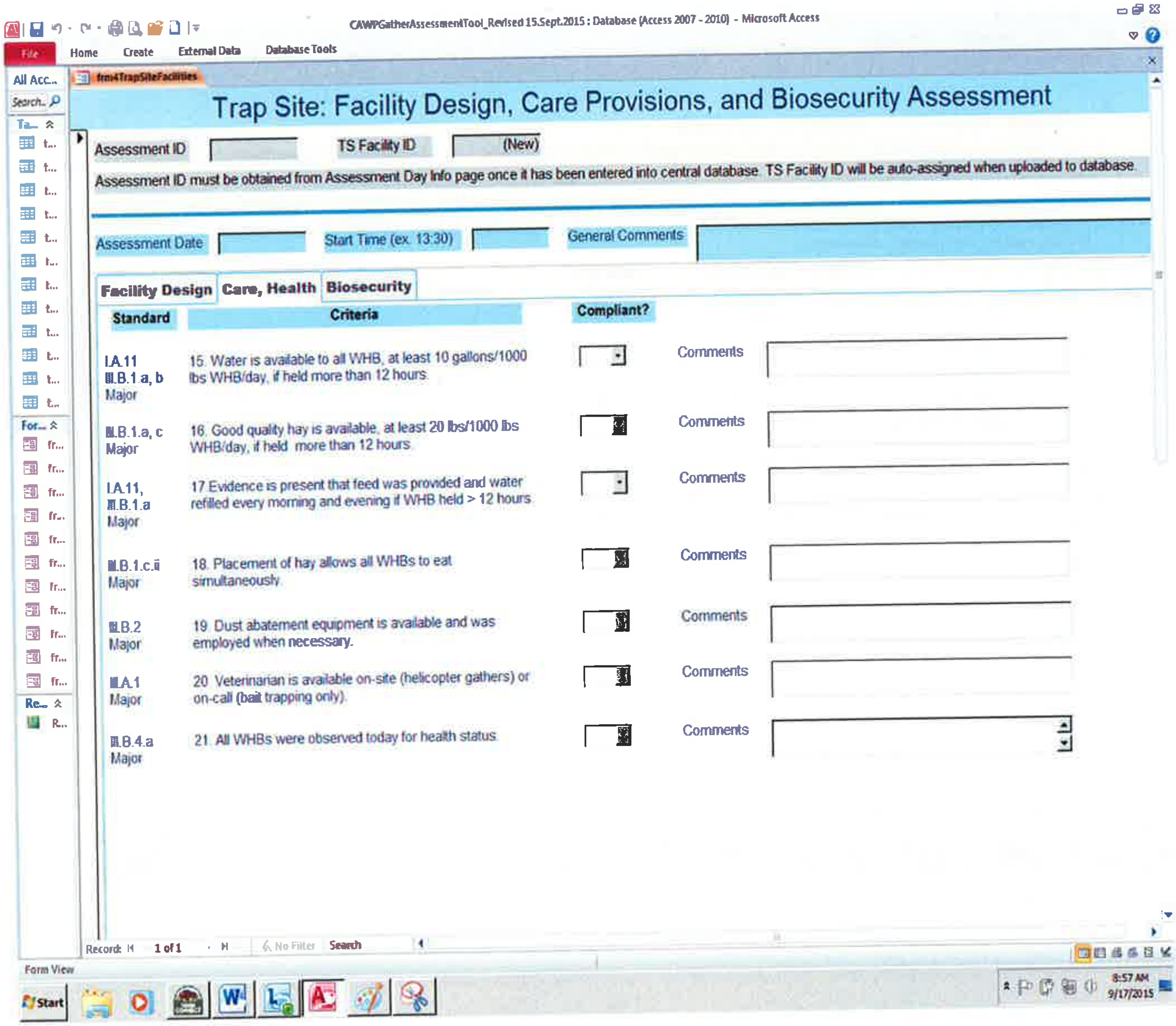
IA 2 Minor	1. Location selected to minimize travel distance		Comments
IA 1 Major	2. Materials are stout, secure, in proper working condition		Comments
IA 12 Minor	3. Pens are constructed with rounded corners		Comments
IA 4 Major	4. Fence panel at least 6' for horses, 5' for burros; bottom rail is no more than 12" from ground		Comments
IA 13 Major	5. Fence panels and gates are covered with secured visual barriers with approx. 48" height with the exception of the initial capture pen as necessary		Comments
IA 1, IA 9 Major	6. Gates are hinged, self-latching, swing freely and latch securely. Entry to trap may be tied with ropes.		Comments
IA 8 Major	7. Padding is on overhead bars of gates and chutes in single file alleys		Comments
IA 7 Major	8. No holes, gaps, openings, protruding surfaces, or sharp edges that could cause injury to WHBs		Comments
IA 15 Minor	9. No trash, debris, reflective or noisy objects		Comments
IA 3 Minor	10. If jute is hung on existing wire fence in the trap wing, wire of fence must be rolled up or let down for length of jute to minimize possible WHB entanglement, unless exception approved.		Comments
III B 2 Major	11. Dust abatement equipment is available and was employed when necessary		Comments
VI A 1 Major	12. Personnel authorized and trained to perform euthanasia and appropriate equipment are on site or within 1 hour travel time		Comments
VI B 1 Major	13. Removal equipment is available to dispose of carcasses.		Comments
IV C 2 a Major	14. If an electric prod is present, it is a commercially available model with DC batteries and is fully charged		Comments

Record: 1 of 1 No Filter Search

Location in close proximity to WH&Bs

7:34 AM 9/17/2015

Form #4b: Trap Site: Facility Design, Care Provisions, and Biosecurity Assessment – Care, Health



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File | Home | Create | External Data | Database Tools

frm4TrapSiteFacilities

Trap Site: Facility Design, Care Provisions, and Biosecurity Assessment

Assessment ID | TS Facility ID (New)

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. TS Facility ID will be auto-assigned when uploaded to database.

Assessment Date | Start Time (ex. 13:30) | General Comments

Facility Design | Care, Health | Biosecurity

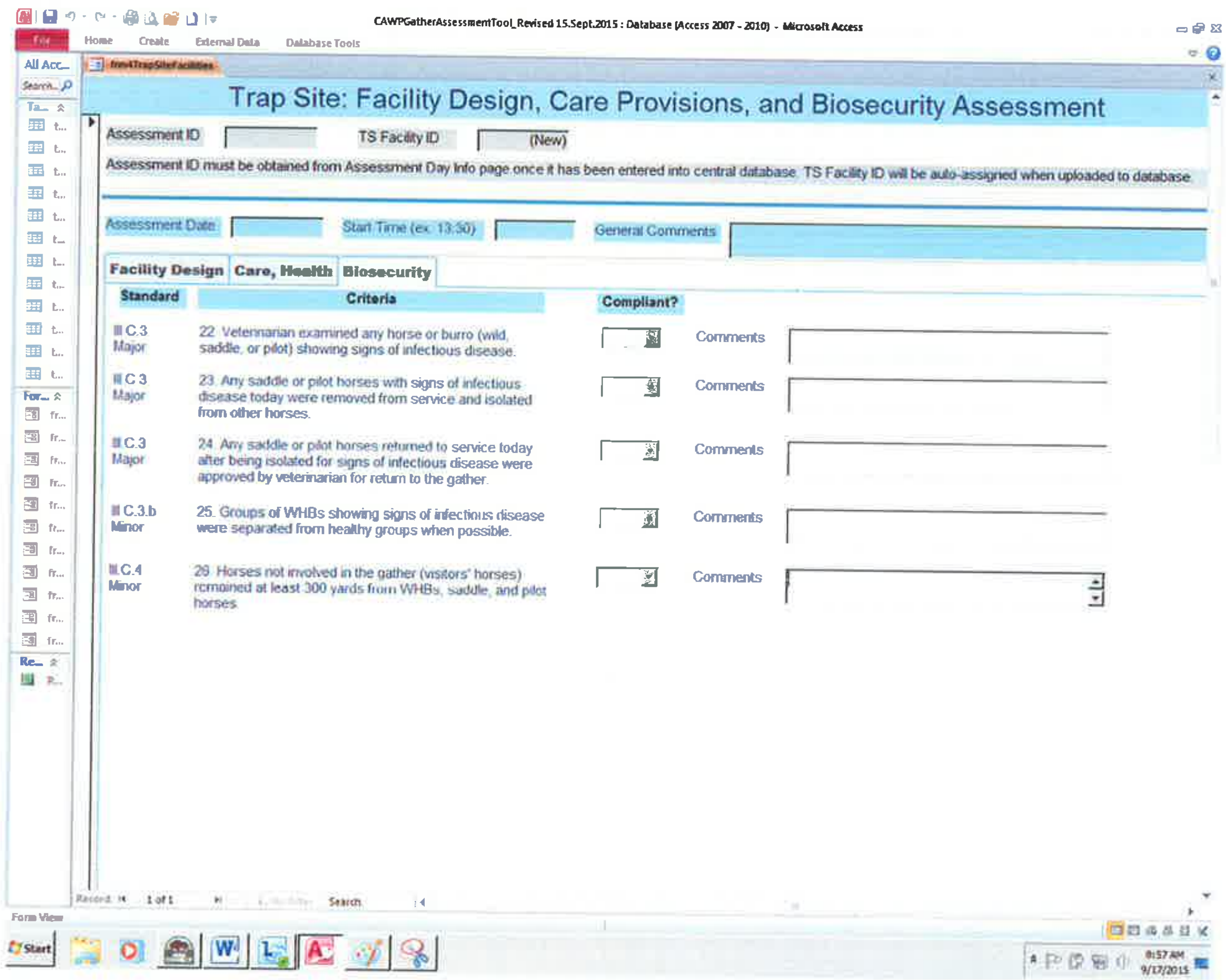
Standard	Criteria	Compliant?	Comments
I.A.11, III.B.1.a, b Major	15. Water is available to all WHB, at least 10 gallons/1000 lbs WHB/day, if held more than 12 hours		Comments
III.B.1.a, c Major	16. Good quality hay is available, at least 20 lbs/1000 lbs WHB/day, if held more than 12 hours		Comments
I.A.11, III.B.1.a Major	17. Evidence is present that feed was provided and water refilled every morning and evening if WHB held > 12 hours		Comments
III.B.1.c.ii Major	18. Placement of hay allows all WHBs to eat simultaneously		Comments
III.B.2 Major	19. Dust abatement equipment is available and was employed when necessary.		Comments
III.A.1 Major	20. Veterinarian is available on-site (helicopter gathers) or on-call (bait trapping only)		Comments
III.B.4.a Major	21. All WHBs were observed today for health status		Comments

Record: 1 of 1 | No Filter | Search

Form View

8:57 AM 9/17/2015

Form #4c: Trap Site: Facility Design, Care Provisions, and Biosecurity Assessment – Biosecurity



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Trap Site: Facility Design, Care Provisions, and Biosecurity Assessment

Assessment ID | TS Facility ID (New)

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. TS Facility ID will be auto-assigned when uploaded to database.

Assessment Date | Start Time (ex: 13:30) | General Comments

Facility Design | Care, Health | Biosecurity

Standard	Criteria	Compliant?	
III C.3 Major	22. Veterinarian examined any horse or burro (wild, saddle, or pilot) showing signs of infectious disease.		Comments
III C.3 Major	23. Any saddle or pilot horses with signs of infectious disease today were removed from service and isolated from other horses.		Comments
III C.3 Major	24. Any saddle or pilot horses returned to service today after being isolated for signs of infectious disease were approved by veterinarian for return to the gather.		Comments
III C.3.b Minor	25. Groups of WHBs showing signs of infectious disease were separated from healthy groups when possible.		Comments
III C.4 Minor	26. Horses not involved in the gather (visitors' horses) remained at least 300 yards from WHBs, saddle, and pilot horses.		Comments

Form #5a: Trap Site: Gather Performance

Trap Site: Wild Horses _Burros

Assessment ID | TS Group ID (New)

Assessment ID must be obtained from Day of Assessment Info page once it has been entered into central database. TS Group ID will be auto-assigned when uploaded to database.

Assessment Date | Start Time (ex. 13:30)

1. How many groups were assessed? Comments

2. How many horses were assessed in total? Comments

3. How many burros were assessed in total? Comments

Gather Performance | **Handling Performance** | **Electric Prods** | **Roping**

Standard	Criteria	Compliant?	
IV B.1 Major	4. Gathers and trap site processing were performed during daylight hours		Comments
II B.7 Major	5. Ambient temperature at trap site was between 10 F and 95 F for horses 10 F and 100 F for burros Or approved by COR/PI and did not exceed 105 F		Comments
II B.5 Major	6. No physical contact was observed between the helicopter and any WHB.		Comments
II B.2 a Major	7. Weak and debilitated WHBs were identified by staff and their capture was directed by PI/COR		Comments
II.B.2.b II.B.2 c Major	8. Distance and rate of movement of WHBs set by PI/COR was not exceeded for any WHB, except animals requiring capture with compromised conditions prior to the gather.		Comments
II B.1 Major	9. No evidence helicopter was operated to evoke repeated erratic behavior in WHB, causing injury or exhaustion.		Comments
II B.1 Major	10. No animals were exhausted as assessed by the on-site veterinarian		Comments
II B 6 Major	11. Multiple attempts were used by the helicopter or capture by roping to bring in any mare/dependent foals together into the trap and not leave them separated.		Comments
II B.3 II.B 6 Major	12. Capture was abandoned for any individual, mare/foal or jenny/foal pair following COR/PI approval		Comments
II.B 6 Major	13. No half of a mare/dependent foal pair remained on the range after attempts to gather the pair		Comments
II.B.2 c Major	14. Euthanasia was performed on the range on compromised WHBs		Comments
VI.A.2 Major	15. Euthanasia was performed according to AVMA guidelines via gunshot or injection of euthanasia agent		Comments
I.A.3 II.B 4 Major	16. Fence lines at the trap or en route to the trap allowed for safe passage and safety from entanglement		Comments
III.B.3.a Major	17. Foals, weak or debilitated WHBs were separated prior to transport to temporary holding facility.		Comments
III.B.3 a Major	18. Separation of dependent foals from mares did not exceed 4 hours, unless authorized or a decision was made to wean foals. (Authorization must be documented.)		Comments
I.A.14 Major	19. WHBs were not disturbed by non-essential personnel or equipment (evidence of disturbance includes: WHBs balked or changed direction when they saw non-essential people, saddle horses or equipment)		Comments

Form #5b: Trap Site: Handling Performance

Trap Site: Wild Horses _Burros

Assessment ID [ ] TS Group ID [(New)]

Assessment ID must be obtained from Day of Assessment Info page once it has been entered into central database. TS Group ID will be auto-assigned when uploaded to database.

Assessment Date [ ] Start Time (ex. 13:30) [ ]

1. How many groups were assessed? [ ] Comments [ ]

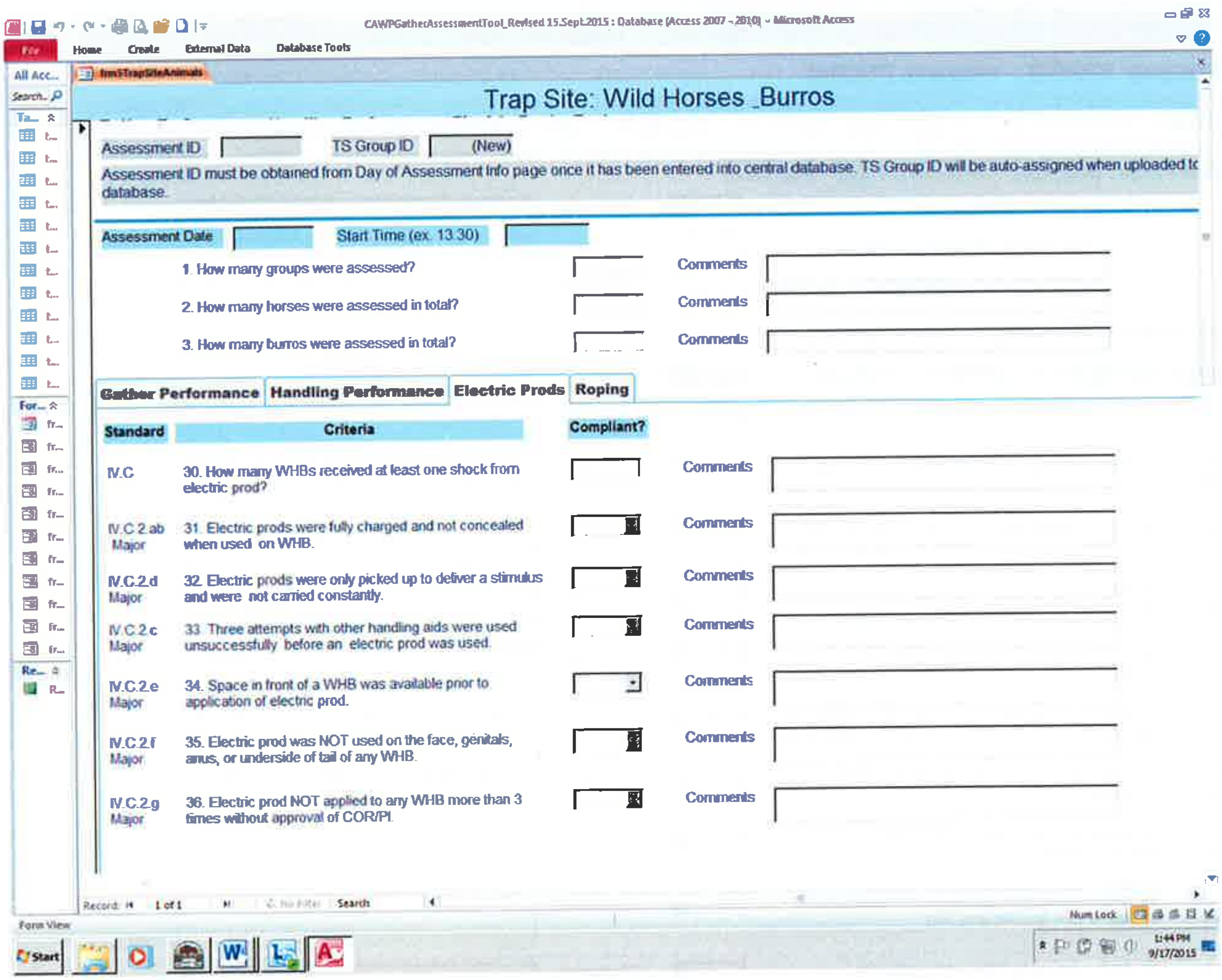
2. How many horses were assessed in total? [ ] Comments [ ]

3. How many burros were assessed in total? [ ] Comments [ ]

Gather Performance | Handling Performance | Electric Prods | Roping

Standard	Criteria	Compliant?	Comments
IV.A.1 Major	20. Hitting, kicking, striking, beating was not observed.		Comments
IV.A.2 Major	21. Dragging without sled, slide board, or slip sheet was not observed. Ropes used for moving animal were attached to sled, slide board or slip sheet, unless being loaded per Section II C.8.		Comments
IV.A.3 Minor	22. Deliberate driving WHBs into other animals, gates, panels, equipment was not observed.		Comments
IV.A.4 Minor	23. Deliberate slamming of gates or doors on WHBs was not observed.		Comments
IV.A.5 Minor	24. Excessive noise or activity causing flighty, disturbed, agitated WHBs was not observed.		Comments
IV.B.2 Minor	25. All WHBs entered runway/chute in forward direction.		Comments
IV.B.3 Minor	26. All WHBs remained in single-file alleyways, runways, or chutes less than 30 min.		Comments
IV.B.4 Minor	27. Equipment, except for helicopters, was operated and located to minimize flighty behavior.		Comments
IV.A.5 IV.B.4 Minor	28. No WHB at the trap site fell due to handling, excessive noise, sudden activity, or equipment operation. (Select Yes if it did not occur.)		Comments
IV.C.1 Minor	29. Handling aids such as flags and shaker paddles were the primary tools for driving and moving WHB		Comments

Form #5c: Trap Site: Electric Prod



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frm5TrapSiteAnimals

Trap Site: Wild Horses _Burros

Assessment ID [ ] TS Group ID [(New)]

Assessment ID must be obtained from Day of Assessment Info page once it has been entered into central database. TS Group ID will be auto-assigned when uploaded tc database.

Assessment Date [ ] Start Time (ex. 13:30) [ ]

1. How many groups were assessed? [ ] Comments [ ]

2. How many horses were assessed in total? [ ] Comments [ ]

3. How many burros were assessed in total? [ ] Comments [ ]

Gather Performance | Handling Performance | Electric Prods | Roping

Standard	Criteria	Compliant?		
IV.C	30. How many WHBs received at least one shock from electric prod?		Comments	
IV.C.2.ab Major	31. Electric prods were fully charged and not concealed when used on WHB.		Comments	
IV.C.2.d Major	32. Electric prods were only picked up to deliver a stimulus and were not carried constantly.		Comments	
IV.C.2.c Major	33. Three attempts with other handling aids were used unsuccessfully before an electric prod was used.		Comments	
IV.C.2.e Major	34. Space in front of a WHB was available prior to application of electric prod.		Comments	
IV.C.2.f Major	35. Electric prod was NOT used on the face, genitals, anus, or underside of tail of any WHB.		Comments	
IV.C.2.g Major	36. Electric prod NOT applied to any WHB more than 3 times without approval of COR/PI.		Comments	

Record: 1 of 1 | Search

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Form #5d: Trap Site: Roping

Trap Site: Wild Horses _Burros

Assessment ID [ ] TS Group ID [(New)]

Assessment ID must be obtained from Day of Assessment Info page once it has been entered into central database. TS Group ID will be auto-assigned when uploaded tc database

Assessment Date [ ] Start Time (ex. 13:30) [ ]

1. How many groups were assessed? [ ] Comments [ ]

2. How many horses were assessed in total? [ ] Comments [ ]

3. How many burros were assessed in total? [ ] Comments [ ]

Gather Performance | **Handling Performance** | **Electric Prods** | **Roping**

Standard	Criteria	Compliant?	
II.C	37. How many WHBs were roped?		Comments
II.C.1 Major	38. Roping was approved by PI/COR prior to procedure.		Comments
II.C.3 Major	39. Ropers dallied rope to horn to stop WHB slowly, not jerk off feet.		Comments
II.C.4 Major	40. WHBs roped and tied in recumbency were monitored by attendant no more than 100 feet from animal		Comments
II.C.5 Major	41. WHBs tied in recumbency were untied within 30 minutes.		Comments
II.C.6 Major	42. Helicopter drive trapping within the trap wings ceased while WHB was tied in recumbency within the trap wings.		Comments
II.C.7 Major	43. Sleds, slide boards, or slip sheets were used to move recumbent WHB		Comments
II.C.8 Major	44. Halters and ropes were used to roll, turn, position, or load a recumbent WHB.		Comments
II.C.8 Major	45. No recumbent WHB was dragged across the ground by halter or rope attached to its body.		Comments
II.C.9 Major	46. WHBs captured by roping were evaluated by veterinarian within 4 hours, marked for identification, and re-evaluated by veterinarian periodically as deemed necessary.		Comments

Form #6a: Temporary Holding Facility: Facility Design

Temporary Holding Facility: Design, Care Provisions, and Biosecurity Assessment

Assessment ID [ ] TH Facility ID [(New)]

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. TH Facility ID will be auto-assigned when uploaded to d

Assessment Date [ ] Start Time (ex. 13:30 [ ] Comments [ ]

Facility Design | **Care, Health** | **Biosecurity**

Standard	Criteria	Compliant?	Comments
I.A.1 Major	1. Materials are stout, secured, in proper working condition.		Comments
I.A.1 I.A.6 Major	2. An appropriate chute for restraint is available (does not apply to bait trapping) and is in working order		Comments
I.A.12 Minor	3. Pens are constructed with rounded corners.		Comments
I.A.4 Major	4. Fence panel height is at least 6' for horses; at least 5' for burros, bottom rail no more than 12" from ground.		Comments
I.A.5, I.A.5.b Major	5. Number of pens is adequate to separate WHBs by: Gender, age, number, temperament Mares/jennies with dependent foals Physical condition (weak/debilitated)		Comments
I.A.5.a Major	6. Pens are capable of expansion (extra panels on hand).		Comments
I.A.1.13 Major	7. Fence panels and gates are covered with secured visual barriers with approx. 48" height.		Comments
I.A.9, I.A.1 Major	8. Gates are hinged, self-latching, swing freely and latch securely.		Comments
I.A.11, III.B.1.b Major	9. If multiple water troughs are present, they are placed in separate locations in pen (e.g. opposite ends of pen).		Comments
I.A.8 Major	10. Padding is installed on overhead bars of gates and chutes.		Comments
I.A.7 Major	11. No holes, gaps, openings, protruding surfaces, or sharp edges are present that could cause injuries to WHBs.		Comments
I.A.15 Minor	12. No trash, debris, reflective, or noisy objects.		Comments
III.B.2 Major	13. Dust abatement equipment is available and was employed when necessary.		Comments
VI.A.1 Major	14. Personnel authorized and trained to perform euthanasia and appropriate equipment are on site or within 1 hour travel time.		Comments
VI.B.1 Major	15. Removal equipment is available to dispose of carcasses.		Comments
IV.C.1 Major	16. Handling aids such as flags and shaker paddles were the primary tools for driving and moving WHBs.		Comments
IV.C.2.a Major	17. If an electric prod is present, it is a commercially available model with DC batteries and is fully charged		Comments

Form #6b: Temporary Holding Facility: Care, Health

Temporary Holding Facility: Design, Care Provisions, and Biosecurity Assessment

Assessment ID [ ] TH Facility ID [(New)]

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. TH Facility ID will be auto-assigned when uploaded to d

Assessment Date [ ] Start Time (ex. 13:30 [ ] Comments [ ]

Facility Design | Care, Health | Biosecurity

Standard	Criteria	Compliant?	
	18. Were WHBs held longer than 12 hours at facility?		Comments
I A 11, III B 1 b Major	19. Water is available to all WHB, at least 10 gallons/1000 lbs WHB/day, if held more than 12 hours		Comments
III B 1 c Major	20. Good quality hay is available, at least 20 lbs/ 1000 lbs WHB/day, if held more than 12 hours.		Comments
I A 11, III B 1 a Major	21. Evidence is present that feed was provided and water refilled every morning and evening if WHB held > 12 hours.		Comments
III B 1 c i Major	22. Hay does not contain poisonous weeds, debris, or toxic substances.		Comments
III B 1 c ii Major	23. Placement of hay allows all WHBs to eat simultaneously		Comments
III B 1 d Minor	24. Water and feed were adjusted for conditions on the range prior to gather		Comments
III B 2 Major	25. Dust abatement equipment is available and was employed when necessary		Comments
III A 1 Major	26. Veterinarian is available on-site or on-call.		Comments
III B 4 a Major	27. All WHBs were observed daily for health		Comments
III B 4 c Major	28. Non-ambulatory WHBs are separated from the general population. Hay and water are accessible within 6 hours after recumbency unless directed otherwise by the veterinarian		Comments
III B 4 d Major	29. The following animals are separated in pens from other WHBs: • Weak or debilitated WHBs • Mares/jennies with dependent foals		Comments
III B 4 f Minor	30. Stocking density: all WHBs in each pen occupy no more than half of that pen when at rest		Comments

Form #6c: Temporary Holding Facility: Biosecurity

Temporary Holding Facility: Design, Care Provisions, and Biosecurity Assessment

Assessment ID [ ] TH Facility ID [(New)]

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. TH Facility ID will be auto-assigned when uploaded to d

Assessment Date [ ] Start Time (ex. 13:30 [ ] Comments [ ]

Facility Design | Care, Health | Biosecurity

Standard	Criteria	Compliant?	Comments
III.C.3 Major	31. Veterinarian examined any horse or burro (wild, saddle, or pilot) showing signs of infectious disease		Comments
III.C.3 Major	32. Any saddle or pilot horses with signs of infectious disease today were removed from service and isolated from other horses.		Comments
III.C.3.a Major	33. Any saddle or pilot horses returned to service today after being isolated for signs of infectious disease were approved by veterinarian for return to the gather.		Comments
III.C.3.b Minor	34. Groups of WHBs showing signs of infectious disease were separated from healthy groups when possible		Comments
III.C.4 Minor	35. Horses not involved in the gather (visitors' horses) remained at least 300 yards from WHBs, saddle, and pilot horses		Comments

Form #7a: Temporary Holding Facility: Handling Performance

Temporary Holding Facility: Wild Horses _Burros

Assessment ID [ ] TH Group ID [(New)]

Assessment ID must be obtained from Day of Assessment Info page once it has been entered into central database. TH Group ID will be auto-assigned when uploaded to database.

Assessment Date [ ] Start Time (ex. 13:30) [ ]

1. Do WHBs need to be trailered from trap site to temporary holding facility? [ ] Comments [ ]

2. If yes, how many trailer loads were assessed? [ ] Comments [ ]

3. How many horses were assessed in total? [ ] Comments [ ]

4. How many burros were assessed in total? [ ] Comments [ ]

Handling Performance | **Electric Prods** | **Roping**

Standard	Criteria	Compliant?	Comments
IV.B.1 Major	5. Processing and sorting were performed during daylight hours.	[ ]	Comments [ ]
IV.A.1 Major	6. Hitting, kicking, striking, beating was not observed.	[ ]	Comments [ ]
IV.A.2 Major	7. Dragging without sled, slide board, or slip sheet was not observed. Ropes used for moving animal were attached to sled, slide board or slip sheet, unless being loaded per Section II.C.8.	[ ]	Comments [ ]
IV.A.3 Minor	8. Deliberate driving WHB into other animals, gates, panels, equipment was not observed.	[ ]	Comments [ ]
IV.A.4 Minor	9. Deliberate slamming of gates or doors on WHB was not observed.	[ ]	Comments [ ]
IV.A.5 Minor	10. Excessive noise or activity causing flighty, disturbed, agitated WHB was not observed.	[ ]	Comments [ ]
IV.B.2 Minor	11. All WHBs entered runway/chute facing forwards.	[ ]	Comments [ ]
IV.B.3 Minor	12. All WHBs remained in single-file alleyways, runways, or chutes less than 30 min.	[ ]	Comments [ ]
IV.B.4 Minor	13. Equipment, except for helicopters, was operated and located to minimize flighty behavior.	[ ]	Comments [ ]
IV.A.5 IV.B.4 Minor	14. No WHB fell due to handling, excessive noise, sudden activity, or equipment operation (select Yes if it did not occur).	[ ]	Comments [ ]
IV.C.1 Major	15. Handling aids such as flags and shaker paddles were the primary tools for driving and moving WHBs.	[ ]	Comments [ ]
III.B.4.b Major	16. Separation of dependent foals from mares did not exceed 4 hours, unless authorized or a decision was made to wean foal. (Authorization must be documented.)	[ ]	Comments [ ]
III.B.4.c Major	17. Non-ambulatory WHBs were examined by the BLM horse specialist or on-call/on-site veterinarian within 4 hours of recumbency.	[ ]	Comments [ ]
III.B.4.e Minor	18. Aggressive WHBs causing serious injury to other WHBs were relocated to a separate pen if possible.	[ ]	Comments [ ]
VI.2 Major	19. Euthanasia was performed according to AVMA guidelines via gunshot or injection of euthanasia agent.	[ ]	Comments [ ]

Form #7b: Temporary Holding Facility: Electric Prods

Temporary Holding Facility: Wild Horses _Burros

Assessment ID must be obtained from Day of Assessment Info page once it has been entered into central database. TH Group ID will be auto-assigned when uploaded to database.

Assessment Date | Start Time (ex. 13:30)

1. Do WHBs need to be trailered from trap site to temporary holding facility?		Comments
2. If yes, how many trailer loads were assessed?		Comments
3. How many horses were assessed in total?		Comments
4. How many burros were assessed in total?		Comments

Handling Performance | **Electric Prods** | **Roping**

Standard	Criteria	Compliant?	
	20. How many WHBs received at least one shock from electric prod?		Comments
IV.C.2.ab Major	21. Electric prods were fully charged and not concealed when used on WHB		Comments
IV.C.2.d Major	22. Electric prods were only picked up to deliver stimulus and were not carried constantly.		Comments
IV.C.2.c Major	23. Three attempts with other handling aids were used unsuccessfully before an electric prod was used.		Comments
IV.C.2.e Major	24. Space in front of a WHB was available prior to application of electric prod.		Comments
IV.C.2.f Major	25. Electric prod was NOT used on the face, genitals, anus, or underside of tail of any WHB.		Comments
IV.C.2.g Major	26. Electric prod was NOT applied to any WHB more than 3 times without approval of COR/PI		Comments

Form #7c: Temporary Holding Facility: Roping

Temporary Holding Facility: Wild Horses _Burros

Assessment ID | TH Group ID (New)

Assessment ID must be obtained from Day of Assessment Info page once it has been entered into central database. TH Group ID will be auto-assigned when uploaded to database.

Assessment Date | Start Time (ex. 13:30)

1. Do WHBs need to be trailered from trap site to temporary holding facility?		Comments
2. If yes, how many trailer loads were assessed?		Comments
3. How many horses were assessed in total?		Comments
4. How many burros were assessed in total?		Comments

Handling Performance | **Electric Prods** | **Roping**

Standard	Criteria	Compliant?	
	27. How many WHBs were roped at the temporary holding facility?		Comments
II.C.1 Major	28. Roping was approved by PI/COR prior to procedure.		Comments
II.C.3 Major	29. Ropers dallied rope to horn to stop WHBs slowly, not jerk off feet.		Comments
II.C.4 Major	30. WHBs roped and tied in recumbency were monitored by attendant no more than 100 feet from animal.		Comments
II.C.5 Major	31. WHBs tied in recumbency were untied within 30 minutes.		Comments
II.C.7 Major	32. Sleds, slide boards, or slip sheets were used to move recumbent WHBs.		Comments
II.C.8 Major	33. Halters and ropes were used to roll, turn, position, or load a recumbent WHB.		Comments
II.C.8 Major	34. No recumbent WHB was dragged across the ground by halter or rope attached to its body.		Comments
II.C.9 Major	35. WHBs captured by roping were evaluated by veterinarian within 4 hours, marked for identification, and re-evaluated by veterinarian periodically for 12 hours or longer if necessary.		Comments

Form #8a: Transport at Trap Site: Trailer Design and Safety

Transport at Trap Site: Facility and Trailer Assessment

Assessment ID ______ Transport Facility ID (New)

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. Transport Facility ID will be auto-assigned when uploaded to database.

Assessment Date ______ Start Time (ex. 13:30) ______ General Comments ______

Trailer Design and Safety | **Loading and Unloading Areas**

Standard	Criteria	Compliant?		
V.B.1 Major	1. Straight deck or stock trailer used; no double-deck or pot trailers. Indicate type and license plate number		Comments	
V.B 1.b Major	2. Trailers have covered roof or overhead bars.		Comments	
V.B.3 Major	3. The width and height of all gates and doors allow WHBs to move through freely		Comments	
V.B.4 Major	4. Gates and doors open and close easily, latch securely		Comments	
V.B.5 Major	5. Rear doors can open full width of trailer		Comments	
V.B.6 Major	6. Ramps have non-slip surface and are in good working condition.		Comments	
V.B.7 Major	7. A trailer 18-40 feet long has a partition to provide 2 compartments; a trailer > 40 feet long has partitions for 3 or more compartments		Comments	
V.B.8 Major	8. Partitions and panels inside trailer are free of sharp edges or holes that could cause injury to WHBs.		Comments	
V.B.9 Major	9. Inside lining of trailer is strong enough to withstand failure by kicking that could lead to injuries		Comments	
V.B.11 Major	10. Surfaces and floors of trailer were cleaned prior to gather.		Comments	

Form #8b: Transport at Trap Site: Loading and Unloading Areas

Transport at Trap Site: Facility and Trailer Assessment

Trailer Design and Safety | **Loading and Unloading Areas**

Standard	Criteria	Compliant?	
I.B.1 Major	11. Facilities are in safe and proper working condition		Comments
I.B.3 Major	12. No holes, gaps, openings, protruding surfaces, or sharp edges that could cause injury to WHBs.		Comments
I.B.1,4 Major	13. Gates and doors open and close easily, swing freely, and latch securely		Comments
I.B.2 Major	14. Side panels of loading ramp/chute are at least 6 feet high and fully covered, e.g. with plywood or metal without holes		Comments
I.B.5 Major	15. Ramp/chute has non-slip surface and no holes or obstacles that could cause WHBs to slip, trip, or fall		Comments
I.B.5 Major	16. Ramp/chute is maintained in safe and proper working condition		Comments
I.B.6 Major	17. Trailer is aligned with loading and unloading chutes and panels such that no gaps exist between the chute/panels and floor or sides of trailer that could lead to WHB injury		Comments
I.B.7 Minor	18. Clearance allowance from ground to floor of stock trailer is no more than 18" for horses and no more than 12" for burros		Comments

Form #9a: Transport at Trap Site: Loading and Unloading Procedures

Transport at Trap Site: Wild Horses _Burros

Assessment ID [ ] Transport Group ID [ ] (New)

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. Transport Group ID will be auto-assigned when uploaded to database.

Assessment Date [ ] Assessment Start Time (ex. 13:30) [ ]

Destination of trailer(s) [ ] General Comments [ ]

1. How many trailer loads were assessed?	[ ]	Comments	[ ]
2. How many horses were assessed in total?	[ ]	Comments	[ ]
3. How many burros were assessed in total?	[ ]	Comments	[ ]

Loading/Unloading Procedures | **Handling Performance** | **Electric Prod**

Standard	Criteria	Compliant?	Comments
V.A.1 Major	4. Sorting and loading/unloading were performed during daylight hours.		Comments
V.C.3 Major	5. Trailer provided minimum space in all compartments, as follows: a. 12 sq ft per adult horse b. 6.0 sq ft per dependent horse foal c. 8.0 sq ft per adult burro d. 4.0 sq ft per dependent burro foal		Comments
V.A.2 Minor	6. WHBs were transported to the BLM preparation facility within 48 hours of capture.		Comments
V.A.2.a Major	7. Shipping delays (e.g. release to range, on-site adoption) were approved by COR/PI.		Comments
V.C.1.a Major	8. No nonambulatory, blind, or severely injured WHBs were loaded.		Comments
V.C.1.b Major	9. No weak or debilitated WHBs were loaded without approval of COR and veterinarian		Comments
V.C.5 Major	10. No saddle horses were transported in same compartment as WHBs.		Comments
V.A.3 Minor	11. WHBs were shipped in order of priority: 1. debilitated 2. pairs 3. weanlings 4. dry mares and studs		Comments
V.C.2 Minor	12. WHBs were sorted for compatibility during travel to minimize possibility of injury		Comments
V.B.2 Major	13. During loading and unloading, all WHBs had adequate headroom. No head contact with roof or gate openings.		Comments
V.B.2 Major	14. During transport, all WHBs had adequate headroom and were able to maintain normal posture with all four feet on floor and no contact with roof or overhead bars.		Comments
V.B.10 Minor	15. Partition gates were used to distribute load during travel in trailers longer than 18 feet.		Comments
V.A.4 Major	16. Planned drive time to BLM preparation facility/ destination does not exceed 10 hours.		Comments
V.C.4 Major	17. Any WHB that was non-ambulatory or recumbent on arrival was evaluated on the trailer, and euthanized or removed using sled, slide board, or slip sheet.		Comments
V.A.5 Minor	18. Vehicle holding WHBs did not exceed a combined period of 3 hours at a standstill during entire journey.		Comments

Form #9b: Transport at Trap Site: Handling Performance

Transport at Trap Site: Wild Horses _Burros

Assessment ID | Transport Group ID (New)

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. Transport Group ID will be auto-assigned when uploaded to database

Assessment Date | Assessment Start Time (ex. 13:30)

Destination of trailer(s) | General Comments

1. How many trailer loads were assessed? Comments
2. How many horses were assessed in total? Comments
3. How many burros were assessed in total? Comments

Loading/Unloading Procedures | Handling Performance | Electric Prod

Standard	Criteria	Compliant?	
IV.A.1 Major	19. Hitting, kicking, striking, beating was not observed		Comments
IV.A.2 Major	20. Dragging without sled, slide board, or slip sheet was not observed. Ropes used for moving animal were attached to sled, slide board or slip sheet, unless being loaded per Section II.C.8.		Comments
IV.A.3 Minor	21. Deliberate driving WHB into other animals, gates, panels, equipment was not observed.		Comments
IV.A.4 Minor	22. Deliberate slamming of gates or doors on WHB was not observed		Comments
IV.A.5 Minor	23. Excessive noise or activity causing flighty, disturbed, agitated WHB was not observed		Comments
IV.B.2 Minor	24. All WHBs entered runway/chute facing forward		Comments
IV.B.3 Minor	25. WHBs should not remain in single-file alleyways, runways, or chutes longer than 30 min.		Comments
IV.B.4 Minor	26. Equipment, except for helicopters, was operated and located to minimize flighty behavior.		Comments
IV.A.5 IV.B.4 Minor	27. No WHB fell due to handling, excessive noise, sudden activity, or equipment operation. (select Yes if it did not occur).		Comments
IV.C.1 Major	28. Handling aids such as flags and shaker paddles were the primary tools for driving and moving WHBs		Comments

Form #9c: Transport at Trap Site: Electric Prod

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. Transport Group ID will be auto-assigned when uploaded to database.

Assessment Date | Assessment Start Time (ex. 13:30)

Destination of trailer(s) | General Comments

1. How many trailer loads were assessed? Comments
2. How many horses were assessed in total? Comments
3. How many burros were assessed in total? Comments

Loading/Unloading Procedures | **Handling Performance** | **Electric Prod**

Standard	Criteria	Compliant?	
	29. How many WHBs received at least one shock from electric prod?		Comments
IV.C.2.ab Major	30. Electric prods were fully charged and not concealed when used on WHBs.		Comments
IV.C.2.d Major	31. Electric prods were only picked up to deliver stimulus and were not carried constantly		Comments
IV.C.2.c Major	32. Three attempts with other handling aids were used unsuccessfully before an electric prod was used		Comments
IV.C.2.e Major	33. Space in front of a WHB was available prior to application of electric prod		Comments
IV.C.2.f Major	34. Electric prod was NOT used on the face, genitals, anus, or underside of tail of any WHB		Comments
IV.C.2.g Major	35. Electric prod was NOT applied to any WHB more than 3 times without approval of COR/PI		Comments

Form #10a: Transport at Temporary Holding: Loading and Unloading Procedures

Transport at Temporary Holding: Wild Horses_Burros

Assessment ID ______ Transport Group ID ______ (New)

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. Transport Group ID will be auto-assigned when uploaded to database.

Assessment Date ______ Assessment Start Time (ex. 13:30) ______

Is assessment for unloading/arrival or loading/departure? ______

If unloading, where did trip originate? ______

If loading, what is trip destination? ______

Drive time from origin to destination? ______

1. How many trailer loads were assessed? ______ Comments ______
2. How many horses were assessed for transportation in total? ______ Comments ______
3. How many burros were assessed for transportation in total? ______ Comments ______

Loading/Unloading Procedures | **Handling Performance** | **Electric Prod**

Standard	Criteria	Compliant?	Comments
V.A.1 Major	4. Sorting and loading/unloading were performed during daylight hours.		Comments
V.C.3 Major	5. Trailer provided minimum space in all compartments, as follows: a. 12 sq ft per adult horse b. 6.0 sq ft per dependent horse foal c. 8.0 sq ft per adult burro d. 4.0 sq ft per dependent burro foal		Comments
V.A.2 Minor	6. WHBs were transported to the BLM preparation facility within 48 hours of capture		Comments
V.A.2.a Major	7. Shipping delays (e.g. release to range, on-site adoption) were approved by COR/PI		Comments
V.C.1.a Major	8. No nonambulatory, blind, or severely injured WHBs were loaded		Comments
V.C.1.b Major	9. No weak or debilitated WHBs were loaded without approval of COR and veterinarian		Comments
V.C.5 Major	10. No saddle horses were transported in same compartment as WHBs		Comments
V.A.3 Minor	11. WHBs were shipped in order of priority: 1. debilitated 2. pairs 3. weanlings 4. dry mares and studs		Comments
V.C.2 Minor	12. WHBs were sorted for compatibility during travel to minimize possibility of injury		Comments
V.B.2 Major	13. During loading and unloading, all WHBs had adequate headroom. No head contact with roof or gate openings		Comments
V.B.2 Major	14. During transport, all WHBs had adequate headroom and were able to maintain normal posture with all four feet on floor and no contact with roof or overhead bars.		Comments
V.B.10 Minor	15. Partition gates were used to distribute load during travel in trailers longer than 18 feet		Comments
V.A.4 Major	16. Planned drive time to BLM preparation facility/destination did not exceed 10 hours		Comments
V.C.4 Major	17. Any WHB that was non-ambulatory or recumbent on arrival was evaluated on the trailer, and euthanized or removed using sled, slide board, or slip sheet.		Comments
V.A.5 Minor	18. Vehicle holding WHBs did not exceed a combined period of 3 hours at a standstill during entire journey		Comments

Form #10b: Transport at Temporary Holding: Handling Performance

Transport at Temporary Holding: Wild Horses _Burros

Assessment ID [ ] Transport Group ID [ ] (New)

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. Transport Group ID will be auto-assigned when uploaded to database.

Assessment Date [ ] Assessment Start Time (ex. 13:30) [ ]

Is assessment for unloading/arrival or loading/departure? [ ]

If unloading, where did trip originate? [ ]

If loading, what is trip destination? [ ]

Drive time from origin to destination? [ ]

1. How many trailer loads were assessed? [ ] Comments [ ]

2. How many horses were assessed for transportation in total? [ ] Comments [ ]

3. How many burros were assessed for transportation in total? [ ] Comments [ ]

Loading/Unloading Procedures | **Handling Performance** | **Electric Prod**

Standard	Criteria	Compliant?	Comments
IV.A.1 Major	19. Hitting, kicking, striking, beating was not observed.		
IV.A.2 Major	20. Dragging without sled, slide board, or slip sheet was not observed. Ropes used for moving animal were attached to sled, slide board or slip sheet, unless being loaded per Section II.C.8		
IV.A.3 Minor	21. Deliberate driving WHB into other animals, gates, panels, equipment was not observed.		
IV.A.4 Minor	22. Deliberate slamming of gates or doors on WHB was not observed.		
IV.A.5 Minor	23. Excessive noise or activity causing flighty, disturbed, agistated WHB was not observed.		
IV.B.2 Minor	24. All WHBs entered runway/chute facing forward.		
IV.B.3 Minor	25. All WHBs remained in single-file alleyways, runways, or chutes less than 30 min.		
IV.B.4 Minor	26. Equipment, except for helicopters, was operated and located to minimize flighty behavior.		
IV.A.5 IV.B.4 Minor	27. No WHB at the trap site fell due to handling, excessive noise, sudden activity, or equipment operation. Select Yes if did not occur.		
IV.C.1 Major	28. Handling aids such as flags and shaker paddles were the primary tools for driving and moving WHBs.		

Form #10c: Transport at Temporary Holding: Electric Prod

Transport at Temporary Holding: Wild Horses _Burros

Assessment ID | Transport Group ID (New)

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. Transport Group ID will be auto-assigned when uploaded to database.

Assessment Date | Assessment Start Time (ex 13:30)

Is assessment for unloading/arrival or loading/departure?

If unloading, where did trip originate?

If loading, what is trip destination?

Drive time from origin to destination?

1. How many trailer loads were assessed? Comments

2. How many horses were assessed for transportation in total? Comments

3. How many burros were assessed for transportation in total? Comments

Loading/Unloading Procedures | **Handling Performance** | **Electric Prod**

Standard	Criteria	Compliant?	
	29 How many WHBs received at least one shock from electric prod?		Comments
IV.C.2.ab Major	30 Electric prods were fully charged and not concealed when used on WHBs.		Comments
IV.C.2.d Major	31 Electric prods were only picked up to deliver stimulus and were not carried constantly		Comments
IV.C.2.c Major	32 Three attempts with other handling aids were used unsuccessfully before an electric prod was used.		Comments
IV.C.2.e Major	33 Space in front of a WHB was available prior to application of electric prod		Comments
IV.C.2.f Major	34 Electric prod was NOT used on the face, genitals, anus, or underside of tail of any WHB		Comments
IV.C.2.g Major	35 Electric prod was NOT applied to any WHB more than 3 times without approval of COR/PI		Comments

Form #11a: Transport at Temporary Holding: Trailer Design and Safety

Transport at Temporary Holding: Facility and Trailer Assessment

Assessment ID | Transport Facility ID (New)

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. Transport Facility ID will be auto-assigned when uploaded to database.

Assessment Date | Start Time (ex. 13:30) | General Comments

Trailer Design and Safety | **Loading and Unloading Areas**

Standard	Criteria	Compliant?	
V.B.1 Major	1. Straight deck or stock trailer used; no double-deck or pot trailers. Indicate type and license plate number		Comments
V.B.1.b Major	2. Trailers have covered roof or overhead bars.		Comments
V.B.3 Major	3. The width and height of all gates and doors allow WHBs to move through freely.		Comments
V.B.4 Major	4. Gates and doors open and close easily, latch securely		Comments
V.B.5 Major	5. Rear doors can open full width of trailer.		Comments
V.B.6 Major	6. Ramps have non-slip surface and are in good working condition		Comments
V.B.7 Major	7. A trailer 18-40 feet long has a partition to provide 2 compartments; a trailer > 40 feet long has partitions for 3 or more compartments		Comments
V.B.8 Major	8. Partitions and panels inside trailer are free of sharp edges or holes that could cause injury to WHBs.		Comments
V.B.9 Major	9. Inside lining of trailer is strong enough to withstand failure by kicking that could lead to injuries		Comments
V.B.11 Major	10. Surfaces and floors of trailer were cleaned prior to gather		Comments

Form #11b: Transport at Temporary Holding: Loading and Unloading Areas

Transport at Temporary Holding: Facility and Trailer Assessment

Assessment ID Transport Facility ID (New)

Assessment ID must be obtained from Assessment Day Info page once it has been entered into central database. Transport Facility ID will be auto-assigned when uploaded to database.

Assessment Date Start Time (ex. 13:30) General Comments

Trailer Design and Safety | **Loading and Unloading Areas**

Standard	Criteria	Compliant?	
LB.1 Major	11. Facilities are in safe and proper working condition.		Comments
LB.3 Major	12. No holes, gaps , openings, protruding surfaces, or sharp edges that could cause injury to WHBs.		Comments
LB.1,4 Major	13. Gates and doors open and close easily, swing freely, and latch securely.		Comments
LB.2 Major	14. Side panels of loading ramp/chute are at least 6 feet high and fully covered, e.g. with plywood or metal without holes.		Comments
LB.5 Major	15. Ramp/chute has non-slip surface and no holes or obstacles that could cause WHBs to slip, trip, or fall.		Comments
LB.5 Major	16. Ramp/chute is maintained in safe and proper working condition.		Comments
LB.6 Major	17. Trailer is aligned with loading and unloading chutes and panels such that no gaps exist between the chute/panels and floor or sides of trailer that could lead to WHB injury.		Comments
LB.7 Minor	18. Clearance allowance from ground to floor of stock trailer is no more than 18" for horses and no more than 12" for burros.		Comments

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Burns District Office
28910 Hwy 20 West
Hines, Oregon 97738
http://www.blm.gov/or/districts/burns

In Reply Refer To:
4700-711 (ORB000) I

EMS Transmission: June 5, 2018
Instruction Memorandum: ORB-000-2018-004
Expires: September 30, 2019

To: Burns District Office

From: Jeff Rose
District Manager

Subject: Oregon Wild Horse and Burro Corral Facility Access for Visitors

Program Area: Wild Horse and Burro Security and Safety Programs

Purpose: The purpose of this instruction memorandum (IM) is to establish policy and procedures for safe and transparent visitation by the public/media at the Oregon Wild Horse Corral Facility in Hines, Oregon.

Policy/Action: Effective immediately, all Burns District Bureau of Land Management (BLM) staff and visitors to the facility must comply with the new policy of this IM for all visitation to the corral facility. This policy establishes the procedures for safe and transparent visitations by the public/media at the Oregon Wild Horse Corral Facility.

Burns District Policy on Visitor Access at the Oregon Wild Horse Corral Facility

Visitors: A visitor is described as any person not employed by the BLM, including volunteers.

- The wild horse and burro (WHB) auto tour and the informational kiosk in front of the adoption office are available for unescorted public visitation during normal business hours (8:00 am–3:00 pm, Monday–Friday). Visitors may drive the self-guided auto tour route, which circles the perimeter of the corrals, without a BLM escort. Use of the auto tour does not require the visitor to check in with BLM staff.
- While in all other areas of the facility, visitors must be accompanied by a BLM Burns District employee, after checking in with a BLM Burns District WHB Program employee. Exceptions to this will be the bonded contract personnel (veterinarians, janitors, manure haulers, hay haulers, etc.) and the sanitation vehicle.
- Visitors may only enter the pens as authorized and while accompanied by a BLM Burns District employee.
- A limited number of visitors will be allowed in the barn (while accompanied by a BLM Burns District employee) during specific activities where space is limited and where the safety of the handlers and horses would not be jeopardized by the presence of additional people. The amount of visitors may vary depending on the activity, animal temperament, or other circumstances. If the group of visitors is too large to accommodate in one tour, small groups may be rotated through the facility as time allows. Activities where visitors may be allowed in the barn include guided facility tours, demonstrations of routine animal preparation procedures, and selection and haltering of horses being adopted.
- Visitors will not be allowed in the barn during most types of animal surgery, when euthanasia is performed, or during any situation where the safety of visitors, employees, and the animals would be jeopardized by the presence of additional people. There may be situations where a limited number of visitors are permitted inside the barn to view animal surgeries or more than routine preparation procedures. The following criteria must be met prior to allowing visitor access during these situations—
    - The visitation is authorized by the Oregon/Washington State Director;
    - The BLM has adequate staffing to escort visitors within the site;
    - There is an observation location which provides for the safety of the visitors and does not jeopardize animal handling or the safety of corral staff or contractors; and
    - Contractors performing services under contract with the BLM agree to public visitation.
- The facility manager has authority to limit the size of any visitor group and to decline access at any time.

- Requests for commercial-type filming or photography (taken in or from areas not generally allowed to the public) at the facility, including drones or remote cameras, must be coordinated through the Burns District Public Affairs Specialist and the Burns District Realty Specialist, who together will determine if a film permit is required and schedule visitor access at the facility. Casual use activities (i.e., noncommercial activities occurring on an occasional or irregular basis that result in little or no impact to public lands) involving still photography or recreational videotaping do not require a permit.
- Any visitor using a drone or remote camera, even for casual use, must be accompanied by a BLM Burns District WHB Program employee at all times. Drones and remote cameras will not be used over the pens at the facility.

Timeframe: Effective upon issuance.

Budget Impact: None.

Background: The Burns District WHB Program staff has a longstanding policy of providing public/media safe access to the corral facility. To continue allowing for transparency and provide a positive working relationship with the public and potential adopters, the facility manager has provided escorted access to the public for activities such as basic processing, selection of animals to adopt, haltering of adopted animals, and guided tours. The public has never been allowed to enter pens without a BLM WHB Program staff member or observe surgeries at the facility.

The number of public/media interested in viewing additional activities at the facility has increased in recent years. For the safety of the visitors, BLM bonded contractors, BLM staff, and the horses/burros, this visitor policy is being implemented.

This policy is in conformance with BLM's Safety and Health Management Handbook, H-1112-1 (May 2015).

Manual/Handbook Sections Affected: None.

Contact: Please direct questions regarding this IM to the Associate District Manager, Holly Orr, at 541-573-4422, or the District Public Affairs Specialist, Tara Thissell, at 541-573-4519.

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240

March 12, 2009

In Reply Refer To:
4710 (260) P

EMS TRANSMISSION 03/17/2009
Instruction Memorandum No. 2009-090
Expires: 09/30/2010

To: All Field Officials (except Alaska)

From: Assistant Director, Renewable Resources and Planning

Subject: Population-Level Fertility Control Field Trials: Herd Management Area (HMA) Selection, Vaccine Application, Monitoring and Reporting Requirements

Program Area: Wild Horse and Burro Program

Purpose: The purpose of this Instruction Memorandum is to establish guidance for population-level fertility control field research trials. The primary objective of these trials is to evaluate the effects of a single year or 22-month Porcine Zona Pellucida (PZP) immunocontraceptive vaccine treatment on wild horse population growth rates while expanding the use of these tools in the field.

Policy/Action: This policy establishes guidelines for selecting HMAs for population-level fertility control treatment, vaccine application, and post-treatment monitoring and reporting. It is the policy of the Bureau of Land Management (BLM) to apply fertility control as a component of all gathers unless there is a compelling management reason not to do so.

HMA Selection

Managers are directed to explore options for fertility control trials in all HMAs or complexes when they are scheduled for gathers. Further, an alternative outlining implementation of a fertility control treatment under a population-level research trial shall be analyzed in all gather plan environmental assessments (EA's). Attachment 1 contains the Standard Operating Procedures (SOPs) for the implementation of the single-year and 22-month PZP agents, which should be referenced in the EA.

Fertility control should not be used in a manner that would threaten the health of individual animals or the long-term viability of any herd. In order to address the latter requirement, managers must evaluate the potential effects of fertility control on herd growth rates through use of the Jenkins Population Model (WinEquus). Fertility control application should achieve a substantial treatment effect while maintaining some long-term population growth to mitigate the effects of potential environmental catastrophes.

Fertility control will have the greatest beneficial impact where:

1. Annual herd growth rates are typically greater than 5%.
2. Post-gather herd size is estimated to be greater than 50 animals.
3. Treatment of at least 50% of all breeding-age mares within the herd is possible using either application in conjunction with gathers or remote delivery (darting). A maximum of 90% of all mares should be treated and our goal should be to achieve as close as to this percentage as possible in order to maximize treatment effects.

Fertility control should not be dismissed as a potential management action even if the above conditions are not met. Regardless of primary capture method (helicopter drive-trapping or bait/water trapping), managers should strive to gather horses in sufficient numbers to achieve the goals of the management action, such as selective removal and fertility control treatment. After decisions are made to apply fertility control, historical herd information, remote darting success (if employed) and post-gather herd demographic data must be reported to the National Program Office (NPO). See the Reporting Requirements section on page four.

Vaccine Application and Animal Identification at Gather Sites Using the 22-Month Vaccine

Once an HMA has been selected as a population-level field trial site, the NPO will designate a trained applicator to administer the vaccine during the scheduled gather. The applicator will be responsible for securing the necessary vaccine from the NPO, transporting all application materials and freeze-marking equipment to the gather site, administering the treatment, and filing a treatment report with the NPO. See Attachment 1 for SOP for Population-level Fertility Control Treatments.

All treated mares will be freeze-marked with two 3.5-inch letters on the left hip for treatment tracking purposes. The only exception to this requirement is when each treated mare can be clearly and specifically identified through photographs. The treatment letters will be assigned and provided by the NPO after the gather and fertility control application is approved by the authorized officer. A different first letter is assigned for each fiscal year starting with fiscal year 2004 and the letter "A." The second letter of the freeze-mark is specific to the application.

Each BLM State Office (SO) is responsible for coordinating with the State Brand Inspector on the use of the identified two-letter freeze-mark. Based on this coordination, possible alternatives or additions to this marking policy are listed below:

1. Use of the adult or foal size angle-numeric BLM freezemark on the neck while recording each treatment product and date with the individual horse's freezemark number.
2. Registration of the BLM fertility control hip mark.
3. Use of a registered brand furnished by the State.
4. Use of the same hip freeze-mark for all fertility control treatments within that State's jurisdiction plus an additional freeze-mark on the neck to differentiate between treatments within the State.
5. Use of the NPO assigned freeze-mark plus additional freeze-mark on the neck to differentiate between treatments within the State.

As an example, the Nevada State Brand Inspector requires that an "F" freeze-mark be applied to the left neck along with the two-letter hip mark assigned by NPO.

Regardless of how the mares are marked, the marks must be identified in the fertility control treatment report in order to track when the mares were treated and the treatment protocol used.

Mares may be considered for re-treatment during subsequent gathers. All re-treatments will consist of the multi-year vaccine unless specifically approved by the NPO. Any re-treated mares must be re-marked or clearly identifiable for future information.

Vaccine Application and Animal Identification Using Remote Delivery (Darting)

Remote delivery of the one year vaccine by a trained darter/applicator will be considered and approved only when (1) application of the current 22-month PZP agent is not feasible because a gather will not be conducted, and (2) the targeted animals can be clearly and specifically identified on an on-going basis through photographs and/or markings. No animals should be darted that cannot be clearly and positively identified later as a treated animal. To increase the success rate of the darting and to insure proper placement of the vaccine, darting should occur along travel corridors or at water sources. If necessary, bait stations using hay or salt may be utilized to draw the horses into specific areas for treatment. The applicator will maintain records containing the basic information on the color and markings of the mare darted and her photographs, darting location, and whether the used darts were recovered from the field. See Appendix 1 for SOP for Population-Level Fertility Control Treatments.

Post-treatment Monitoring

At a minimum, the standard data collected on each treated herd will include one aerial population survey prior to any subsequent gather. This flight will generally occur 3 to 4 years after the fertility control treatment and will be conducted as a routine pre-gather inventory funded by the Field Office (FO). The flight should be timed to assure that the majority of foaling is completed, which for most herds will require that flights be scheduled after August 1st. In addition to pre-gather population data (herd size), information on past removals, sex ratio, and age structure (capture data) will be submitted to the NPO after the first post-treatment gather.

The following standard data will be collected during all post-treatment population surveys:

1. Total number of adult (yearling and older) horses observed.
2. Total number of foals observed.

These data are to be recorded on the Aerial Survey Report form (Attachment 4). In planning post-treatment population surveys, the new population estimation techniques being developed by U.S. Geological Survey (USGS) are strongly recommended. In general, however, it is not necessary that anyone try to identify treated and untreated mares and specifically which mares have foaled during aerial surveys.

To obtain more specific information on vaccine efficacy, some HMAs may be selected for intensive monitoring beginning the first year after treatment and ending with the first gather that follows treatment. These surveys should be completed annually within the same month for consistency of the data. Selection will be based on the proportion of treated mares in the herd, degree of success with vaccine application, degree to which HMA selection criteria are met, and opportunities for good quality data collection. This determination will be made by the WH&B Research Advisory Team and the NPO in consultation with the appropriate Field Office (FO) and State Office (SO). HMAs selected for intensive monitoring will be identified in that specific State's Annual Work Plan. Washington Office 260 (WO260) will provide funding for the annual surveys in those HMAs selected for intensive monitoring.

Field Office personnel may conduct more intensive on-the-ground field monitoring of these herds as time and budget allow. These data should be limited to: 1) the annual number of marked and unmarked mares with and without foals and 2) foaling seasonality. These data, generated for FO use, should be submitted to the NPO to supplement research by the USGS.

Reporting Requirements

1) When an HMA is selected for fertility control treatment, the HMA manager will initiate and complete the appropriate sections of the Gather, Removal, and Treatment Summary Report (Attachment 2) and submit the report to the NPO. At the conclusion of the gather and treatment, the HMA manager will complete the remainder of the Gather, Removal, and Treatment Summary Report and submit it to the NPO within 30 days. The NPO will file and maintain these reports, with a copy sent to the National WH&B Research Coordinator.

2) Following treatment, the fertility control applicator will complete a PZP Application Report and PZP Application Data Sheet (Attachments 3 & 4) and submit it to the NPO that summarizes the treatment. The NPO will maintain this information and provide copies of the reports to appropriate FOs and USGS.

3) Managers are required to send post-treatment monitoring data (Aerial Survey Report, Attachment 5) to the NPO within 30 days of completing each aerial survey. Any additional on-the-ground monitoring data should be sent to the NPO on an annual basis by December 31st.

4) During the next post-treatment gather (generally 4 to 6 years after treatment), the manager will complete a new Gather, Removal, and Treatment Summary Report with pertinent information and submit the report to the NPO. Completion of this report will fulfill the requirements for monitoring and reporting for each population-level study. A possible exception would be if mares are treated (or re-treated) and the HMA is retained as a population-level study herd.

The USGS will analyze all standard data collected. The results of these analyses along with other research efforts will help determine the future use of PZP fertility control for management of wild horse herds by the BLM.

Timeframe: This Instruction Memorandum is effective upon issuance.

Budget Impact: Implementation of this policy will achieve cost savings by reducing the numbers of excess animals removed from the range and minimizing the numbers of less adoptable animals removed. The costs to administer the one-year PZP agent include the labor and equipment costs for the applicator and assistant of roughly $4,000/month and the treatment cost of approximately $25 per animal. The costs to administer the 22-month PZP agent include the capture cost of about $1,000 per animal treated (under normal sex ratios it requires two horses, one stud and one mare, to be captured for each mare treated) and the PZP vaccine is approximately $250 per animal. The budgetary savings for each foal not born due to fertility control is about $500 for capture, $1,100 for adoption prep and short-term holding, $500-1,000 for adoption costs, and approximately $475 per year for long-term holding of animals removed but not adopted. For each animal that would have been maintained at long term holding for the remainder of its life after capture, the total cost savings is about $13,000. Any additional FO-level monitoring will be accomplished while conducting other routine field activities at no additional cost.

Population-level studies will help to further evaluate the effectiveness of fertility control in wild horse herds. Recent research results showed that application of the current 22-month PZP contraceptive appears capable of reducing operating costs for managing wild horse populations. Application of a 3-4 year contraceptive, when developed, tested, and available, may be capable of reducing operating costs by even more (Bartholow, 2004).

Background: The one-year PZP vaccine has been used with success on the Pryor Mountain and the Little Book Cliffs Wild Horse Ranges. The 22-month PZP vaccine has been administered to 1,808 wild horse mares in 47 HMAs since fiscal year 2004. This formulation has been shown to provide infertility potentially through the third year post-treatment as determined by a trial conducted at the Clan Alpine HMA in 1999. The intent of the ongoing population-level fertility control trials is to determine if the rate of population growth in wild horse herds can be reduced through the use of the currently available 22-month time-release PZP vaccine, applied within a 3-4 year gather and treatment cycle. Monitoring data collected over the next few years are essential to determine the effectiveness of the vaccine when applied on a broad scale as well as its potential for management use.

PZP is classified as an Investigational New Animal Drug and some level of monitoring will continue to be required until such time as the Food and Drug Administration (FDA) or the Environmental Protection Agency (EPA) either reclassify the vaccine or provide some other form of relief.

Manual/Handbook Sections Affected: The monitoring requirements do not change or affect any manual or handbook.

Coordination: The requirements outlined in this policy have been evaluated by the National Wild Horse and Burro Research Advisory Team, coordinated with the National Wild Horse and Burro Advisory Board, and reviewed by Field Specialists.

Contact: Questions concerning this policy should be directed to Alan Shepherd, WH&B Research Coordinator at the Wyoming State Office in Cheyenne, Wyoming at (307) 775-6097.

Reference: Bartholow, J.M. 2004. **An economic analysis of alternative fertility control and associated management techniques for three BLM wild horse herds.** Fort Collins, CO: U.S. Geological Survey. Open-File Report 2004-1199. 33 p.

Signed by:
Edwin L. Roberson
Assistant Director
Renewable Resources and Planning

Authenticated by:
Robert M. Williams
Division of IRM Governance,WO-560

5 Attachments
1- Standard Operating Procedure for Population0level Fertility Control Treatments (2 pp)
2- Gather Removal, and Treatment Report (3 pp)
3- PZP Application Report (1 p)
4- PZP Application Data Sheet (1 p)
5- Aerial Survey Report (1 p)

Attachment 1: Standard Operating Procedures for Population-level Fertility Control Treatments

One-year liquid vaccine:

The following implementation and monitoring requirements are part of the Proposed Action:

1. PZP vaccine would be administered through darting by trained BLM personnel or collaborating research partners only. For any darting operation, the designated personnel must have successfully completed a Nationally recognized wildlife darting course and who have documented and successful experience darting wildlife under field conditions.
2. Mares that have never been treated would receive 0.5 cc of PZP vaccine emulsified with 0.5 cc of Freund's Modified Adjuvant (FMA) and loaded into darts at the time a decision has been made to dart a specific mare. Mares identified for re-treatment receive 0.5 cc of the PZP vaccine emulsified with 0.5 cc of Freund's Incomplete Adjuvant (FIA).
3. The liquid dose of PZP vaccine is administered using 1.0 cc Pneu-Darts with 1.5" barbless needles fired from either Dan Inject® or Pneu-Dart® capture gun.
4. Only designated darters would mix the vaccine/adjuvant and prepare the emulsion. Vaccine-adjuvant emulsion would be loaded into darts at the darting site and delivered by means of a capture gun.
5. Delivery of the vaccine would be by intramuscular injection into the left or right hip/gluteal muscles while the mare is standing still.
6. Safety for both humans and the horse is the foremost consideration in deciding to dart a mare. The Dan Inject® gun would not be used at ranges in excess of 30 m while the Pneu-Dart® capture gun would not be used over 50 m, and no attempt would be taken when other persons are within a 30-m radius of the target animal.
7. No attempts would be taken in high wind or when the horse is standing at an angle where the dart could miss the hip/gluteal region and hit the rib cage. The ideal is when the dart would strike the skin of the horse at a perfect 90° angle.
8. If a loaded dart is not used within two hours of the time of loading, the contents would be transferred to a new dart before attempting another horse. If the dart is not used before the end of the day, it would be stored under refrigeration and the contents transferred to another dart the next day. Refrigerated darts would not be used in the field.
9. No more than two people should be present at the time of a darting. The second person is responsible for locating fired darts. The second person should also be responsible for identifying the horse and keeping onlookers at a safe distance.
10. To the extent possible, all darting would be carried out in a discrete manner. However, if darting is to be done within view of non-participants or members of the public, an explanation of the nature of the project would be carried out either immediately before or after the darting.
11. Attempts will be made to recover all darts. To the extent possible, all darts which are discharged and drop from the horse at the darting site would be recovered before another darting occurs. In exceptional situations, the site of a lost dart may be noted and marked, and recovery efforts made at a later time. All discharged darts would be examined after recovery in order to determine if the charge fired and the plunger fully expelled the vaccine.
12. All mares targeted for treatment will be clearly identifiable through photographs to enable researchers and HMA managers to positively identify the animals during the research project and at the time of removal during subsequent gathers.
13. Personnel conducting darting operations should be equipped with a two-way radio or cell phone to provide a communications link with the Project Veterinarian for advice and/or assistance. In the event of a veterinary emergency, darting personnel would immediately contact the Project Veterinarian, providing all available information concerning the nature and location of the incident.

14. In the event that a dart strikes a bone or imbeds in soft tissue and does not dislodge, the darter would follow the affected horse until the dart falls out or the horse can no longer be found. The darter would be responsible for daily observation of the horse until the situation is resolved.

22-month time-release pelleted vaccine:

The following implementation and monitoring requirements are part of the Proposed Action:

1. PZP vaccine would be administered only by trained BLM personnel or collaborating research partners.
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 delivered using a modified syringe and jabstick to inject the pellets into the gluteal muscles of the mares being returned to the range. The pellets are designed to release PZP over time similar to a time-release cold capsule.
3. Delivery of the vaccine would be by intramuscular injection into the gluteal muscles while the mare is restrained in a working chute. The primer would consist of 0.5 cc of liquid PZP emulsified with 0.5 cc of Freunds Modified Adjuvant (FMA). The pellets would be loaded into the jabstick for the second injection. With each injection, the liquid or pellets would be injected into the left hind quarters of the mare, above the imaginary line that connects the point of the hip (hook bone) and the point of the buttocks (pin bone).
4. In the future, the vaccine may be administered remotely using an approved long range darting protocol and delivery system if or when that technology is developed.
5. All treated mares will be freeze-marked on the hip or neck HMA managers to positively identify the animals during the research project and at the time of removal during subsequent gathers.

Monitoring and Tracking of Treatments:

1. At a minimum, estimation of population growth rates using helicopter or fixed-wing surveys will be conducted before any subsequent gather. During these surveys it is not necessary to identify which foals were born to which mares; only an estimate of population growth is needed (i.e. # of foals to # of adults).
2. Population growth rates of herds selected for intensive monitoring will be estimated every year post-treatment using helicopter or fixed-wing surveys. During these surveys it is not necessary to identify which foals were born to which mares, only an estimate of population growth is needed (i.e. # of foals to # of adults). If, during routine HMA field monitoring (on-the-ground), data describing mare to foal ratios can be collected, these data should also be shared with the NPO for possible analysis by the USGS.
3. A PZP Application Data sheet will be used by field applicators to record all pertinent data relating to identification of the mare (including photographs if mares are not freeze-marked) and date of treatment. Each applicator will submit a PZP Application Report and accompanying narrative and data sheets will be forwarded to the NPO (Reno, Nevada). A copy of the form and data sheets and any photos taken will be maintained at the field office.
4. A tracking system will be maintained by NPO detailing the quantity of PZP issued, the quantity used, disposition of any unused PZP, the number of treated mares by HMA, field office, and State along with the freeze-mark(s) applied by HMA and date.

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240
http://www.blm.gov
March 4, 2015

In Reply Refer To:
4750 (260) P

EMS TRANSMISSION 03/24/2016
Instruction Memorandum No. 2015-070
Expires: 09/30/2018

To: All Field Office Officials (except Alaska)

From: Assistant Director, Renewable Resources and Planning

Subject: Animal Health, Maintenance, Evaluation and Response

Program Area: Wild Horse and Burro (WH&B) Program

Purpose: The purpose of this Instruction Memorandum (IM) is to establish policy and procedures for the proactive and preventative medical care of animals managed by the WH&B Program including deworming, vaccination, evaluation of animal condition and determination of an appropriate end-of-life action when indicated for reasons of an act of mercy, health or safety.

Policy/Action: Effective immediately, all Bureau of Land Management (BLM) Washington DC, state, district, and field offices must comply with the policies described in this IM. The key contents of this policy are:

- Deworming and vaccination schedule, diseases to vaccinate against and frequency of treatment (Attachment 1).
- Animal evaluation and response that includes evaluating animal health, body condition scoring, and the authority, training, approved methods, reporting documentation and reasons for ending an animal's life as an act of mercy, health or safety (Attachment 2, 3 and 4).

Timeframe: All portions of this policy are effective immediately with the exception of the formal training requirements identified in Attachment 2. For a period of three months from the date of issuance of this policy, personnel who already have experience performing euthanasia but have not yet received formal training may continue to do so for emergency situations when a trained person is not immediately available, as a last resort. After this time, only personnel trained by a veterinarian may end an animal's life as an act of mercy, health or safety.

Budget Impact: This memorandum is a reissuance and an update of existing policy with minimal changes. This reissued guidance does not result in costs beyond those already incurred under existing policy except for the additional training requirements for personnel authorized to end an animal's life. The cost for the required training is about $250 per person depending on the training venue. The cost of vaccinations and deworming for animals in off-range corrals is $85 during the first year and $40 annually thereafter for booster vaccinations. Annual deworming and vaccinations are not administered to animals in off-range pastures. The cost to end an animal's life ranges from $50 to $250 depending on circumstances.

Background: The authority for ending a wild horse or burro's life is provided by Public Law 92-195, Wild Free-Roaming Horses and Burros Act of 1971 Section 1333 (b)(2)(A) and 43 CFR 4730.l. The policy contained in this IM amends and/or replaces previous policies contained in BLM Manual 4750-1 Wild Horse and Burro Preparation and Management Handbook and in BLM Manual H-4700-1 Wild Horses and Burros Management Handbook.

The administration of vaccines and dewormer to the wild horses and burros removed from the public lands and maintained at off-range corrals has been a long-standing practice within the Wild Horse and Burro Program and is a required health care standard operating procedure. Decisions to end a wild horse or burro's life for reasons related to acts of mercy, health, and safety require that the BLM evaluate individual animals affected by injury, physical defect, acute, chronic or incurable disease, severe tooth loss, poor condition, old age or behavior characteristics posing safety hazards to handlers. During gathers, the animal's ability to survive the stress of removal and its probability of surviving on the range, as well as the animal's welfare and potential for suffering if released or transported to a BLM off-range preparation facility, are all considered. Humane, long-term care of wild horses and burros located at off-range corrals, pastures, ecosanctuaries and other facilities require periodic evaluation of their condition by qualified BLM personnel or a veterinarian to provide for their well-being. These evaluations will, at times, result in decisions that require ending an animal's life.

Manual/Handbook Sections Affected: BLM Manual 4750-1 Wild Horse and Burro Preparation, Chapter III - Identification and Basic Health Care will need to be amended to provide for rabies and West Nile vaccinations required by this and previous IMs. The Wild Horses and Burros Management Handbook, H-4700-1 section 4.9 is superseded by this IM and replaced in its entirety.

Coordination: This IM was coordinated among WO-200, WO-260, WO-600, WH&B state leads, WH&B specialists, and WH&B facility managers.
Contact: Any questions regarding this IM can be directed to Joan Guilfoyle, Division Chief, Wild Horse and Burro Program (WO-260), at 202-912-7260.

Signed by:
Shelley J. Smith
Acting, Deputy Assistant Director
Resources and Planning

Authenticated by:
Robert M. Williams
Division of IRM Governance,WO-860

4 Attachments
1 - De-worming and Vaccination Schedule (1 p)
2 - Animal Evaluation and Response (9 pp)
3 - Henneke Equine Body Scoring Chart (1 p)
4 - Final Gather Data Report (2 pp)

Attachment 2: Animal Evaluation and Response

A. Euthanasia for Reasons Related to Acts of Mercy, Health and Safety

The Authorized Officer (AO) will euthanize or authorize the euthanasia of a wild horse or burro when any of the following conditions exist.

(1) A chronic or incurable disease, injury, lameness, or serious physical defect (includes severe tooth loss or wear, club foot, and other severe acquired or congenital abnormalities);

(2) A Henneke body condition score (Attachment 3) of less than three with a poor or hopeless prognosis for improvement;

(3) An acute or chronic illness, injury, physical condition, or lameness that cannot be treated or has a poor or hopeless prognosis for recovery;

(4) An order from a state or federal animal health official authorizing the humane destruction of the animal(s) as a disease control measure;

(5) The animal exhibits dangerous characteristics beyond those inherently associated with the wild characteristics of wild horses and burros; or

(6) The animal poses a public safety hazard (e.g., loose on a busy highway) and an alternative remedy (capture or return to a herd management area (HMA)) is not immediately available.

B. Authorized Delegations and Required Training

I. Authority to Authorize Euthanasia

Decisions regarding the euthanasia of a wild horse or burro rest solely with the Bureau of Land Management's (BLM's) AO, defined in 43 CFR 4700.0-5 as "any employee of the Bureau of Land Management to whom has been delegated the authority to perform the duties described herein," and further defined by BLM Manual – 1203 or the Authorized Officer's Representative (AR) (persons designated by the AO as described in 43 CFR 4730.1). In some cases, the decision to euthanize an animal must be made in the field and cannot always be anticipated. To minimize suffering by providing euthanasia in a timely manner, managers should have a sufficient number of individuals trained to perform euthanasia that meet the state director's firearm standards, the requirements outlined in 43 CFR 4700, and in this Instruction Memorandum. When possible, a veterinarian should be consulted prior to euthanasia unless circumstances necessitating euthanasia are obvious (e.g., a broken leg or other severe injury) and a logistical delay in obtaining this consultation would only prolong an animal's suffering.

II. Authorization to Perform Euthanasia

Authorized Officers may delegate the authority to perform euthanasia in writing to anyone known to the AO to have the required training, skill, experience, and equipment to perform euthanasia described in this policy (See Section D, How Euthanasia Will Be Performed). Individuals to whom the AO may consider delegating this authority include: BLM employees, veterinarians, individuals under contract with the BLM, individuals performing duties under assistance agreements with the BLM, federal or state wildlife management officers, animal control officers, and law enforcement officers.

On gathers, at preparation facilities (facilities where animals are prepared for transport or adoption), at short-term holding (STH) or long-term pasture (LTP) facilities, inmate training facilities and at eco-sanctuaries, the AO is responsible for ensuring trained personnel are available to perform euthanasia at appropriate times. This includes anytime when wild horses or burros are being captured, sorted, worked, or loaded for transportation, regardless of location. At adoptions and public events, the AO will ensure that a veterinarian is on-site or on-call to perform timely and discreet euthanasia if necessary as an act of mercy.

III. Training Requirements

Only persons trained by a veterinarian will be authorized to perform euthanasia. This training may be provided by any veterinarian known to the AO to have the necessary knowledge and experience to provide this guidance to lay persons. This training will not be required to be completed on an annual basis; however, the Washington Office (WO) may direct individuals to take refresher training if there are significant changes in the acceptable practices.

When a firearm is used to perform euthanasia by a non-BLM employee, that individual must have formal training or certification in firearms safety. Appropriate certification for non-BLM personnel would include a hunter or firearms safety qualification recognized as satisfying a state-mandated hunter safety requirement or a firearms safety class certified by the National Rifle Association, law enforcement, or military program.

BLM employees performing euthanasia must be authorized to use a firearm by the state director and meet all requirements specified in the state office firearms policy. If a state has not issued a firearms policy addressing Wild Horses and Burros (WH&B) euthanasia, the BLM employees performing euthanasia must complete annual training for certification in firearms safety and shooting proficiency in accordance with the BLM Handbook H-1112-2, Safety and Health for Field Operations.

C. Euthanasia Related to Specific WH&B Management Activities

I. Euthanasia During Gather Operations

This section sets euthanasia policy during WH&B gather operations. For a description of the Organizational Chain of Command at gathers as well as roles and responsibilities of all gather personnel and contractors, see IM No. 2013-060, Wild Horse and Burro Gathers: Management by Incident Command System.

During gather operations, the Lead Contracting Officers Representative (COR), as delegated by the AO prior to the gather, will authorize the release or euthanasia of any wild horse or burro that they believe will not tolerate the handling stress associated with transportation, adoption preparation, or holding. No wild horse or burro should be released or shipped to a preparation or other facility with a preexisting condition that requires immediate euthanasia as an act of mercy. The Incident Commander (IC) or COR should, as an act of mercy and after consultation with the on-site veterinarian, euthanize any animal that meets any of the conditions described in A1 through A6 above.

II. Euthanasia On-The-Range

This section sets euthanasia policy for the BLM in field situations associated with on-the-range WH&B management, including lands other than those administered by the BLM where WH&Bs are present.

The BLM WH&B specialist responsible for management of an HMA will evaluate the condition of wild horses and burros throughout the year during routine resource monitoring efforts. If an animal is found to be suffering from any of the conditions listed in A1 through A6 above, the animal should be euthanized, if possible, on the range as an act of mercy. If euthanasia is not possible, humane killing as described in Section D below may be performed as an act of mercy.

On the range, the euthanasia may be performed by any BLM employee or other qualified individual that has been delegated that authority by the AO, has had the required training in euthanasia and firearms safety as described above and has the appropriate equipment available.

III. Euthanasia at Short-Term Holding, and Preparation and Inmate Training Facilities

This section sets euthanasia policy for the BLM in short-term holding (STH) facilities. If euthanasia is necessary at a STH facility, it will be performed by a trained and qualified individual as authorized by the AO. The BLM employees and contractors follow comprehensive animal welfare guidelines to protect the health and welfare of wild horses and burros under their care. However, acute or chronic problems can develop during captivity and the handling of wild animals that are most humanely addressed by euthanasia. Some conditions may not immediately be apparent during gathers or other points of origin, require additional assessment or evaluation over time, or may best be addressed after an animal is moved to a STH or preparation facility. Euthanasia at all STH and preparation facilities will be applied as follows:

(a) If an animal is affected by any of the conditions described in A1 through A6 above that causes acute pain or suffering and immediate euthanasia would be an act of mercy, the AO or AR must ensure the animal is immediately euthanized.

(b) If an animal is affected by any of the conditions described in A1 through A6 above, but is not in acute pain, the AO should first consult a veterinarian. For example, if the animal has a physical defect or deformity that would adversely impact its quality of life if it were placed in the adoption program or in long-term pasture facilities, but acute suffering is not apparent, a veterinarian should be consulted prior to euthanasia. If the consultation confirms the animal meets a condition described in A1 through A6 above, the animal will be euthanized in a timely manner.

(c) If the AO or AR concludes, after consultation with a veterinarian, that an animal in a STH facility is affected by any of the conditions described in A1 through A6 or cannot tolerate the stress of transportation to another facility or adoption preparation, then the animal will be euthanized.

IV. Euthanasia at Long-Term Pasture Facilities or Eco-Sanctuaries

This section sets euthanasia policy for the BLM at LTP and eco-sanctuary facilities.

For LTPs, the BLM COR or Project Inspector (PI), and for eco-sanctuaries, the Program Officer (PO) or PI responsible for oversight of the agreement will evaluate all horses and burros and establish their body condition periodically throughout the year, particularly if the facility is experiencing drought or some other event which might limit forage availability. During the year, if any animal is affected by any of the conditions listed in A1 through A6 above, the COR, PO, PI, contractor, partner or another person authorized by the AO and meeting the requirements found in Section B of this IM will euthanize that animal, if possible. On an annual basis, a team will formally evaluate the condition of each animal on the LTPs and eco-sanctuaries. The evaluation team will consist of a BLM WH&B specialist and a U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) or other veterinarian acceptable to the BLM. The action plan for the formal evaluation is as follows:

(a) All animals will be inspected by field observation to evaluate their apparent health, overall condition and body condition, and identify animals that may need to be euthanized to prevent a slow death due to a deterioration of their condition. This evaluation will be based on a visual inspection and the Henneke body condition scoring system. The evaluations should be conducted prior to severe winter weather to identify horses with body condition scores of three or less.

(b) Animals with a body condition score of three or less that appear to be acutely suffering will be euthanized in the field by the PI or designated person such as the contractor, within 24 hours of the evaluation. Animals that are chronically affected with a body condition score of less than three will be euthanized within two weeks. Horses with a score of three will remain in the field and will be re-evaluated by the contractor and the PI for that contract in 60 days to see if their condition is improving, staying the same or declining. Those that are declining in condition will be euthanized as soon as possible after the second evaluation.

(c) Arrangements for carcass disposal for euthanized animals will be in accordance with applicable state and county laws and ordinances.

V. Euthanasia During Transportation

Problems can develop during transport, or become exacerbated by transportation, of an animal. If emergency euthanasia is necessary during transportation for any of the conditions described in A1 through A6 above, the truck driver will immediately contact the AO, thc COR, or other identified BLM representative. Under these circumstances, a veterinarian should be contacted immediately to evaluate the animal and perform euthanasia if indicated as soon as possible. If necessary, the animal(s) may need to be off-loaded at the closest BLM or suitable livestock handling facility to ensure that euthanasia can be performed safely and effectively.

VI. Euthanasia at Adoptions or Public Events

The AO will ensure that a veterinarian is on-site or on-call and available to respond within two hours at any adoption or public event. If a veterinarian is unable to respond within that timeframe, the animal should be loaded on to a trailer and taken to the closest qualified veterinarian. The AO will consult with the veterinarian prior to deciding to euthanize an animal and the veterinarian will perform the euthanasia in a timely and discreet manner.

VII. Euthanasia of a Large Number of Animals

When the need for euthanasia of a large number of animals is anticipated for reasons related to acts of mercy, chronic or acute injury, disease or safety, the likely course of action should be identified and outlined in advance whenever possible. When field monitoring and pre-gather planning identify an increased likelihood that large numbers of animals may need to be euthanized during a gather, this should be addressed in the gather plan. In an on-the-range, preparation, STH, LTP, or eco-sanctuary facility situation, where a gather is not involved, advance planning should also be completed by the AO whenever possible. Arrangements should be made for a USDA APHIS or other veterinarian experienced with WH&B to visit the site and consult with the AO on euthanasia decisions. This consultation should be based on an examination of the animals by the veterinarian. It should include a detailed, written evaluation of the conditions, circumstances or history of the situation and the number of animals involved. Where appropriate, this information should be specific for each animal affected. During this planning stage, it is critical that the AO include the state office WH&B program lead, appropriate state office, district office, and field office managers, and any contractors that may be involved.

VIII. Euthanasia of Unusually Dangerous Animals

Unusually aggressive wild horses and burros can pose an unacceptable risk of injury to personnel when maintained in enclosed spaces where some level of handling is required. In rare cases, animals on the range can also be dangerous to domestic animals and/or people. When a horse or burro is unusually dangerous, it is reasonable to conclude that an average adopter could not humanely care for the animal as required by the regulations (e.g., provide proper transportation, feeding, medical care and handling, 43 CFR 4750.1). The BLM cannot solve the problem by removing unusually dangerous animals from the adoption system and placing them in a LTP or eco-sanctuary facility because this resolution also poses significant risk of injury, both to animals in transport, and to the BLM personnel and LTP and eco-sanctuary operators.

When deciding to euthanize an animal because it is unusually dangerous, the AO, in consultation with a veterinarian or other individuals with expertise in animal care, handling and behavior (as designated by the AO), must determine that the animal poses a *significant and unusual danger to people or other animals beyond that normally associated with wild horses and burros*. The AO must document the aspects of the animal's behavior that make it unusually dangerous and include this documentation in a report which should be maintained in the appropriate HMA case file and recorded in the Wild Horse and Burro Program System (WHBPS).

D. How Euthanasia will be Performed

When necessary, euthanasia will be performed in a dignified and discreet manner that is recognized and approved by the AVMA in their Guidelines for the Euthanasia of Animals: 2013 Edition. Two methods will be used as follows: 1) injection of a lethal dose of a barbiturate derivative such as sodium pentobarbital solution, or 2) gunshot to the brain of an animal that is calm and still, or humanely-restrained.

- Injections
  Only commercially available pentobarbital products will be used for injectable euthanasia of conscious animals. Products will be administered by a veterinarian or technician working under the supervision of a veterinarian as may be dictated by state or federal regulations. Consideration must be given for timely and appropriate carcass disposal when animals are euthanized by injection of pentobarbital products. When injectable agents are used, the veterinarian supervising the euthanasia process is responsible for ensuring carcasses are properly disposed of so tissue residues do not threaten wildlife species that may be attracted to and consume blood or carrion from

euthanized animals.

- Gunshot

  A properly placed gunshot to the brain of an animal that is calm and still, or humanely-restrained, instantly produces an unconscious state followed quickly by a painless and humane death. This method of euthanizing wild horses and burros requires only a minimum of handling and restraint; and, when performed on the range, drug residues that may poison wildlife or enter the environment following carcass disposal are not a concern. Only qualified and experienced persons skilled in the safe handling and use of firearms and trained by a veterinarian will perform the procedure. The optimal placement of a gunshot is from the front of the animal, perpendicular to the skull at a point one inch above the intersection of two imaginary diagonal lines drawn like an "X" from the eyes to the base of the ears. Typically, when euthanizing a wild horse or burro in this manner, the animal will be approached to within five-to-six feet and the gun will be held within a few inches or up to two-to-three feet from the animal.

  For familiarity among operators, the preferred firearm for routine use will be a 22 magnum caliber revolver. A 22 long rifle caliber revolver may also be used and some other types and calibers of firearms typical for law enforcement or self-defense use (9mm, 38, 357, 40, or 45 calibers), if they are familiar to the operator. Carbine rifles in lieu of a handgun in these same calibers can also be effective when used at the same distances described above for handguns. The 22 magnum is highly effective, easily controlled and offers the lowest risk of ricochet or having the bullet exit the carcass. Only hollow point or other controlled expansion types of bullets should be used to maximize tissue destruction while minimizing the risk of ricochet or having the bullet exit the carcass. Animals may be euthanized while standing calmly on a trailer or confined in a small pen, portion of an alleyway or chute if the operator can get adequate visual and physical access to the animal. This is most easily and safely accomplished if the operator can be positioned above the animal. Animals that may be agitated, fractious or will not stand calmly may need to be placed in a chute or tied down for restraint; and this may be preferable for safety and reliability. Euthanasia should not be attempted when restraint is not adequate or the animal is not standing quietly. Animals moving freely in a large open pen are generally not adequately restrained and euthanasia should not be attempted. When more than one animal must be euthanized at one time, the procedure may be done at one time in the same trailer or chute, but they should be in separate compartments.

Following euthanasia, death must be verified prior to moving the carcass for disposal. The animal should be examined for cessation of vital signs including pulse and rhythmic breathing. Complete pupillary dilation and a lack of the corneal reflex are other indicators that death has occurred. Unconscious animals should only be restrained, handled and moved as if they were conscious until death is confirmed. Carcass disposal should be in accordance with state and local requirements, where applicable.

As recognized by the American Veterinary Medical Association (AVMA), circumstances exist with free-roaming wild animals where capture and chemical or physical restraint may not be practical prior to euthanasia and may only serve to prolong or exacerbate the distress of an injured or suffering animal. Under these conditions, and when an animal cannot be approached within a few feet, humane killing may be indicated to end the animal's suffering as quickly and humanely as possible. In these instances, methods typically used when hunting big-game animals of North America (e.g., elk, moose) in an ethical and responsible manner will be employed. It is not appropriate in these instances to use smaller caliber (e.g., 5.56 mm) rifles or other weapons targeted at the brain from longer distances. High-powered rifles targeted at the heart/lung or shoulder areas of an animal standing still and at typical hunting distances will be used in this circumstance. For familiarity among operators, the recommended firearm for this routine use is a bolt-action scoped rifle in a 30-06 caliber. Other firearm types and calibers with similar killing power typical for hunting large North American big-game animals (7mm magnum, .270, .308, .338 Win Mag, etc.) may be used if they are familiar to the operator; however a .30-06 bolt action scoped rifle sighted in for 200 yards offers a predictable and ethical means of quickly killing a large animal in the most humane manner possible under these circumstances. Only hollow point or other controlled expansion types of bullets should be used to maximize tissue destruction and minimize the risk of ricochet. It is not appropriate to substitute the use of a high-powered rifle from a distance for euthanasia using a gunshot to the brain when an animal can be restrained or in situations such as during gathers, or at temporary or STH facilities when restraint and use of a more conventional euthanasia technique can be applied.

As noted by the AVMA Panel on Euthanasia, the psychological response experienced by people when observing euthanasia or death in any form is an emotional one dependent on the background of the observer. Grief and distress over the loss of life are the most common reactions. Expert technique and maintaining a calm and professional atmosphere during the procedure can help minimize these reactions in the persons who must perform the procedures as well as co-workers or bystanders. For safety as well as discretion, only mission-critical persons should be nearby when euthanasia is performed. The BLM employees and contractors involved in or observing the process should behave in a dignified and discreet manner that avoids public spectacle. While these considerations should not outweigh the primary responsibility of using the most rapid and painless euthanasia method possible under the circumstances, animals should be euthanized and carcasses moved away from public view whenever possible; animals may need to be moved off-site prior to euthanasia. In some circumstances, the use of tarps or vehicles as a visual screen may also be appropriate.

As noted by the AVMA, circumstances may arise that are not clearly covered by any policy or set of guidelines for euthanasia. Whenever such situations arise, a veterinarian experienced with wild horses and burros should be consulted for their professional judgment of acceptable techniques for euthanasia. The animal's species-specific physiologic and behavioral characteristics, size, approachability and degree of suffering will be taken into consideration. In all situations, the method of euthanasia that minimizes suffering and distress of the animal will be chosen.

E. Documentation and Reporting of Euthanized Animals

A record of an animal's death by euthanasia during a gather, during transport, at facilities or during an adoption event, will be maintained by the BLM within WHBPS. The death record will identify the animal by using a description and/or freeze mark if present, the date of the death, where the animal died and the reason(s) that euthanasia was performed. If the euthanasia was performed in the field or during a gather operation, then a copy of the death record should also be maintained in the appropriate HMA case file.

When euthanasia is performed at a gather, the lead COR or IC, in addition to the process detailed above, will report the actions taken during gather operations in the comment section of the Daily Gather Overview, and in the Final Gather Data Report (Attachment 4) in accordance with IM No. 2013-061, Wild Horse and Burro Gathers: Internal and External Communication and Reporting.

F. Planning and Communication

The WH&B specialist or the BLM employee responsible for an HMA, facility or public event is responsible for having a euthanasia plan of action in place at all times where there are federally protected wild horses and burros. The plan will address practical considerations such as (1) who will have designated authority to make decisions regarding euthanasia; (2) who will perform the procedure; (3) what method(s) of euthanasia will be used; and (4) how carcass disposal will be addressed.

When a large number of animals may need to be euthanized, a communications plan for internal and external contacts (including early alerts to state and Washington offices) should be developed in advance and implemented concurrently while addressing the situation at-hand. The communications plan should address the need for the action, as well as the appropriate messages to the public and the media, including why animals are being euthanized and how the action is consistent with the BLM's responsibilities and policy.

All operation plans for gathers, adoptions and public events where it is possible that animals may need to be euthanized will include contingency plans that address the capability for performing the function. Each state will develop and implement a training and certification plan for those employees that will be tasked with euthanizing animals. A veterinarian will be present or on-call for all gathers, adoptions, and public events.

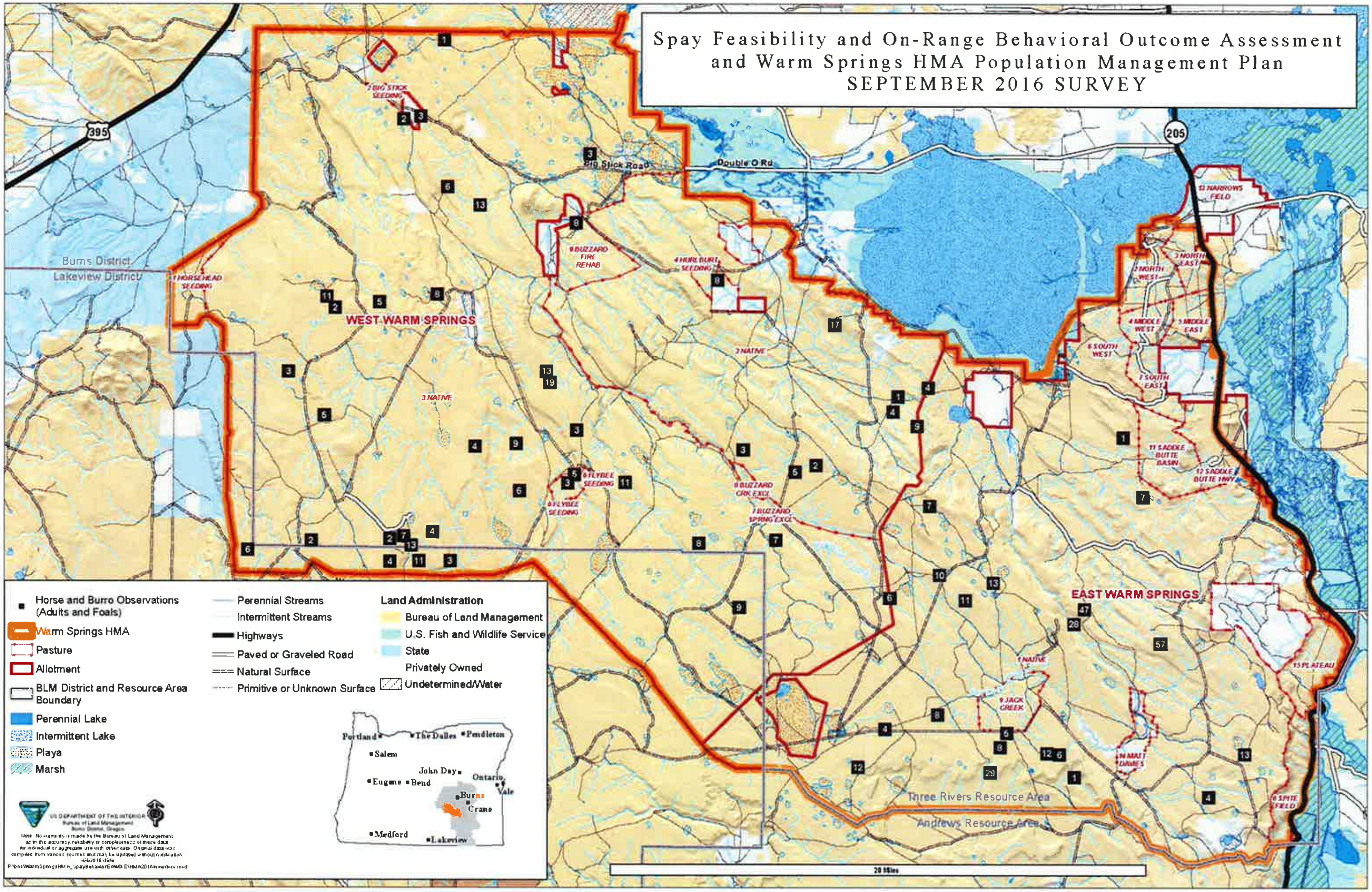
Warm Springs HMA – Inventory, Gather and Release History since 1972.

Date	Activity	# of Adult Horses	# of Horse Foals	# of Adult Burros	# Burro Foals	Comments
1972	Inventory	24(E) 40(W)		0		
				1		
1973	Inventory	41(E) 19(W)		1		
				12		
1974	Inventory	59(E) 81(W)		3		
				17		
1975	Inventory	63(E) 89(W)		3		
				9		
1976	Inventory	93(E) 106(W)		1		
				10		
3/18/1978	Gather	53(E)				19 were Shetlands
1978	Returned	10(E)				
9/19/1979	Inventory	102(E)		2		
		190(W)		7		
12/12/1980	Gather	234(W)				
Dec-80	Returned	4(W)				
1/3/1982	Gather	55(E)				
1/14/1982	Returned	3				
10/27/1982	Inventory	130(E)				
1/4/1983	Returned	1				
12/26/1984	Inventory	65(W)		5		
6/23/1986	Inventory	313(E)				
		99(W)				
1/11/1987	Gather	233				
2/18/1987	Returned	7				
1/30/1988	Gather	51				
2/6/1989	Gather	56				
7/28/1989	Returned	8				
11/9/1990	Inventory	102(E)				
		108(W)		8		
12/6/1990	Gather	133				
12/20/1990	Returned	21(E)				
		9(W)				
2/1/1991	Gather	59				
6/21/1991	Returned	19(E)				
9/4/1991	Returned	12(W)				
12/19/1991	Returned	7(E)				
		4(W)				

5/13/1992	Gather	5				
8/3/1992	Inventory	82(W)				
12/18/1992	Returned	5(E)				
10/13/1992		2(W)				
7/27/1993	Inventory	49(E)				
		179(W)		6		
1/8/1994	Gather	118				
1/27/1994	Returned	44(W)				
1/27/1994	Inventory	50(E)				
		60(W)		6		
6/16/1995	Returned	3(E)				
9/13/1996	Inventory	97 (E)				
		182(W)		6		
11/1/1996	Gather	163				
11/29/1996	Returned	42				
6/17/1997		4				Geldings
10/7/1998	Released			4		From California HMA, to boost genetic variability
8/22/2001	Gathered	319				
9/14/2001	Returned	28(E)				Post gather survey, 11 burros.
		17(W)				
9/1/2004	Inventory	128(E)				
9/7/2006	Gather	249				2 were mules + 4 private horses
10/27/2006	Returned	18				
4/13/2010	Inventory	174(E)				16 Burros not counted in the Angie Canyon area.
		168(W)		14		
11/2/2010	Gather	223	58			19 not gathered
11/13/2010	Returned	86				36 studs, 50 mares (35 received PZP)
2/4/2014	Ground Count			19		Did not cover main burro area around Iron Mtn.
5/29/2014	Ground Count			29	1	Iron Mountain area only
9/5/2014	Gather	8		8		Private lands, Buzzard Well
9/8/2014	Inventory	126 (East)	17			

		127 (W)	27	27		
1/8/2015	Gather	3		3		Private lands outside HMA.
4/17/2015	Inventory			14		Did not cover main burro area around Iron Mtn.
5/3/2016	Ground Count			21	1	Did not cover main burro area around Iron Mtn.
9/27/2016	Inventory	279 (East)	36			
		218 W	38	19	8	9 horses on State Land
6/7/2017	Ground Count			12	2	Iron Mountain area only.

*** This table uses the raw data count of horse/burros collected during the flights, as opposed to the data analyzed for sighting probabilities and systematic biases.



Spay Feasibility and On-Range Behavioral Outcome Assessment
and Warm Springs HMA Population Management Plan
SEPTEMBER 2016 SURVEY
395
205
Double O Rd
Big Stick Road
Burns District
Lakeview District
WEST WARM SPRINGS
EAST WARM SPRINGS
Three Rivers Resource Area
Andrews Resource Area
20 Miles
Horse and Burro Observations (Adults and Foals)
Warm Springs HMA
Pasture
Allotment
BLM District and Resource Area Boundary
Perennial Lake
Intermittent Lake
Playa
Marsh
Perennial Streams
Intermittent Streams
Highways
Paved or Graveled Road
Natural Surface
Primitive or Unknown Surface
Land Administration
Bureau of Land Management
U.S. Fish and Wildlife Service
State
Privately Owned
Undetermined/Water
Portland
The Dalles
Pendleton
Salem
John Day
Ontario
Eugene
Bend
Burns
Vale
Crane
Medford
Lakeview

MEMORANDUM

To: Rob Sharp, Paul Griffin (BLM)
CC: Bob Hopper, James Price, Bea Wade, Jared Bybee (BLM)
From: Bruce Lubow, IIF Data Solutions
Date: 22 October, 2016
RE: Statistical analysis for 2016 horse survey of horse populations in Warm Springs HMA and Stinkingwater HMA, Oregon

I. Summary Table

Survey areas and Dates:	September 27, 2016 Warm Springs HMA (OR0007) September 28, 2016 Stinkingwater HMA (OR0008)
Type of Survey	Simultaneous Double-observer
Aviation Company	John Kelly, pilot, El Aero Services (Elko, NV); Bell 206l3 Long Ranger, N226GM
Agency Personnel	Rob Sharp, James Price, Kyle Jackson (BLM), Paul Wiel, helicopter manager (BLM)

Table 1. Estimated population sizes (Estimate) are for the numbers of horses in the surveyed areas at the time of survey. 90% confidence intervals are shown in terms of the lower limit (LCL) and upper limit (UCL). The coefficient of variation (CV) is a measure of precision; it is the standard error as a percentage of the estimated population. Number of horses seen (No. Seen) leads to the estimated percentage of horses that were present in the surveyed area, but that were not recorded by any observer (% Missed). The estimated number of horses associated with each HMA but located outside the HMA's boundaries is already included in the total estimate for that HMA.

Area	Age Class	Estimate (No. Horses)	LCL[a]	UCL	Std Err	CV	No. Horses Seen	% Missed	Estimated # of Groups	Estimated Group Size	Foals per 100 Adults	Est. No. Horses Outside HMA
Warm Springs HMA[b]	Total	586	538	649	29.6	5.1%	566	3.4%	64	9.2	14.2	12
	Foals	73	67	81	3.9	5.3%						
	Adults	513	472	570	26.4	5.2%						
Stinkingwater HMA	Total	252	219	289	21.1	8.4%	235	6.6%	35	7.1	18.0	41
	Foals	38	33	44	3.6	9.3%						
	Adults	213	186	244	17.9	8.4%						

[a] 90% confidence interval based on percentiles of bootstrap simulation results. The lower 90% confidence interval limit (LCL) is actually less than the number of horses sighted during the survey for these estimates. This is a normal statistical result and reflects the fact that a confidence interval expresses what would likely happen if the survey were repeated. If repeated many times, some surveys would miss more horses and produce lower estimates, even after corrections, than were actually observed during this survey. Clearly, I conclude that there are at least as many horses as were observed during this survey, rather than using the lower confidence limit as a minimum number.

[b] 19 adult burros and 8 foal burros were also observed in Warm Springs HMA, but those data were not analyzed to estimate total burro abundance.

II. Narrative

In September of 2016, Bureau of Land Management (BLM) personnel conducted simultaneous double-count aerial surveys of the wild horse populations in Warm Springs HMA and Stinkingwater HMA, and some adjacent lands (Figure 1). These 2 HMAs are not contiguous, and are not managed as a complex.

The helicopter surveys addressed here were conducted using survey methods recommended by BLM policy (BLM 2010) and a recent National Academy of Sciences review (NRC 2013). I analyzed the combined set of these data to estimate sighting probabilities for horses, which I then used to correct the raw counts for systematic biases (undercounts) that are known to occur in aerial surveys (Lubow and Ransom 2016), and to provide confidence intervals (which are measures of uncertainty) associated with the estimated population sizes.

Population Results

The estimated total horse populations (Table 1) within or associated with the HMAs that were the focus of the surveys were adequate for analysis, resulting in 94 observed horse groups (Table 2, Figure 1). Of these, 88 horse groups in 2016 had data recorded in a way so that they were suitable to be used in estimating statistical estimates of sighting probability. All 94 observations made during 2016 aerial surveys were used to inform the total estimates of population size. Confidence intervals and coefficients of variation are within acceptable levels of precision for management purposes (Table 1).

I estimate the mean size of detected horse groups, after correcting for missed groups, to be 8.5 horses/group across surveyed areas with a median of 6 horses/group. I note that the detected groups may have been composed of more than one social band. I estimate a composition of 15.3 foal horses per 100 adults at the time of these surveys (Table 1). Given the September survey date, this number is likely to be close to the total foaling rate for 2016, though some foals may have died after birth but before the start of the surveys.

In addition to observed horses, the survey crew detected six groups of burros within Warm Springs HMA, along with one group of horses that contained 1 adult burros. This number of burro group observations was too few to analyze with double-observer methods, to generate an estimate of burro abundance. Observed burro groups sizes of burros (adults, foals) were (1, 1), (2, 1), (6, 2), (6, 2), (1, 0), (2, 2), and the single adult that was with horses. Thus, the total number of observed burros in Warm Springs HMA was 19 adults and 8 foals. The actual number of burros in the HMA is likely to be larger than the observed numbers.

Sighting Probability Results

The front seat observers saw 86.2% of the horse groups (86.8% of the horses) seen by any observer, whereas the back seat observers saw 71.3% of all horse groups (78.2% of horses) seen (Table 2). These results demonstrate that simple raw counts do not fully reflect true population size, without statistical corrections for missed groups made possible by the double observer method and reported here.

Accumulation of more data from future helicopter surveys of these areas or comparable areas in Oregon using a consistent set of observers, aircraft, transect spacing, and field protocol could further increase confidence in the statistical estimates, providing that observers and their seating, the approximate seasonal timing of surveys, and methodology remain relatively constant. The 2016 surveys used 1 front seat observer and 2 back-seat observers, and the position of the back seat observers was properly shifted between flights. This is the optimal seating arrangement should continue into the future. The back seat observers that contributed to these surveys were experienced and had high sighting abilities, which is commendable.

Informed by preliminary analyses, past analyses for this survey area, and *a priori* reasoning, I considered 48 alternative models. In these alternatives, I include an intercept and an additive effect for front observers' sighting probability for groups located on the pilot's side of the flight line in all models, plus combinations of 5 additional covariates believed *a priori* to be likely predictors of sighting probability: (1) horse group size; (2) horse group activity; (3) percent vegetation cover; (4) distance from the transect to the group; and (5) one of 3 alternates for back-seat observer effects: an average effect, individual effects for each back-seat observer, or no incremental back seat effect (i.e., no difference from the front-seat observer). Due to the small sample size of observations with each covariate value (*n*), I could not consider several additional parameters: terrain type, vegetation cover type, and lighting conditions.

Of the covariates tested, support (% of AIC_c model weight) was moderate for: average back-seat effect (65.3%), horse activity (57.5%), and vegetation cover percent (39.0%). Support was minimal for the effects of: front-seat sightability of horses on the pilot's side (28.2%), distance (27.3%) and individual back-seat observer effects (24.7%). As expected, estimated sighting probability was higher for groups that were larger, closer, or active, and lower for groups in greater vegetation cover or on the pilot's side. Sighting probability was lower, on average, for back-seat observers, but differed slightly among the individual observers (Table 3).

The estimated sighting probabilities for the combined observers ranged across horse groups from 80.2-100%. Comparing actual horses seen to the estimated population size computed from the estimated sighting probabilities, I estimate that 4.4% of the horses in these surveys were never seen by any of the observers (Table 1). A combination of skilled observers, low vegetation cover for most (<50% cover for >95% of groups observed), and closely spaced transects were primarily responsible for these high sighting probabilities. Group size was as high as 57 horses. There were 28 horse groups with ≥10 horses (29.8% of groups, containing 59.3% of the horses), therefore large group size was likely a contributor to high sighting probabilities.

Assumptions and Caveats

Given several potential sources of bias, listed below, it is more likely that the estimates are somewhat lower, rather than higher, than the true population. Considering the relatively high sighting probabilities and precision estimated for these surveys, the population estimates I present here appear to provide a sound and reliable basis for management decisions. Although the sample size available for this analysis was adequate, a larger survey would provide additional information about sighting probability and the effect of various covariates, thereby increasing confidence in the results.

The reliability of results from any population survey that is based on the simultaneous double-observer method rests on several important assumptions. First, the results obtained from these surveys are estimates of the horses present in the areas surveyed at the time of the survey and should not be used to make inferences beyond this context. I must presume that pre-flight planning by the district specialists and the BLM aerial survey coordinator led to the surveyed areas including as much as possible of the areas used by each population of horses using the surveyed HMAs. These HMAs are largely enclosed by fencing or natural barriers, except for a portion of the southern boundary of Stinkingwater HMA. Although fences and topographic barriers can provide deterrents to animal movement that help to contain them within the areas surveyed, these barriers may not present either a continuous, unbroken barrier or an impenetrable one. It is always possible that the surveys did not necessarily extend as far beyond the boundary as horses might move. Consequently, there is the possibility that temporary emigration from the surveyed areas may have contributed to some animals of a given population not being present in the surveyed areas and the numbers of animals found within the survey areas at another time could differ substantially.

Second, the validity of the analysis rests on the assumption that all groups of animals are flown over once during a survey period, and thus have exactly one chance to be counted by the front and back seat observers, or that groups flown over more than once are identified and considered only once in the analysis. Groups counted more than once would constitute 'double counting,' which would lead to estimates that are biased higher than the true number of groups present. Each of these surveys was completed on a single day, which should have helped to reduce the risk of double counting. The identification of 'marker' horses (horses with unusual coloration) in observed group was recorded on paper in a few cases, and variation in group sizes probably helped the observers to reduce the risk of double counting during aerial surveys. Most importantly, observers took photographs of many observed groups, and used those photos after landing to identify any groups that might have been inadvertently recorded twice. Additionally, groups that were never available to be seen (for example, due to temporary emigration from the study area or due to moving, undetected, from an unsurveyed area to one already surveyed) can lead to estimates that are negatively biased compared to the true population size. A substantial network of fencing within these HMAs likely reduced movements during this survey, thus minimizing this risk. The results presented here are based on a survey design and methods that assume that any unobserved movements were random, so the effects of missed and double counted groups would cancel each other out, on average over time given a sufficient sample size, but not necessarily during a single survey.

Third, this method assumes that all horse groups with identical sighting covariate values have equal sighting probability. If there is additional variability in sighting probability not accounted for in the sighting models, such heterogeneity could lead to a negative bias (underestimate) of the population. The relatively good sighting conditions that led to very high predicted sighting probabilities during this survey suggest that this issue may be of minimal importance.

A fourth assumption is that the number of animals in each group is counted accurately. In very large groups it may be common to miss a few animals unless photographs are taken and scrutinized after the flight. Relying on raw counts made from a fixed wing aircraft could lead to biased estimates of population size. Observers in this survey circled over large groups to get as accurate a count as possible and used photography for most of the observed groups, thereby minimizing the risk of undercounting group size.

Recommendations for Future Surveys

This survey was well designed and generally followed the specified protocols. Nevertheless, several observations about the data may offer opportunities to improve future surveys.

1. Planned transect spacing was good and was followed closely by the pilot. Spacing over the open terrain and sparsely vegetated areas of Warm Springs HMA should continue to be 1.75 miles, and spacing over the more rugged and vegetated terrain at Stinkingwater HMA should continue to be 0.5 to 1 mile, depending on local topography and vegetation.
2. The number and ability of the observers was generally good, with back seat observer positions rotated correctly between only two observers. Future survey flights in these HMAs should continue to use the same single front seat observer and the same two back seat observers as were used in 2016, if possible.
3. More reliable estimates would be possible by pooling data across additional or expanded surveys so that common sighting characteristics estimated across the larger data set.

However, to realize the benefits of pooling across years (temporal pooling) or across additional HMAs (spatial pooling), it is important to use the same observers, pilots, aircraft, flight speed, and survey season as much as possible to reduce the uncertainty introduced by observers with minimal data history and to minimize the number of unique parameters in the sightability models that need to be estimated. Numerous nearby HMAs provide ample opportunity to combine larger areas into a single survey.

4. I emphasize the importance of continuing to use photography for large horse groups (>10) to ensure that such groups are counted accurately. The current draft of the standard operating procedures for aerial surveys requires use of photography for all groups of >20 horses; however I advise that it be used for groups of ≥10 horse. Given the potential for animals in these HMAs to form large groups, it is important to have accurate counts of group size for each large group. Surveys should continue to use a reliable, high-resolution camera with an adequate telephoto or zoom lens for the distance between observer and horses for this purpose.

Table 2. Tally of raw counts of horses and horse groups by observer (front, back, and both) for combined data from Warm Springs HMA, and Stinkingwater HMA surveyed in September, 2016.

Observer	Groups Seen (Raw Count)	Horses Seen (Raw Count)	Actual Sighting Rate[a] (groups)	Actual Sighting Rate[a] (horses)
Front	81	695	86.2%	86.8%
Back	67	626	71.3%	78.2%
Both	54	520	57.4%	64.9%
Combined	94	801		

[a] Percentage of all groups seen that were seen by each observer.

Table 3. Effect of observers and sighting condition covariates on estimated sighting probability of horse groups for both front and rear observers. Baseline case (**bold**) for horses presents the predicted sighting probability a group of 6 horses (the median group size observed) that are not moving, in 0% vegetation cover, ¼-½ miles from the transect, and with the average back-seat observer. Other example cases vary a covariate or observer, one effect at a time, as indicated in the left-most column, to illustrate the relative magnitude of each effect. Sighting probabilities for each row should be compared to the baseline (first row) to see the effect of the change in each observer or condition. Baseline values are shown in bold wherever they occur. Sighting probabilities are weighted averages across all 48 models considered (Burnham and Anderson 2002).

	Sighting Probability, Front Observer	Sighting Probability, Back Observer
Baseline	**89.2%**	**77.3%**
Effect of group size (N=1)	88.9%	76.7%
Effect of active group	93.1%	84.7%
Effect of vegetation cover (50%)	85.5%	70.8%
Effect of vegetation cover (100%)	80.8%	63.4%
Effect of distance (0-¼ mile)	89.5%	77.9%
Effect of Pilot's Side	51.6%	**77.3%**
Effect of observer JP in back	**89.2%**	94.8%
Effect of observer KJ in back	**89.2%**	86.0%
No back seat effect	**89.2%**	89.2%

Literature Cited

Bureau of Land Management. 2010. Wild horse and burro population inventory and estimation: Bureau of Land Management Instructional Memorandum No. 2010-057. 4 p.

Burnham, K., and D. R. Anderson. 2002. Model selection and multimodel inference: a practical information-theoretic approach. Springer-Verlag, New York, New York.

Lubow, B. C., and J. I. Ransom. 2016. Practical bias correction in aerial surveys of large mammals: validation of hybrid double-observer with sightability method against known abundance of feral horse (*Equus caballus*) populations. PLoS-ONE 11(5):e0154902. doi:10.1371/journal.pone.0154902.

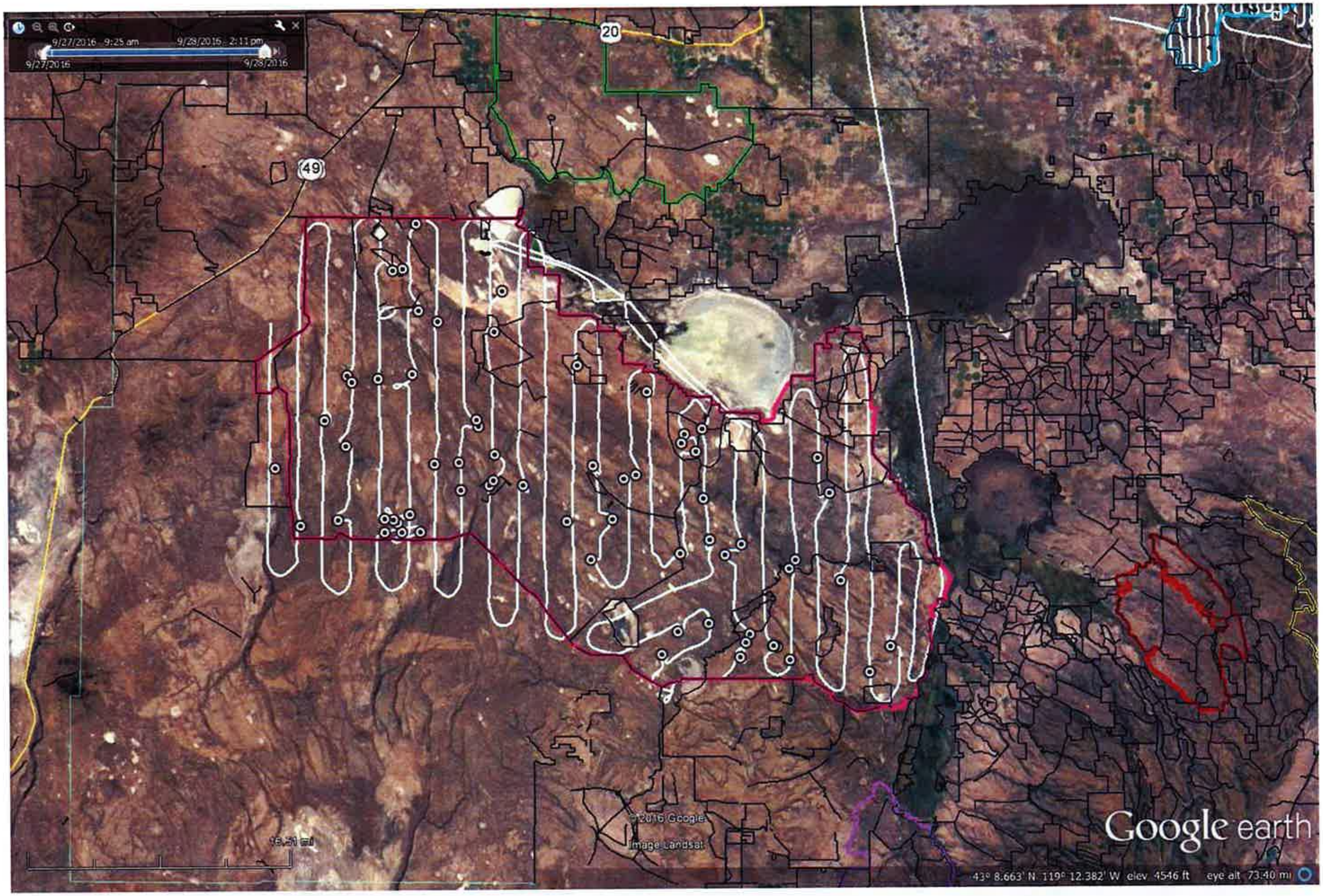
National Research Council. 2013. Using Science to Improve the BLM Wild Horse and Burro Program. The National Academies Press. Washington, D.C.

Figure 1 (following pages). Maps of survey tracks flown (white lines), fences (black lines), locations of observed horse groups (black and white circles), and surveyed HMA boundaries.

Panel A. Warm Springs HMA (magenta, surveyed) and nearby HMAs shown for reference: Palomino Buttes HMA (green), Kiger HMA (red), Riddle Mountain HMA (yellow), and South Steens HMA (purple).

Panel B. Stinkingwater HMA (turquoise, surveyed) and nearby HMAs shown for reference: Hog Creek HMA (light blue) and Cold Springs HMA (dark blue).

A.



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9/28/2016 - 2:11 pm
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20
49
©2016 Google
Image Landsat
Google earth
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B.


20
© 2016 Google
Image Landsat
Google earth
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Warm Springs HMA WinEquus Simulations

No Action
Start population of 852
Initial Age Distribution: garage93
Survival Probabilities: garsurv Foaling
Rates: garfoal

Experimental years: 2018-2022
Control population
Start with exactly 100 animals; starting ages shown in screenshot Removal in 2022, reduce population to 48 horses.
Gate cut
Percent of population that can be gathered: 100%

Treatment population:
Start with exactly 100 animals; starting ages shown in screenshot
Contraceptive at 100% for 5 years
Treat 0% of foals, yearlings, and 2 year olds, 75% of all age classes 3+
Removal in 2022, reduce population to 48 horses.
Gather for fertility treatment regardless of population size? YES
Gate cut
Percent of population that can be gathered: 100%

2022-2028
Starting population of 96
Gather at 178 (minimum interval of 3 years), gathering to 96
Initial gather year = 2022
90% of population can be captured Gate cut

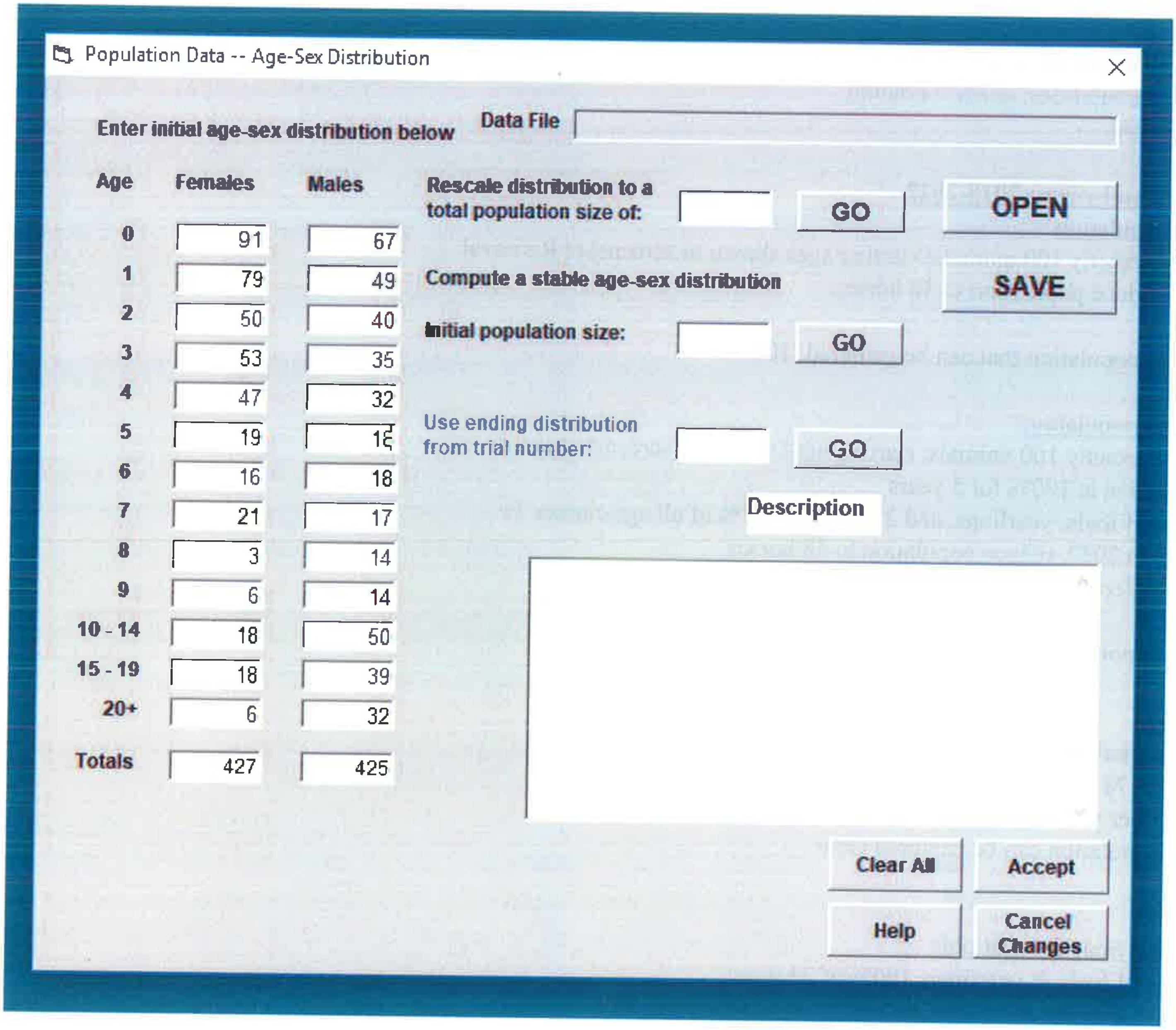
Option 1 – Spay 2+ year olds
Treat 0% of foals & yearlings, 100% of 2+ ages
Gather for fertility control regardless of population size: YES
Minimum interval between gathers: 5 years

Option 2 – Spay 5+ year olds
Treat 0% of foals through 4 year olds, 100% of 5+ year olds
Gather for fertility control regardless of population size: YES
Minimum interval between gathers: 5 year

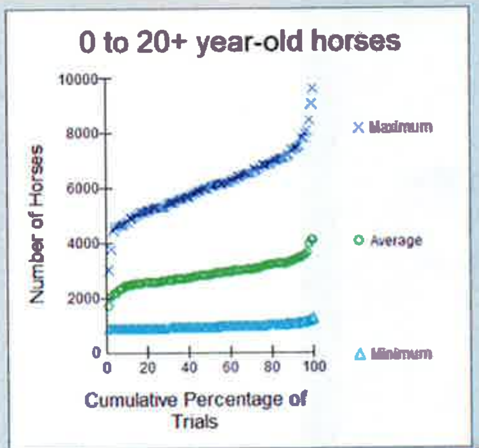
Option 3 – Removals only
Minimum interval between gathers: 5 year

Option 4 – PZP 2+ year olds
Treat 0% of foals & yearlings, 100% of 2+ year olds
% Effectiveness: Year 1 = 52%, Year 2 = 30%
Minimum interval between gathers: 5 year

No Action – Starting Population



No Action



Population Sizes in 11 Years*

	Minimum	Average	Maximum
Lowest Trial	859	1694	3036
10th Percentile	871	2442	4861
25th Percentile	894	2563	5314
Median Trial	940	2828	6085
75th Percentile	984	3114	6851
90th Percentile	1050	3335	7432
Highest Trial	1256	4090	9637

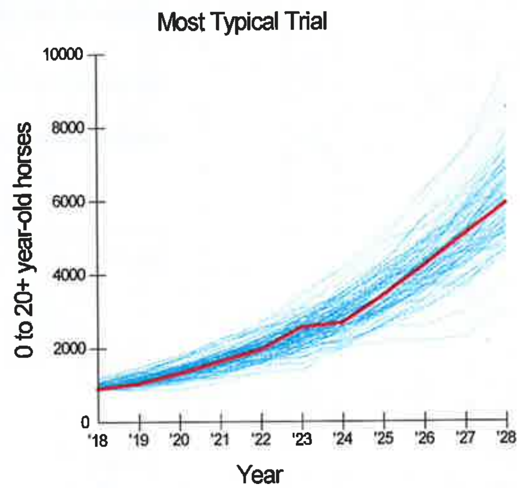
* 0 to 20+ year-old horses

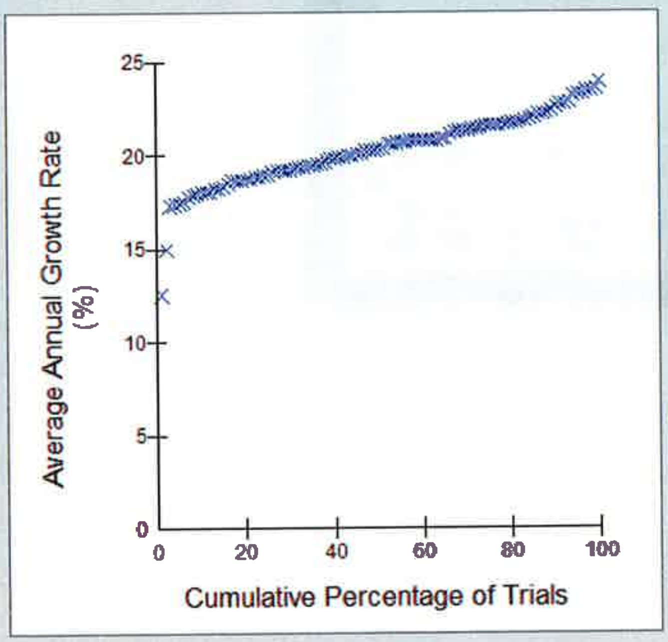
Explanation

Explanation

In 11 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 859 and the highest was 9637. In half the trials, the minimum population size in 11 years was less than 940 and the maximum was less than 6085. The average population size across 11 years ranged from 1694 to 4090.

OK





Average Growth Rate in 10 Years

Lowest Trial	12.5%
10th Percentile	18.0%
25th Percentile	19.0%
Median Trial	20.4%
75th Percentile	21.6%
90th Percentile	22.7%
Highest Trial	23.9%

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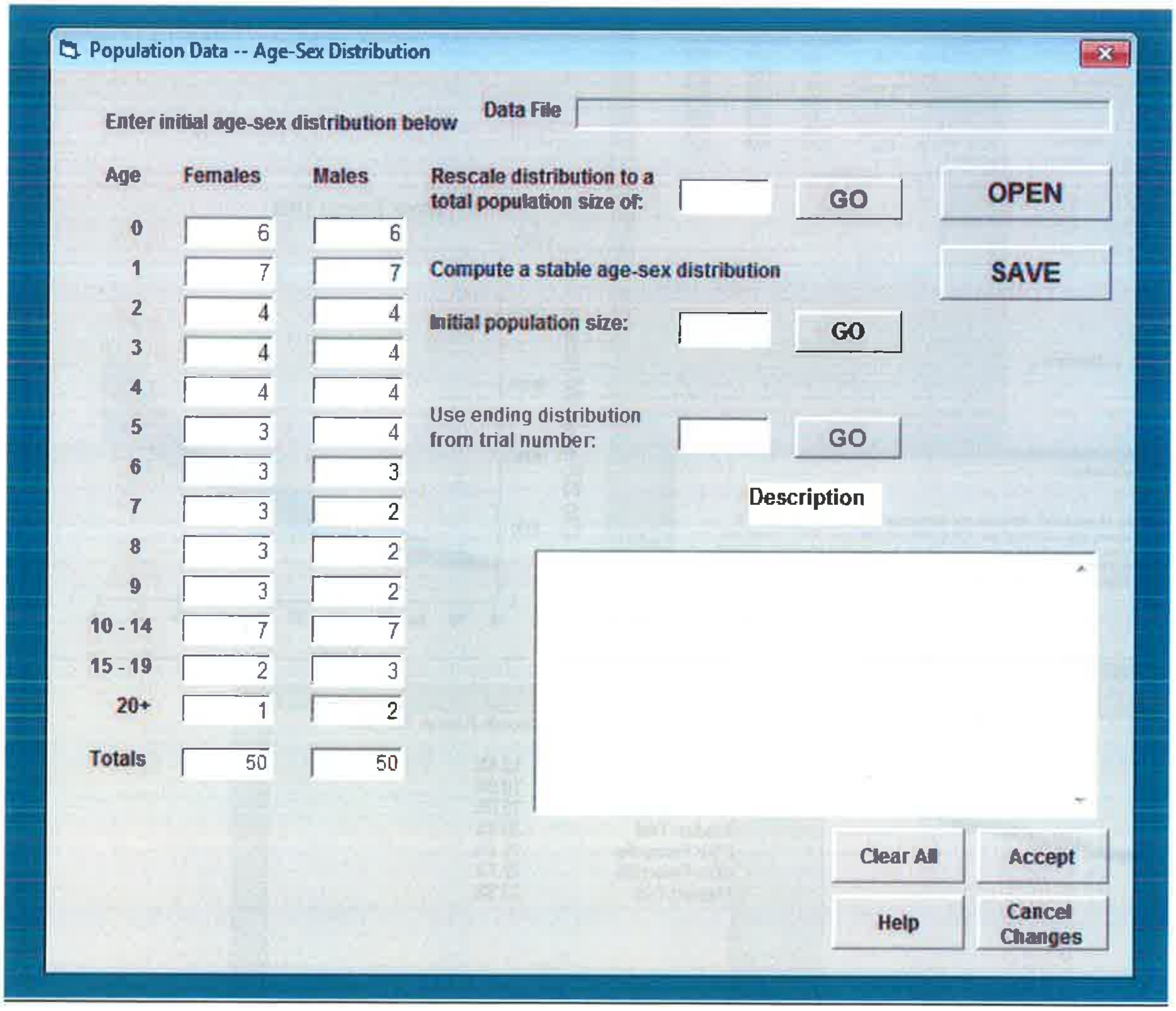
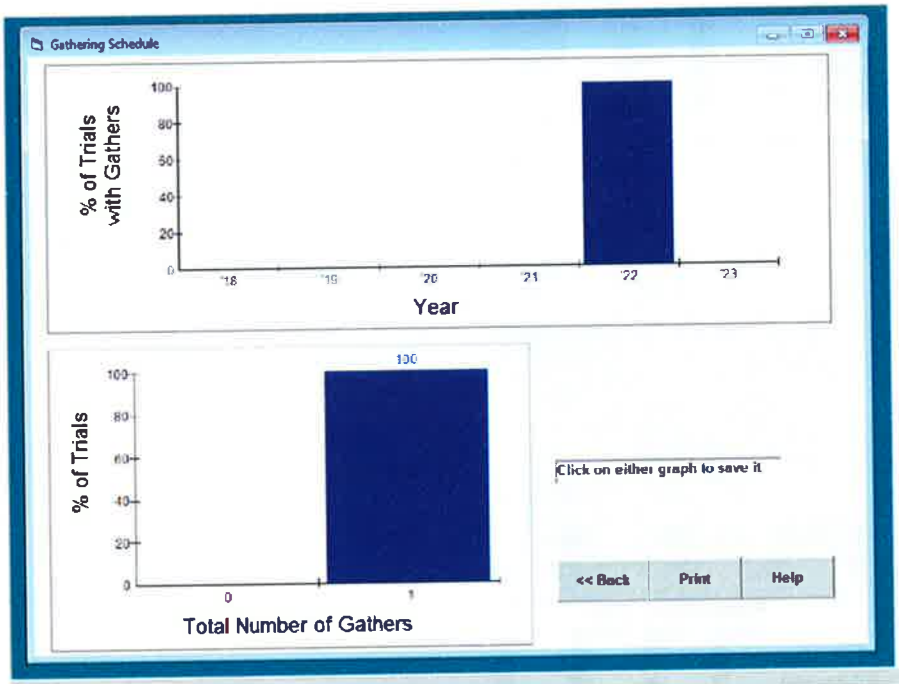
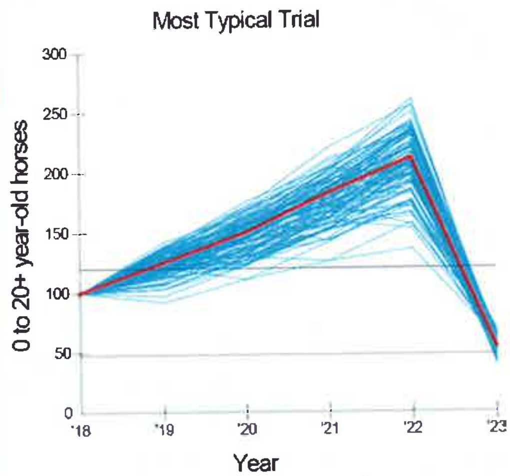
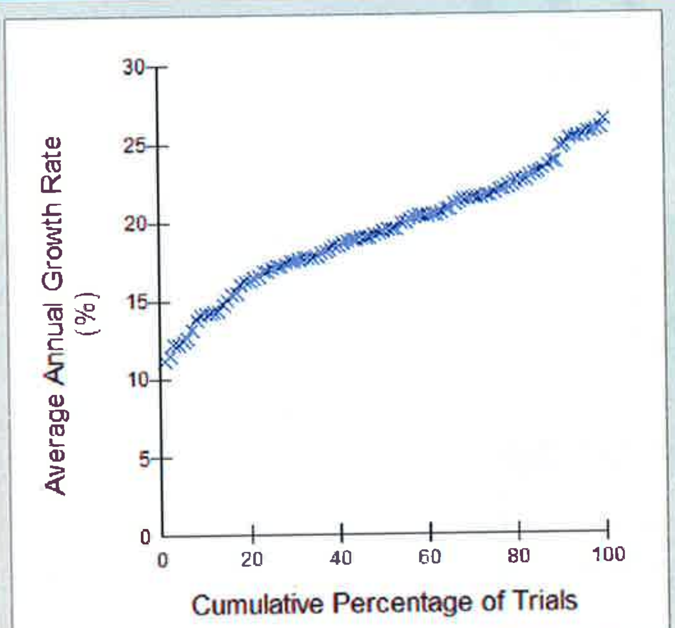
<u>2018 Starting Population</u>



<u>Control Population 2018-2022</u>







Average Growth Rate in 5

Lowest Trial	11.2%
10th Percentile	14.2%
25th Percentile	17.1%
Median Trial	19.5%
75th Percentile	21.9%
90th Percentile	24.8%
Highest Trial	26.4%

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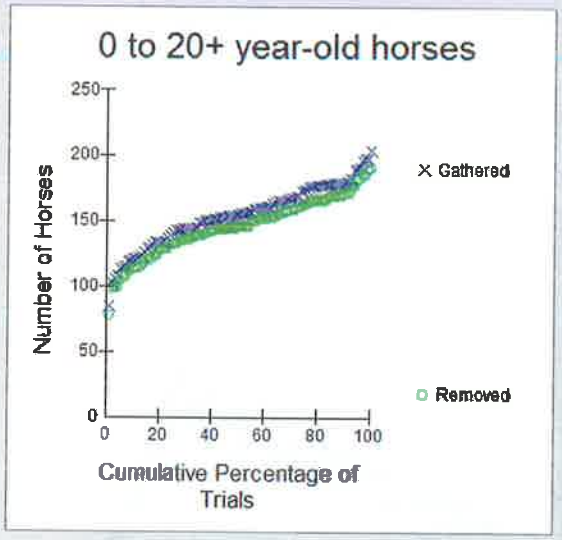
Control Population 2018-2022 continued…



	Totals in 6 Years* Gathered	Removed
Lowest Trial	85	77
10th Percentile	121	112
25th Percentile	142	132
Median Trial	156	146
75th Percentile	174	162
90th Percentile	180	170
Highest Trial	204	190

* 0 to 20+ year-old horses

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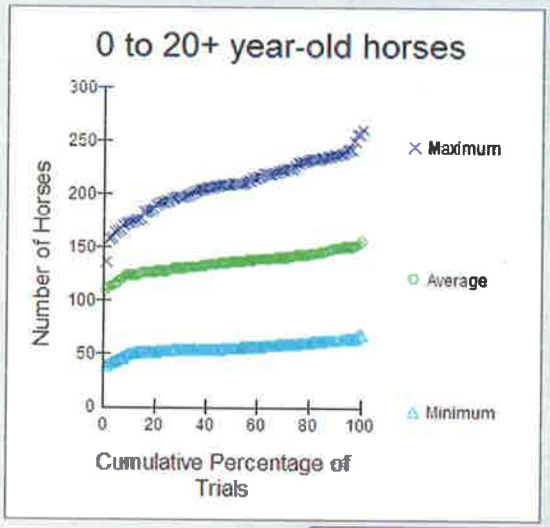


	Population Sizes in 6 Years* Minimum	Average	Maximum
Lowest Trial	39	109	136
10th Percentile	50	124	174
25th Percentile	53	128	196
Median Trial	56	136	210
75th Percentile	60	142	230
90th Percentile	64	149	238
Highest Trial	68	156	261

* 0 to 20+ year-old horses

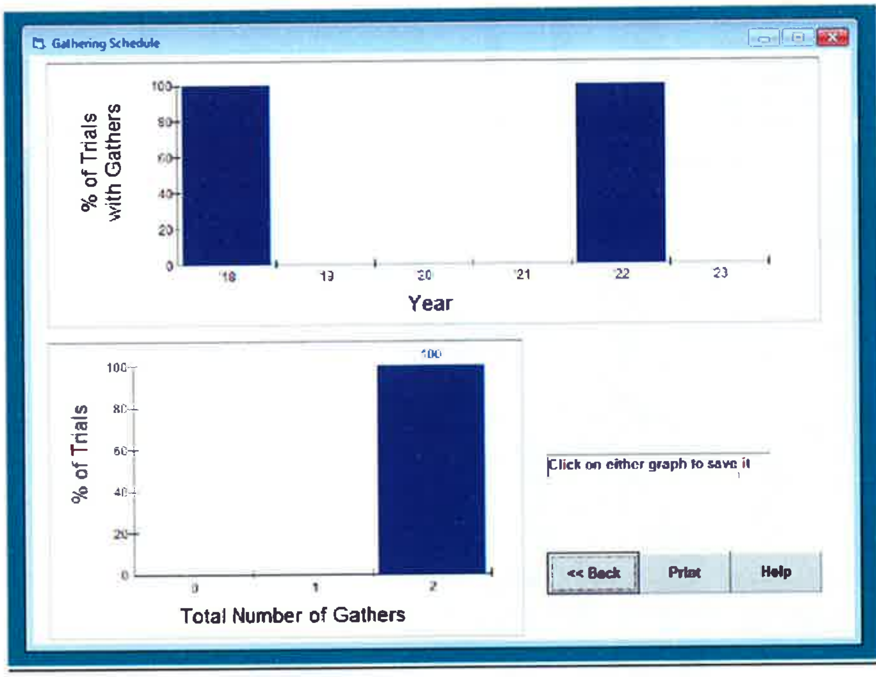
Explanation

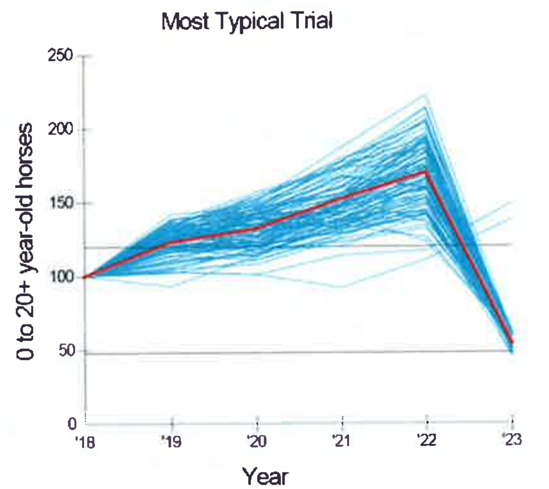
Explanation

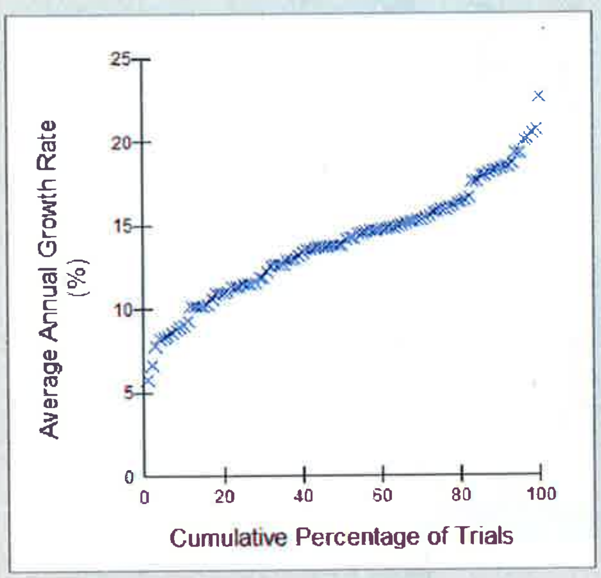
In 6 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 39 and the highest was 261. In half the trials, the minimum population size in 6 years was less than 56 and the maximum was less than 210. The average population size across 6 years ranged from 109 to 156.

OK

Treatment Population 2018-2022







Average Growth Rate in 5 Years

Lowest Trial	5.7%
10th Percentile	9.1%
25th Percentile	11.5%
Median Trial	14.0%
75th Percentile	15.9%
90th Percentile	18.5%
Highest Trial	22.6%

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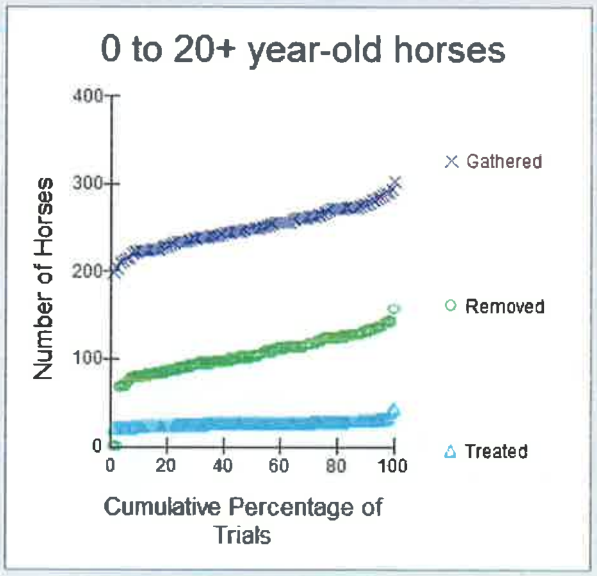
Treatment Population 2018-2022 continued…



Totals in 6 Years*

	Gathered	Removed	Treated
Lowest Trial	199	0	21
10th Percentile	224	80	23
25th Percentile	234	90	25
Median Trial	250	102	26
75th Percentile	268	122	28
90th Percentile	278	132	30
Highest Trial	302	157	44

* 0 to 20+ year-old horses

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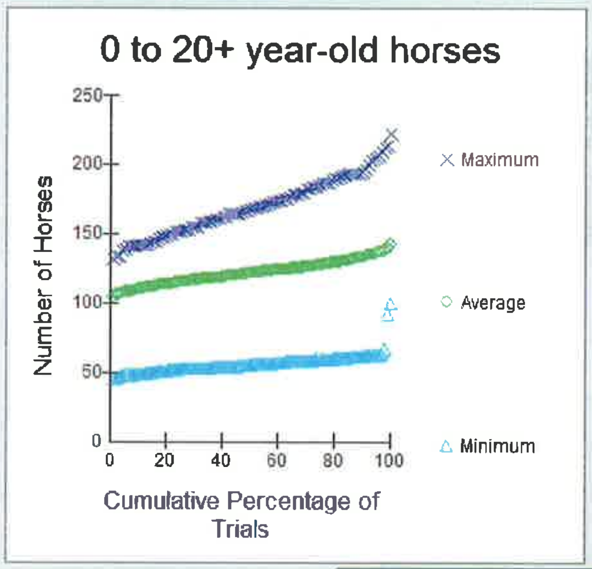


Population Sizes in 6 Years*

	Minimum	Average	Maximum
Lowest Trial	45	104	132
10th Percentile	49	110	142
25th Percentile	53	116	152
Median Trial	56	122	168
75th Percentile	59	128	186
90th Percentile	61	134	196
Highest Trial	100	142	222

* 0 to 20+ year-old horses

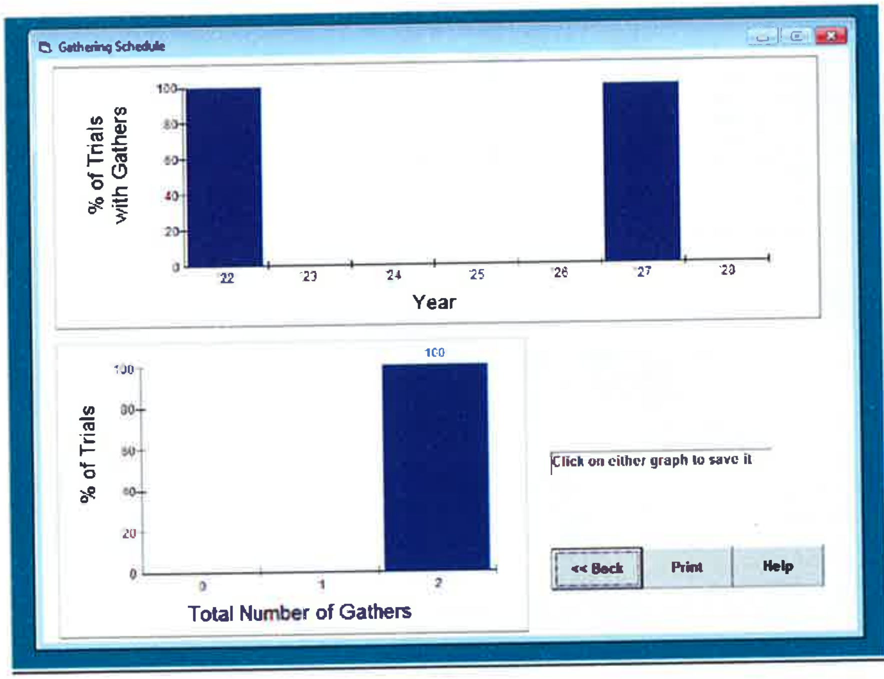
Explanation

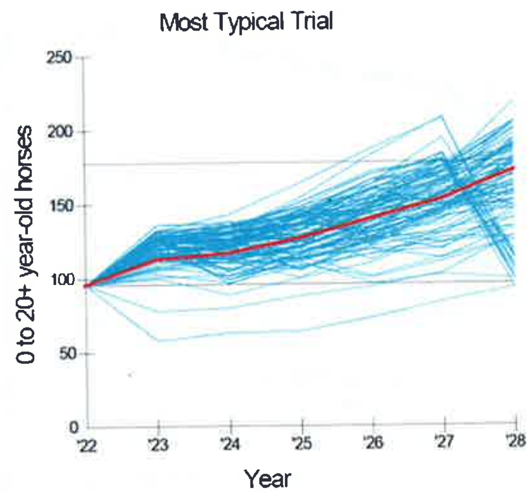
Explanation

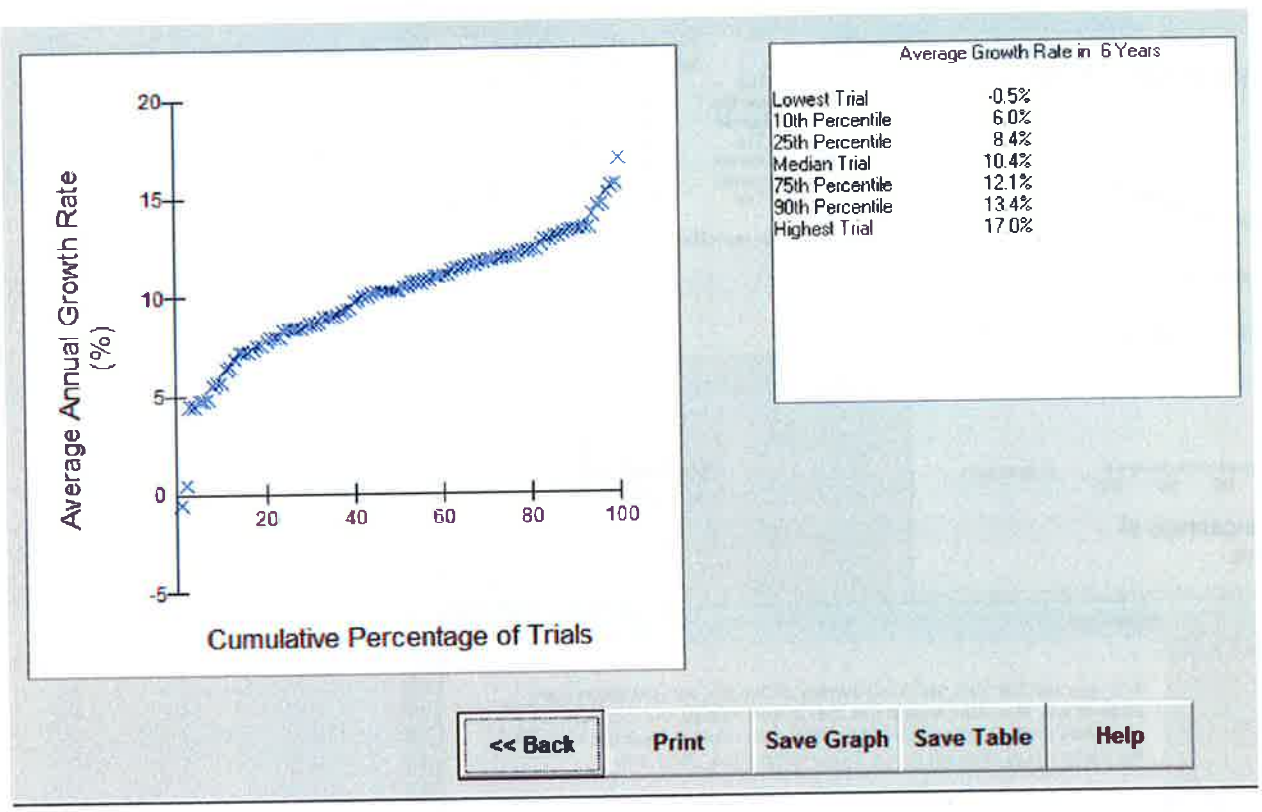
In 6 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 45 and the highest was 222. In half the trials, the minimum population size in 6 years was less than 56 and the maximum was less than 168. The average population size across 6 years ranged from 104 to 142.

OK

Option 1: 2022-2028, Spay 2+ year olds



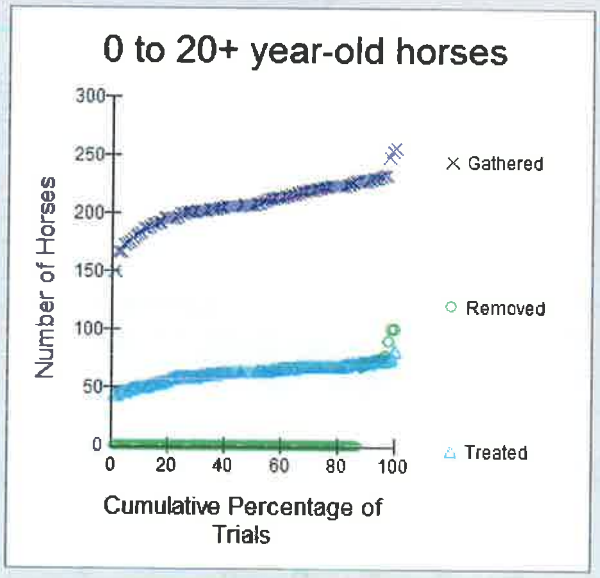




Average Growth Rate in 6 Years

Lowest Trial	-0.5%
10th Percentile	6.0%
25th Percentile	8.4%
Median Trial	10.4%
75th Percentile	12.1%
90th Percentile	13.4%
Highest Trial	17.0%

Option 1: 2022-2028 continued…, Spay 2+ year olds



	Totals in 7 Years*		
	Gathered	Removed	Treated
Lowest Trial	150	0	44
10th Percentile	185	0	50
25th Percentile	200	0	60
Median Trial	208	0	64
75th Percentile	223	0	68
90th Percentile	230	71	72
Highest Trial	257	101	83

* 0 to 20+ year-old horses

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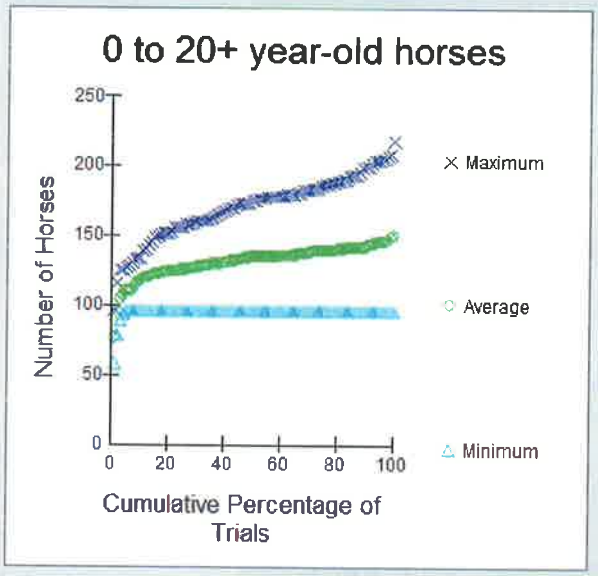


	Population Sizes in 7 Years*		
	Minimum	Average	Maximum
Lowest Trial	58	76	96
10th Percentile	96	118	136
25th Percentile	96	125	157
Median Trial	96	134	175
75th Percentile	96	139	186
90th Percentile	96	143	200
Highest Trial	96	149	218

* 0 to 20+ year-old horses

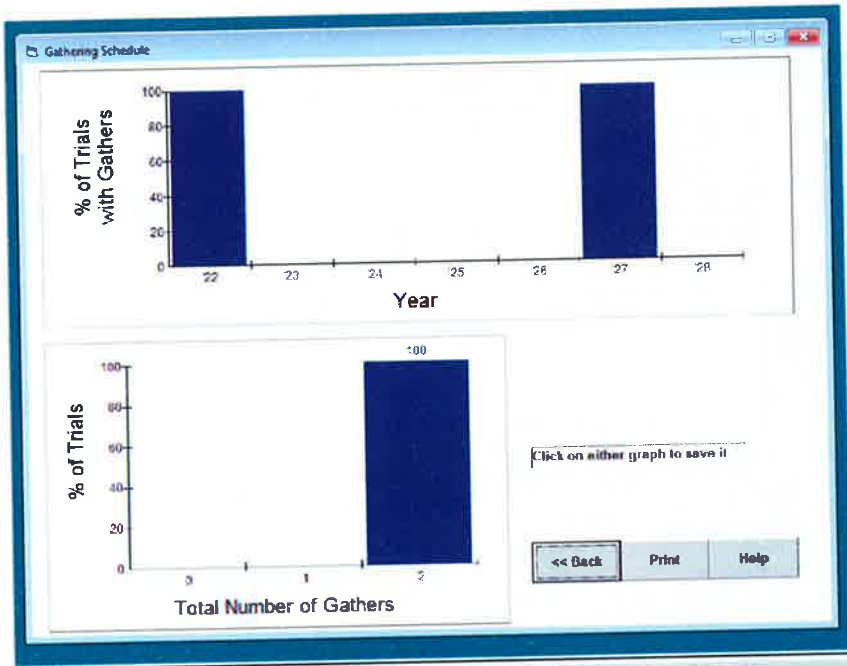
Explanation

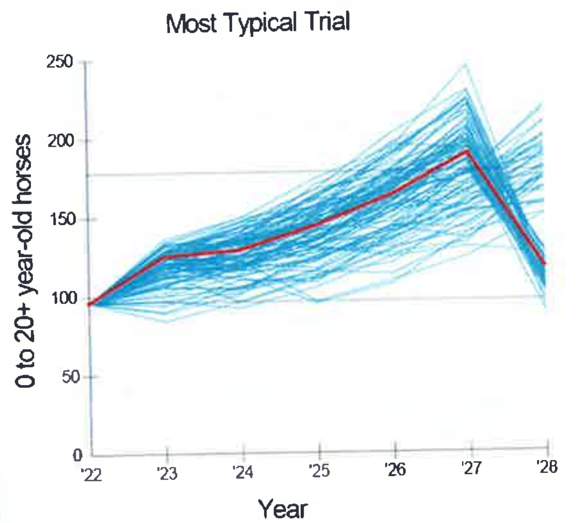
Explanation

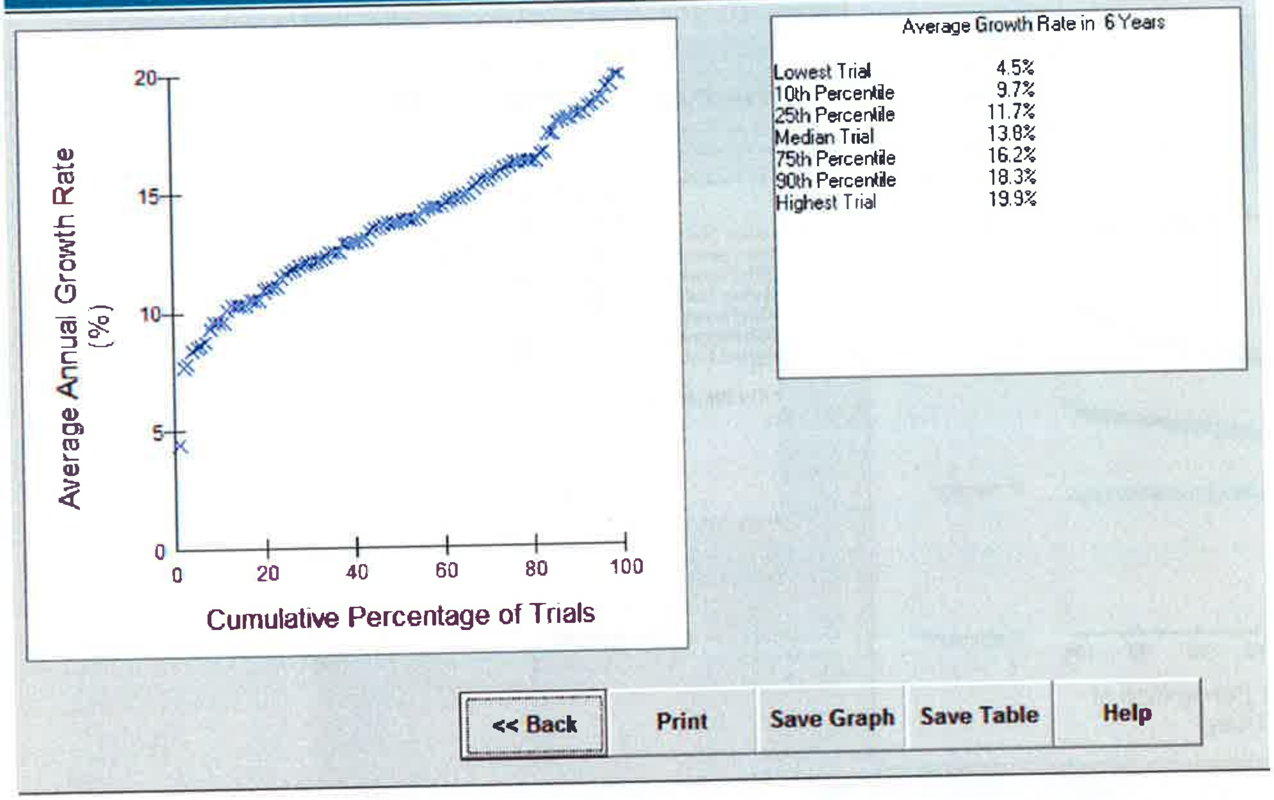
In 7 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 58 and the highest was 218. In half the trials, the minimum population size in 7 years was less than 96 and the maximum was less than 175. The average population size across 7 years ranged from 76 to 149.

OK

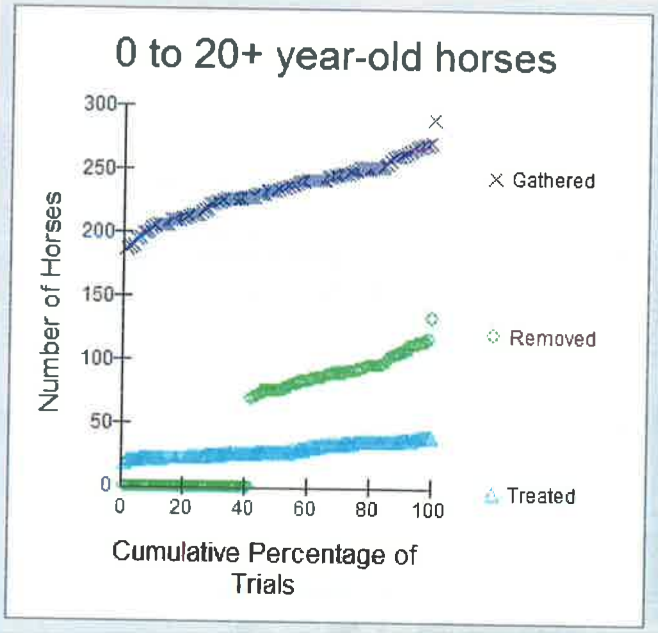
Option 2: 2022-2028, Spay 5+ year olds







Option 2: 2022-2028 continued…., Spay 5+ year olds



Totals in 7 Years*	Gathered	Removed	Treated
Lowest Trial	187	0	19
10th Percentile	206	0	22
25th Percentile	218	0	24
Median Trial	236	76	28
75th Percentile	251	92	36
90th Percentile	264	107	38
Highest Trial	290	134	40

* 0 to 20+ year-old horses

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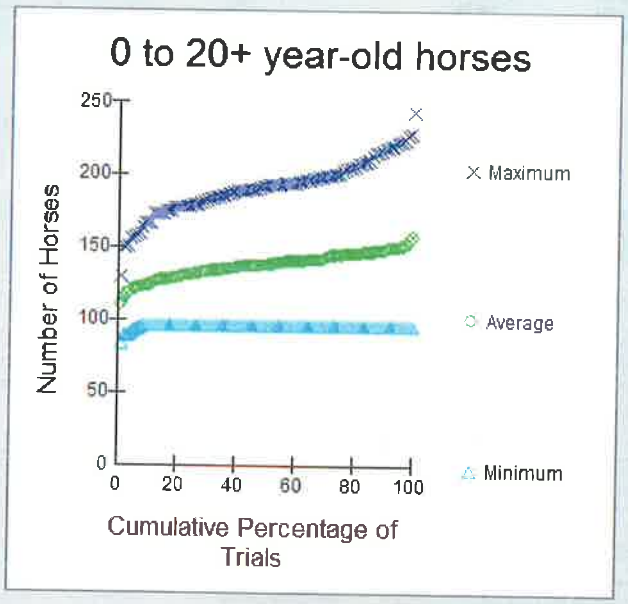


Population Sizes in 7 Years*	Minimum	Average	Maximum
Lowest Trial	84	110	130
10th Percentile	96	123	167
25th Percentile	96	131	180
Median Trial	96	138	192
75th Percentile	96	145	202
90th Percentile	96	149	219
Highest Trial	96	158	244

* 0 to 20+ year-old horses

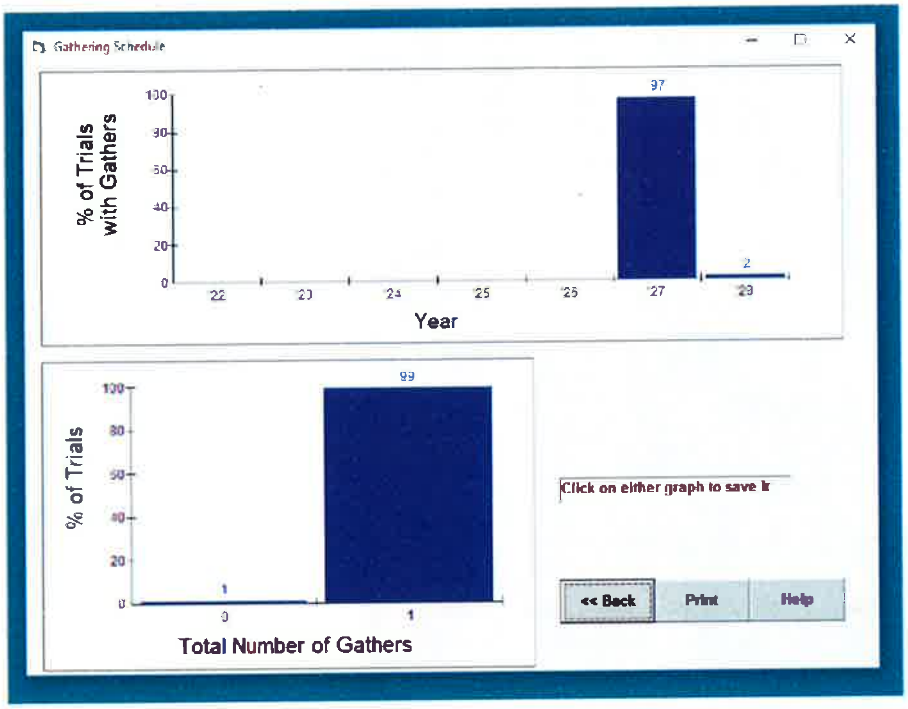
Explanation

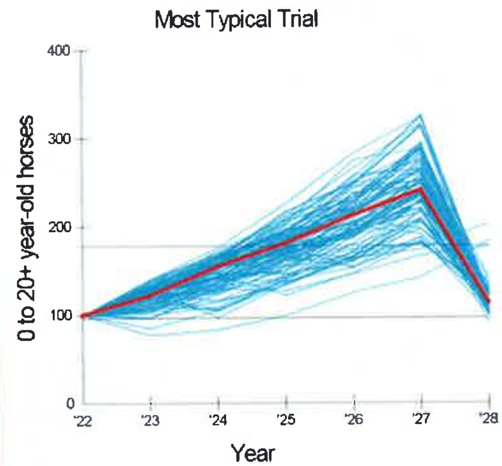
Explanation

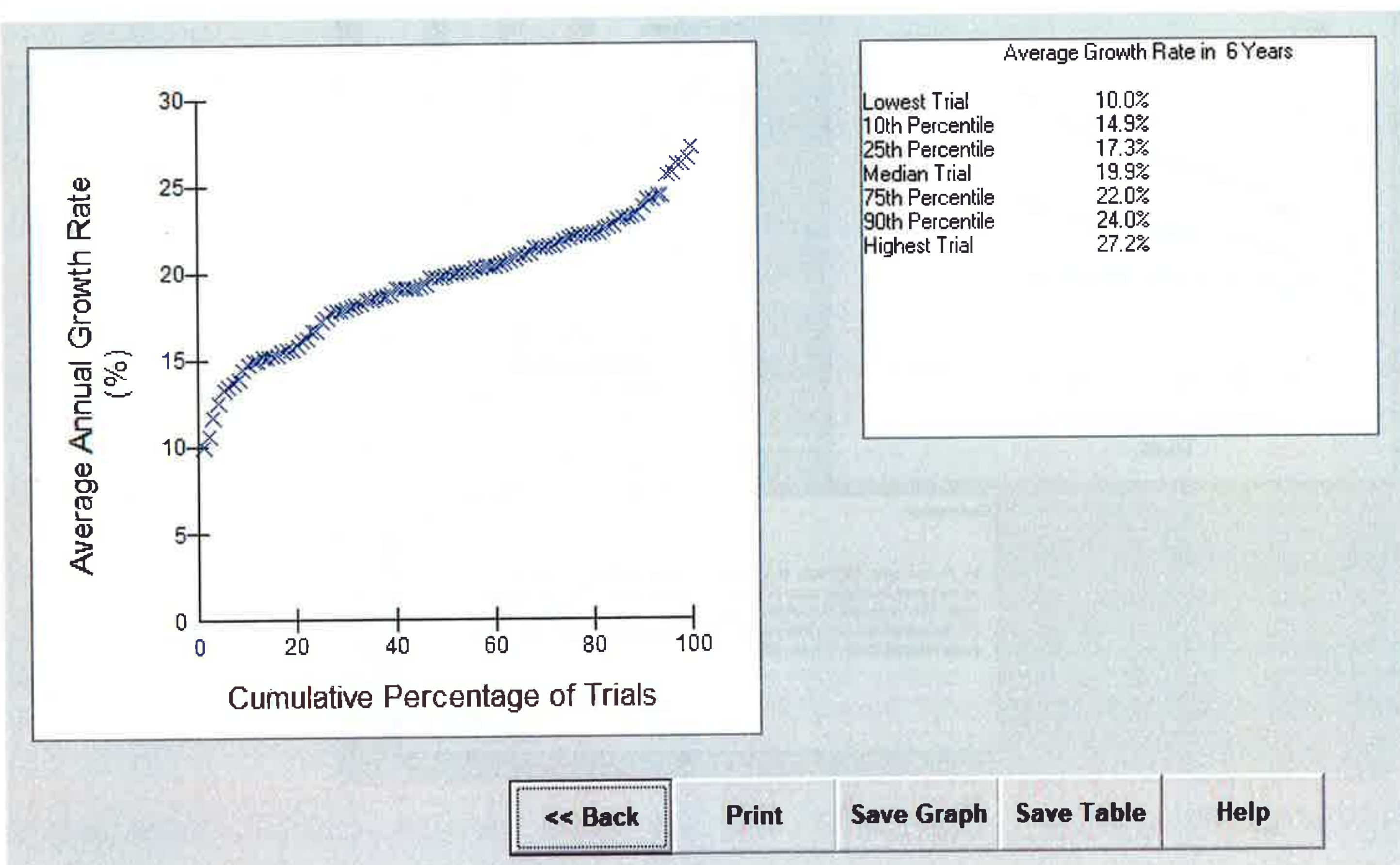
In 7 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 84 and the highest was 244. In half the trials, the minimum population size in 7 years was less than 96 and the maximum was less than 192. The average population size across 7 years ranged from 110 to 158.

OK

Option 3: 2022-2028, Removals only

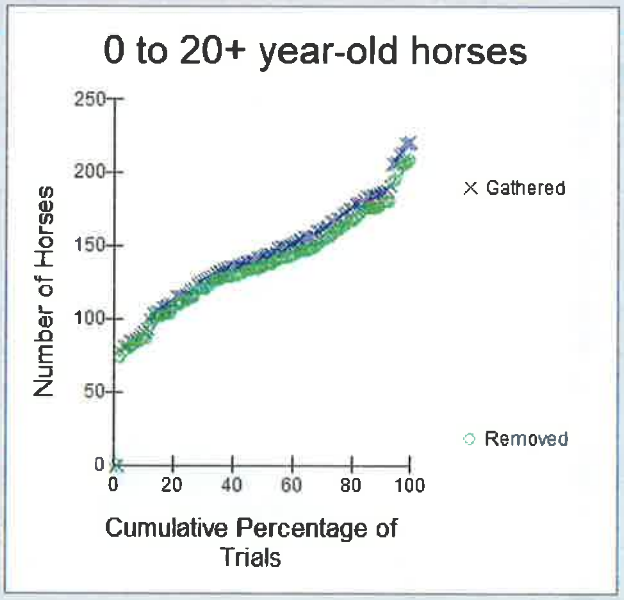






Average Growth Rate in 6 Years	
Lowest Trial	10.0%
10th Percentile	14.9%
25th Percentile	17.3%
Median Trial	19.9%
75th Percentile	22.0%
90th Percentile	24.0%
Highest Trial	27.2%

Option 3: 2022-2028 continued…, Removals only



	Totals in 7 Years* Gathered	Removed
Lowest Trial	0	0
10th Percentile	92	86
25th Percentile	119	114
Median Trial	144	136
75th Percentile	169	161
90th Percentile	187	178
Highest Trial	221	209

* 0 to 20+ year-old horses

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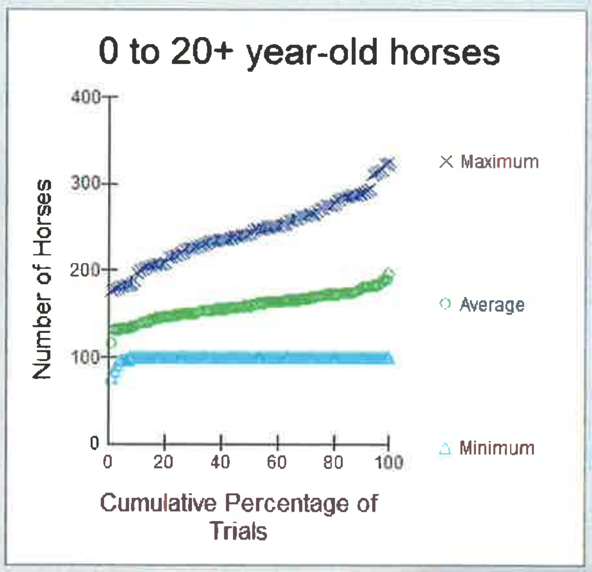


	Population Sizes in 7 Years* Minimum	Average	Maximum
Lowest Trial	77	116	177
10th Percentile	100	137	198
25th Percentile	100	148	220
Median Trial	100	159	245
75th Percentile	100	169	272
90th Percentile	100	180	290
Highest Trial	100	196	326

* 0 to 20+ year-old horses

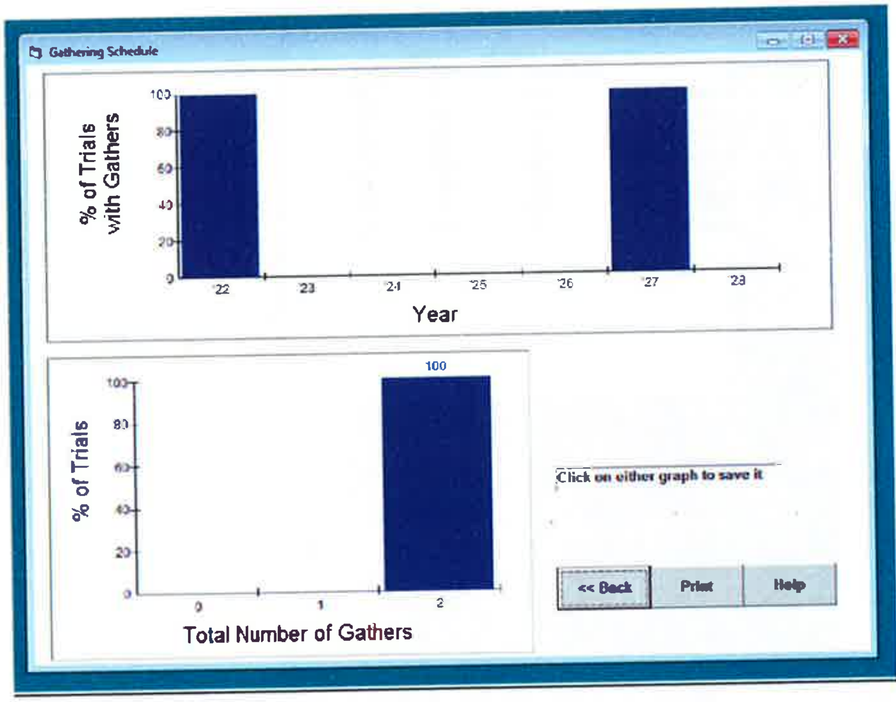
Explanation

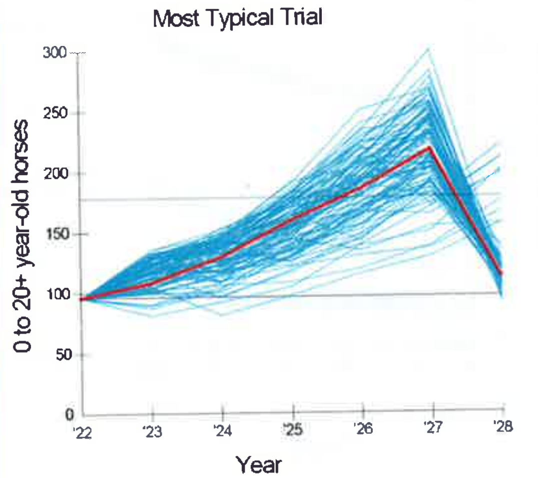
Explanation

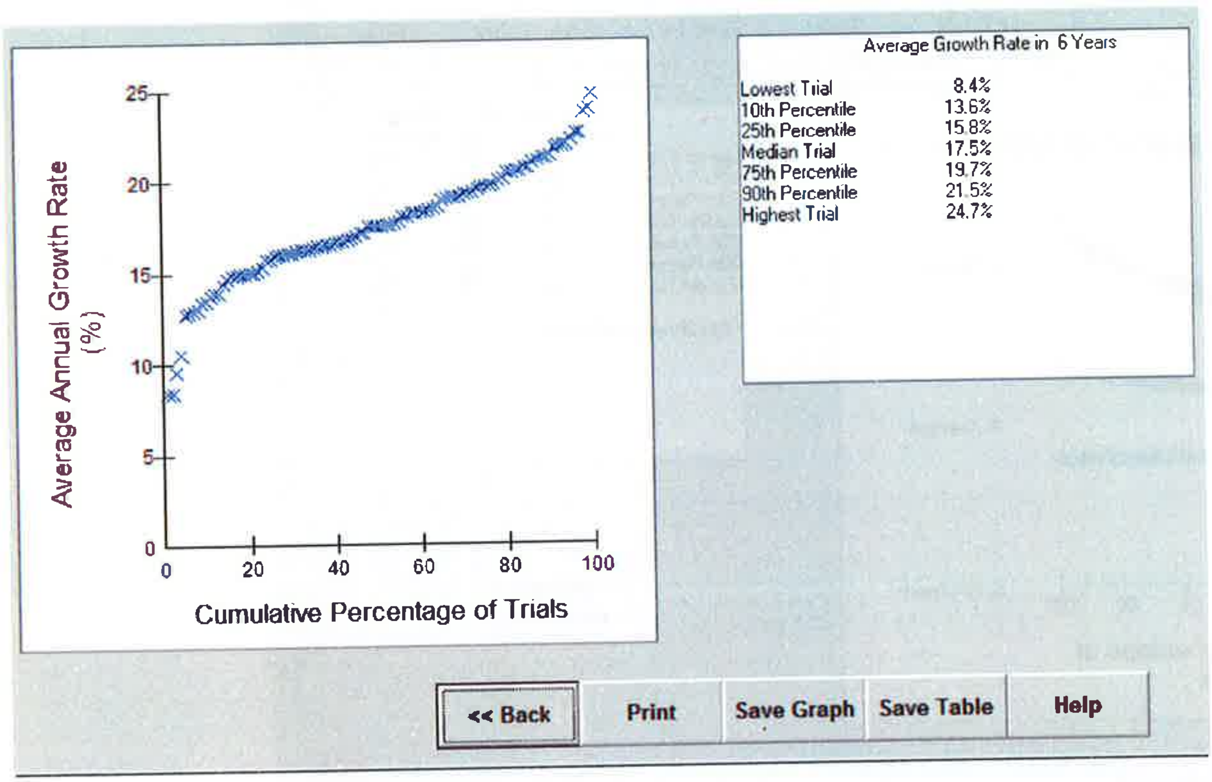
In 7 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 77 and the highest was 326. In half the trials, the minimum population size in 7 years was less than 100 and the maximum was less than 245. The average population size across 7 years ranged from 116 to 196.

OK

<u>Option 4: 2022-2028, PZP 2+ year olds</u>



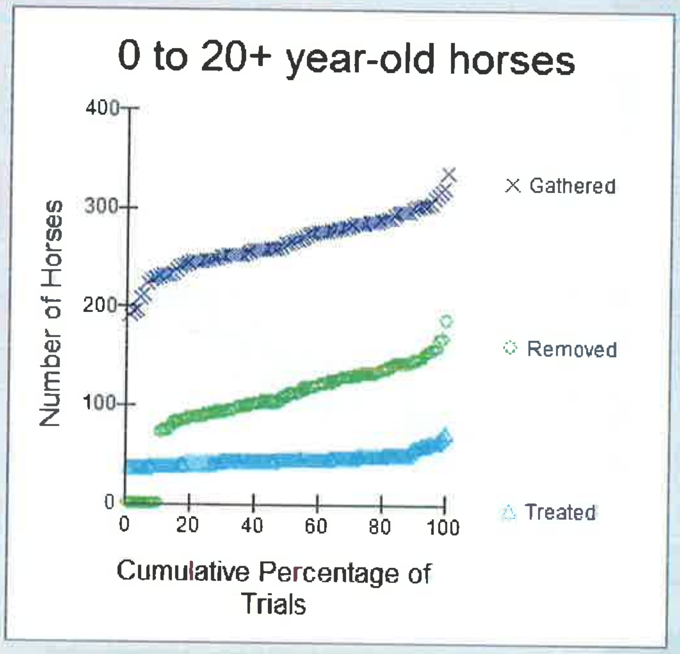




Average Growth Rate in 6 Years

Lowest Trial	8.4%
10th Percentile	13.6%
25th Percentile	15.8%
Median Trial	17.5%
75th Percentile	19.7%
90th Percentile	21.5%
Highest Trial	24.7%

Option 4: 2022-2028 continued…, PZP 2+ year olds



	Totals in 7 Years*		
	Gathered	Removed	Treated
Lowest Trial	191	0	36
10th Percentile	232	37	38
25th Percentile	248	90	41
Median Trial	266	110	45
75th Percentile	287	132	48
90th Percentile	303	146	57
Highest Trial	337	187	72

* 0 to 20+ year-old horses

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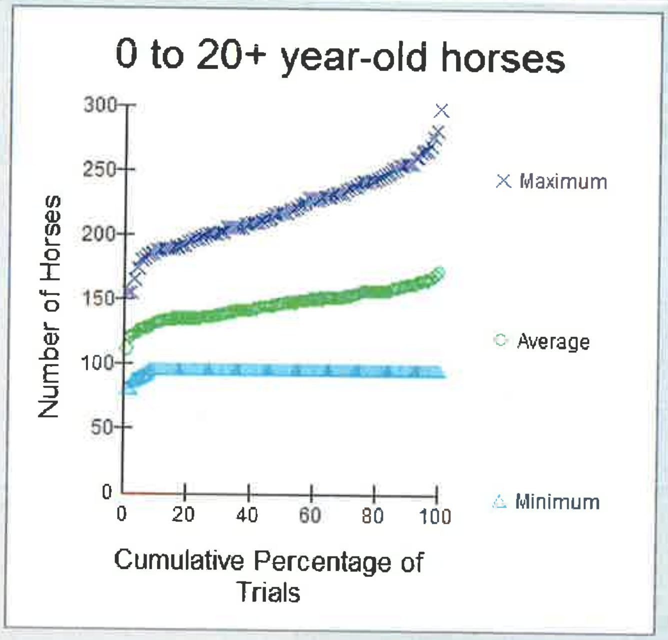


	Population Sizes in 7 Years*		
	Minimum	Average	Maximum
Lowest Trial	81	111	156
10th Percentile	96	132	189
25th Percentile	96	136	200
Median Trial	96	147	218
75th Percentile	96	156	242
90th Percentile	96	162	257
Highest Trial	96	172	299

* 0 to 20+ year-old horses

Explanation

Explanation

In 7 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 81 and the highest was 299. In half the trials, the minimum population size in 7 years was less than 96 and the maximum was less than 218. The average population size across 7 years ranged from 111 to 172.

OK

Porcine Zona Pellucida (PZP) Literature Review (as of May 2018)

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 wild 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 (ORPs) is a BLM priority. The WFRHBA of 1971 specifically provides for contraception and sterilization (section 3.b.1). No finding of excess animals is required for BLM to pursue contraception in wild horses or wild burros. The following literature review is intended to summarize what is known and what is not known about potential effects of treating mares with porcine zona pellucida (PZP) vaccine. As noted below, some negative consequences of vaccination are possible. PZP vaccines are administered only to females.

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). 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 population is in excess of AML, then contraception alone would result in some continuing environmental effects of horse overpopulation. Successful contraception reduces future reproduction. Limiting future population increases of horses could limit increases in environmental damage from higher densities of horses than currently exist. Horses are long-lived, potentially reaching 20 years of age or more in the wild and, if the population is above AML, treated horses returned to the HMA may continue exerting negative environmental effects, throughout their life span. In contrast, if horses above AML are removed when horses are gathered, that can lead to an immediate decrease in the severity of ongoing detrimental environmental effects to rangeland water, soils and vegetation.

Successful contraception would be expected to reduce the frequency of horse gather activities, as well as wild horse 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 12-20%, or up to 30% 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 adoptions and total holding costs. If applying contraception to horses requires capturing and handling horses, the risks and costs associated with capture and handling of horses may be comparable to those of gathering for removal, but with expectedly lower adoption and long-term 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 below, 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). 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 negative consequences of inaction, such as continued overpopulation and rangeland health degradation.

Porcine Zona Pellucida (PZP) Vaccine Formulations

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 for free-ranging wild horse herds. 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 or eliminate 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 and winter access is available. 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).

Both forms of PZP can safely be reapplied as necessary to control the population growth rate. Even with repeated booster treatments of PZP, it is expected that most mares would return to fertility, though some mares treated repeatedly may not (see PZP Direct Effects, below).

The BLM currently uses two PZP formulations for fertility control of wild horse mares, ZonaStat-H (PZP Native) and PZP-22. PZP can be applied via hand injections 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, only annual boosters are required. For maximum effectiveness, PZP should be administered within the December to February timeframe. The procedures to be followed for application of PZP are detailed in *Instruction Memorandum No. 2009-909 Attachment 1: Standard Operating Procedures for Population-level Porcine Zona Pellucida Fertility Control Treatments*.

For the first administration of the PZP-22 vaccine pellet formulation given to any mare, she would receive a single dose of the two-year PZP contraceptive vaccine 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. Subsequent 'booster' doses given to mares that have received the PZP-22 vaccine pellets may be either of ZonaStat-H, or of PZP-22 vaccine pellets (Rutberg et al. 2017). 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 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% 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% or more can be maintained in horses that are boostered annually (Kirkpatrick et al. 1992). Approximately 60% to 85% 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%	~20-50%

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%	~55-75%	~40-75%

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% 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% 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 will continue to foal normally.

Reversibility of PZP vaccine 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 purposes 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 to 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. 2016b). 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 of PZP 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 application 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.

Parturition phenology (birthing season) for North American feral horses has been shown to peak during May (Berger 1986, Garrott and Siniff 1992, Nunez et al. 2010) and photoperiod and temperature are powerful inputs driving the biological rhythms of conception and birth in horses. With an 11-month gestation period, this timing maximizes the likelihood that foals will be born and spend their first few months of life at a time when the weather is warm and food is plentiful (Crowell-Davis 2007). Ransom et al. (2013) 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 81% 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 freeze-marking, 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 of PZP vaccination

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 BLM gathers on other HMAs 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 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 PZP booster treatment continue into the future, the chronic cycle of overpopulation and large gathers and removals would no longer occur, 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 of PZP vaccine

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, Powell 1999, 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 WFRHBA 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 Specific to PZP Vaccination

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 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). 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.

References

Ashley, M.C., and D.W. Holcombe. 2001. Effects of stress induced by gathers and removals on reproductive success of feral horses. Wildlife Society Bulletin 29:248-254.

Bagavant, H., C. Sharp, B. Kurth, and K.S.K. Tung. 2002. Induction and immunohistology of autoimmune ovarian disease in cynomolgus macaques (*Macaca fascicularis*). American Journal of Pathology 160:141-149.

Barber, M.R., and R.A. Fayer-Hosken. 2000. Evaluation of somatic and reproductive immunotoxic effects of the porcine zone pellucida vaccination. Journal of Experimental Zoology 286:641-646.

Bartholow, J.M. 2004. An economic analysis of alternative fertility control and associated management techniques for three BLM wild horse herds. USGS Open-File Report 2004-1199.

Bartholow, J. 2007. Economic benefit of fertility control in wild horse populations. The Journal of Wildlife Management 71:2811-2819.

Bechert, U., J. Bartell, M. Kutzler, A. Menino, R. Bildfell, M. Anderson, and M. Fraker. 2013. Effects of two porcine zona pellucida immunocontraceptive vaccines on ovarian activity in horses. The Journal of Wildlife Management 77:1386-1400.

Bechert, U.S., and M.A. Fraker. 2018. Twenty years of SpayVac research: potential implications for regulating feral horse and burro populations in the United States. Human-Wildlife Interactions 12:117-130.

BLM. 2010. BLM-4700-1 Wild Horses and Burros Management Handbook. Washington, D.C.

BLM. 2015. Instruction Memorandum 2015-151; Comprehensive animal welfare program for wild horse and burro gathers. Washington, D.C.

Cooper, D.W. and C.A. Herbert. 2001. Genetics, biotechnology and population management of over-abundant mammalian wildlife in Australasia. Reproduction, Fertility and Development, 13:451-458.

Cooper, D.W. and E. Larsen. 2006. Immunocontraception of mammalian wildlife: ecological and immunogenetic issues. Reproduction, 132, 821–828.

Creel, S., B. Dantzer, W. Goymann, and D.R. Rubenstein. 2013. The ecology of stress: effects of the social environment. Functional Ecology 27:66-80.

Curtis, P.D., R.L. Pooler, M.E. Richmond, L.A. Miller, G.F. Mattfeld, and F.W Quimby. 2001. Comparative effects of GnRH and porcine zona pellucida (PZP) immunocontraceptive vaccines for controlling reproduction in white-tailed deer (*Odocoileus virginianus*). Reproduction (Cambridge, England) Supplement 60:131-141.

de Seve, C.W. and S.L. Boyles-Griffin. 2013. An economic model demonstrating the long-term cost benefits of incorporating fertility control into wild horse (*Equus caballus*) management in the United States. Journal of Zoo and Wildlife Medicine 44(4s:S34-S37).

Duncan, C.L., J.L. King, and P. Stapp. 2017. Effects of prolonged immunocontraception on the breeding behavior of American bison. Journal of Mammalogy 98:1272-1287.

Environmental Protection Agency (EPA). 2012. Porcine Zona Pellucida. Pesticide fact Sheet. Office of Chemical Safety and Pollution Prevention 7505P. 9 pages.

Feh, C. 2012. Delayed reversibility of PZP (porcine zona pellucida) in free-ranging Przewalski's horse mares. In International Wild Equid Conference. Vienna, Austria: University of Veterinary Medicine.

Fonner, R. and A.K. Bohara. 2017. Optimal control of wild horse populations with nonlethal methods. Land Economics 93:390-412.

French, H., E. Peterson, R. Ambrosia, H. Bertschinger, M. Schulman, M. Crampton, R. Roth, P. Van Zyl, N. Cameron-Blake, M. Vandenplas, and D. Knobel. 2017. Porcine and recombinant zona pellucida vaccines as immunocontraceptives for donkeys in the Caribbean. Proceedings of the 8th International Wildlife Fertility Control Conference, Washington, D.C.

Garrott, R.A., and M.K. Oli. 2013. A Critical Crossroad for BLM's Wild Horse Program. Science 341:847-848.

Gray, M.E. and E.Z. Cameron. 2010. Does contraceptive treatment in wildlife result in side effects? A review of quantitative and anecdotal evidence. Reproduction 139:45-55.

Gross, J.E. 2000. A dynamic simulation model for evaluating effects of removal and contraception on genetic variation and demography of Pryor Mountain wild horses. Biological Conservation 96:319-330.

Gupta, S., and V. Minhas. 2017. Wildlife population management: are contraceptive vaccines a feasible proposition? Frontiers in Bioscience, Scholar 9:357-374.

Hailer, F., B. Helander, A.O. Folkestad, S.A. Ganusevich, S. Garstad, P. Hauff, C. Koren, T. Nygård, V. Volke, C. Vilà, and H. Ellegren. 2006. Bottlenecked but long-lived: high genetic diversity retained in white-tailed eagles upon recovery from population decline. Biology Letters 2:316-319.

Hall, S. E., B. Nixon, and R.J. Aiken. 2016. Non-surgical sterilization methods may offer a sustainable solution to feral horse (*Equus caballus*) overpopulation. Reproduction, Fertility and Development, published online: https://doi.org/10.1071/RD16200

Hampton, J.O., T.H. Hyndman, A. Barnes, and T. Collins. 2015. Is wildlife fertility control always humane? Animals 5:1047-1071.

Heilmann, T.J., R.A. Garrott, L.L. Cadwell, and B.L. Tiller, 1998. Behavioral response of free-ranging elk treated with an immunocontraceptive vaccine. Journal of Wildlife Management 62: 243-250.

Herbert, C.A. and T.E. Trigg. 2005. Applications of GnRH in the control and management of fertility in female animals. Animal Reproduction Science, 88:141-153.

Hobbs, N.T., D.C. Bowden and D.L. Baker. 2000. Effects of Fertility Control on Populations of Ungulates: General, Stage-Structured Models. Journal of Wildlife Management 64:473-491.

Joonè, C.J., H.J. Bertschinger, S.K. Gupta, G.T. Fosgate, A.P. Arukha, V. Minhas, E. Dieterman, and M.L. Schulman. 2017a. Ovarian function and pregnancy outcome in pony mares following immunocontraception with native and recombinant porcine zona pellucida vaccines. Equine Veterinary Journal 49:189-195.

Joonè, C.J., H. French, D. Knobel, H.J. Bertschinger, and M.L. Schulman. 2017b. Ovarian suppression following PZP vaccination in pony mares and donkey jennies. Proceedings of the 8th International Wildlife Fertility Control Conference, Washington, D.C.

Joonè, C.J., M.L. Schulman, G.T. Fosgate, A.N. Claes, S.K. Gupta, A.E. Botha, A-M Human, and H.J. Bertschinger. 2017c. Serum anti-Müllerian hormone dynamics in mares following immunocontraception with anti-zona pellucida or -GnRH vaccines, Theriogenology (2017), doi: 10.1016/

Joonè, C.J., M.L. Schulman, and H.J. Bertschinger. 2017d. Ovarian dysfunction associated with zona pellucida-based immunocontraceptive vaccines. Theriogenology 89:329-337.

Kane, A.J. 2018. A review of contemporary contraceptives and sterilization techniques for feral horses. Human-Wildlife Interactions 12:111-116.

Kaur, K. and V. Prabha. 2014. Immunocontraceptives: new approaches to fertility control. BioMed Research International v. 2014, ArticleID 868196, 15 pp. http:/dx.doi.org/10.1155/2014/868196

Kean, R.P., A. Cahaner, A.E. Freeman, and S.J. Lamont. 1994. Direct and correlated responses to multitrait, divergent selection for immunocompetence. Poultry Science 73:18-32.

Killian, G., D. Thain, N.K. Diehl, J. Rhyan, and L. Miller. 2008. Four-year contraception rates of mares treated with single-injection porcine zona pellucida and GnRH vaccines and intrauterine devices. Wildlife Research 35:531–539.

Kirkpatrick, J.F. and J.W. Turner. 1991. Compensatory reproduction in feral horses. Journal of Wildlife Management 55:649-652.

Kirkpatrick, J.F., I.M.K. Liu, J.W. Turner, R. Naugle, and R. Keiper. 1992. Long-term effects of porcine zonae pellucidae immunocontraception on ovarian function in feral horses (*Equus caballus*). Journal of Reproduction and Fertility 94:437-444.

Kirkpatrick, J.F. and A. Turner. 2002. Reversibility of action and safety during pregnancy of immunization against porcine zona pellucida in wild mares (*Equus caballus*). Reproduction Supplement 60:197-202.

Kirkpatrick, J.F. and A. Turner. 2003. Absence of effects from immunocontraception on seasonal birth patterns and foal survival among barrier island wild horses. Journal of Applied Animal Welfare Science 6:301-308.

Kirkpatrick, J.F., A.T. Rutberg, and L. Coates-Markle. 2010. Immunocontraceptive reproductive control utilizing porcine zona pellucida (PZP) in federal wild horse populations, 3rd edition. P.M. Fazio, editor. Downloaded from http://www.einsten.net/pdf/110242569.pdf

Kirkpatrick, J.F., A.T. Rutberg, L. Coates-Markle, and P.M. Fazio. 2012. Immunocontraceptive Reproductive Control Utilizing Porcine Zona Pellucida (PZP) in Federal Wild Horse Populations. Science and Conservation Center, Billings, Montana.

Knight, C.M. 2014. The effects of porcine zona pellucida immunocontraception on health and behavior of feral horses (*Equus caballus*). Graduate thesis, Princeton University.

Liu, I.K.M., M. Bernoco, and M. Feldman. 1989. Contraception in mares heteroimmunized with pig zonae pellucidae. Journal of Reproduction and Fertility, 85:19-29.

Madosky, J.M., Rubenstein, D.I., Howard, J.J. and Stuska, S., 2010. The effects of immunocontraception on harem fidelity in a feral horse (*Equus caballus*) population. Applied Animal Behaviour Science, 128:50-56.

Magiafoglou, A., M. Schiffer, A.A. Hoffman, and S.W. McKechnie. 2003. Immunocontraception for population control: will resistance evolve? Immunology and Cell Biology 81:152-159.

Mask, T.A., K.A. Schoenecker, A.J. Kane, J.I.Ransom, and J.E. Bruemmer. 2015. Serum antibody immunoreactivity to equine zona protein after SpayVac vaccination. Theriogenology, 84:261-267.

Mills, L.S. and F.W. Allendorf. 1996. The one-migrant-per-generation rule in conservation and management. Conservation Biology 10:1509-1518.

National Research Council (NRC). 2013. Using science to improve the BLM wild horse and burro program: a way forward. National Academies Press. Washington, DC.

Nettles, V. F. 1997. Potential consequences and problems with wildlife contraceptives. Reproduction, Fertility and Development 9, 137–143.

Nuñez, C.M.V., J.S. Adelman, C. Mason, and D.I. Rubenstein. 2009. Immunocontraception decreases group fidelity in a feral horse population during the non-breeding season. Applied Animal Behaviour Science 117:74-83.

Nuñez, C.M., J.S. Adelman, and D.I. Rubenstein. 2010. Immunocontraception in wild horses (*Equus caballus*) extends reproductive cycling beyond the normal breeding season. PLoS one, 5(10), p.e13635.

Nuñez, C.M.V, J.S. Adelman, J. Smith, L.R. Gesquiere, and D.I. Rubenstein. 2014. Linking social environment and stress physiology in feral mares (*Equus caballus*): group transfers elevate fecal cortisol levels. General and Comparative Endocrinology. 196:26-33.

Nuñez, C.M., J.S. Adelman, H.A. Carr, C.M. Alvarez, and D.I. Rubenstein. 2017. Lingering effects of contraception management on feral mare (*Equus caballus*) fertility and social behavior. Conservation Physiology 5(1): cox018; doi:10.1093/conphys/cox018.

Nuñez, C.M.V. 2018. Consequences of porcine zona pellucidz immunocontraception to feral horses. Human-Wildlife Interactions 12:131-142.

Powell, D.M. 1999. Preliminary evaluation of porcine zona pellucida (PZP) immunocontraception for behavioral effects in feral horses (*Equus caballus*). Journal of Applied Animal Welfare Science 2:321-335.

Powell, D.M. and S.L. Monfort. 2001. Assessment: effects of porcine zona pellucida immunocontraception on estrous cyclicity in feral horses. Journal of Applied Animal Welfare Science 4:271-284.

Powers, J.G., Baker, D.L., Monello, R.J., Spraker, T.J., Nett, T.M., Gionfriddo, J.P., and Wild, M.A. 2013. Effects of gonadotropin-releasing hormone immunization on reproductive function and behavior in captive female Rocky Mountain elk (*Cervus elaphus nelsoni*). Journal of Zoo and Wildlife Medicine meeting abstracts S147.

Ransom, J.I. and B.S. Cade. 2009. Quantifying equid behavior: A research ethogram for free-roaming feral horses. U.S. Geological Survey Techniques and Methods Report 2-A9.

Ransom, J.I., B.S. Cade, and N.T. Hobbs. 2010. Influences of immunocontraception on time budgets, social behavior, and body condition in feral horses. Applied Animal Behaviour Science 124:51-60.

Ransom, J.I., J.E. Roelle, B.S. Cade, L. Coates-Markle, and A.J. Kane. 2011. Foaling rates in feral horses treated with the immunocontraceptive porcine zona pellucida. Wildlife Society Bulletin 35:343-352.

Ransom, J.I., N.T. Hobbs, and J. Bruemmer. 2013. Contraception can lead to trophic asynchrony between birth pulse and resources. PLoS one, 8(1), p.e54972.

Ransom, J.I., J.G. Powers, N.T. Hobbs, and D.L. Baker. 2014a. Ecological feedbacks can reduce population-level efficacy of wildlife fertility control. Journal of Applied Ecology 51:259-269.

Ransom, J.I., J.G. Powers, H.M. Garbe, M.W. Oehler, T.M. Nett, and D.L. Baker. 2014b. Behavior of feral horses in response to culling and GnRH immunocontraception. Applied Animal Behaviour Science 157: 81-92.

Roelle, J.E., and J.I. Ransom. 2009. Injection-site reactions in wild horses (*Equus caballus*) receiving an immunocontraceptive vaccine: U.S. Geological Survey Scientific Investigations Report 2009–5038.

Roelle, J.E., F.J. Singer, L.C. Zeigenfuss, J.I. Ransom, F.L. Coates-Markle, and K.A. Schoenecker. 2010. Demography of the Pryor Mountain Wild Horses, 1993-2007. U.S. Geological Survey Scientific Investigations Report 2010–5125.

Roelle, J.E. and S.J. Oyler-McCance. 2015. Potential demographic and genetic effects of a sterilant applied to wild horse mares. US Geological Survey Open-file Report 2015-1045.

Roelle, J.E., S.S. Germaine, A.J. Kane, and B.S. Cade. 2017. Efficacy of SpayVac ® as a contraceptive in feral horses. Wildlife Society Bulletin 41:107-115.

Rubenstein, D.I. 1981. Behavioural ecology of island feral horses. Equine Veterinary Journal 13:27-34.

Rutberg, A., K. Grams, J.W. Turner, and H. Hopkins. 2017. Contraceptive efficacy of priming and boosting does of controlled-release PZP in wild horses. Wildlife Research: http://dx.doi.org/10.1071/WR16123

Sacco, A.G., M.G. Subramanian, and E.C. Yurewicz. 1981. Passage of zona antibodies via placenta and milk following active immunization of female mice with porcine zonae pellucidae. Journal of Reproductive Immunology 3:313-322.

Sarker, N., M. Tsudzuki, M. Nishibori, and Y. Yamamoto. 1999. Direct and correlated response to divergent selection for serum immunoglobulin M and G levels in chickens. Poultry Science 78:1-7.

Science and Conservation Center (SCC). 2015. Materials Safety Data Sheet, ZonaStat-H. Billings, Montana.

Shumake, S.A. and G. Killian. 1997. White-tailed deer activity, contraception, and estrous cycling. Great Plains Wildlife Damage Control Workshop Proceedings, Paper 376.

Skinner, S.M., Mills, T., Kirchick, H.J. and Dunbar, B.S., 1984. Immunization with Zona Pellucida Proteins Results in Abnormal Ovarian Follicular Differentiation and Inhibition of Gonadotropin-induced Steroid Secretion. Endocrinology, 115:2418-2432.

Turner, J.W., I.K.M. Liu, and J.F. Kirkpatrick. 1996. Remotely delivered immunocontraception in free-roaming feral burros (*Equus asinus*). Journal of Reproduction and Fertility 107:31-35.

Turner, J.W., I.K. Liu, A.T. Rutberg, and J.F. Kirkpatrick. 1997. Immunocontraception limits foal production in free-roaming feral horses in Nevada. Journal of Wildlife Management 61:873-880.

Turner, J.W., I.K. Liu, D.R. Flanagan, K.S. Bynum, and A.T. Rutberg. 2002. Porcine zona pellucida (PZP) immunocontraception of wild horses (*Equus caballus*) in Nevada: a 10 year study. Reproduction Supplement 60:177-186.

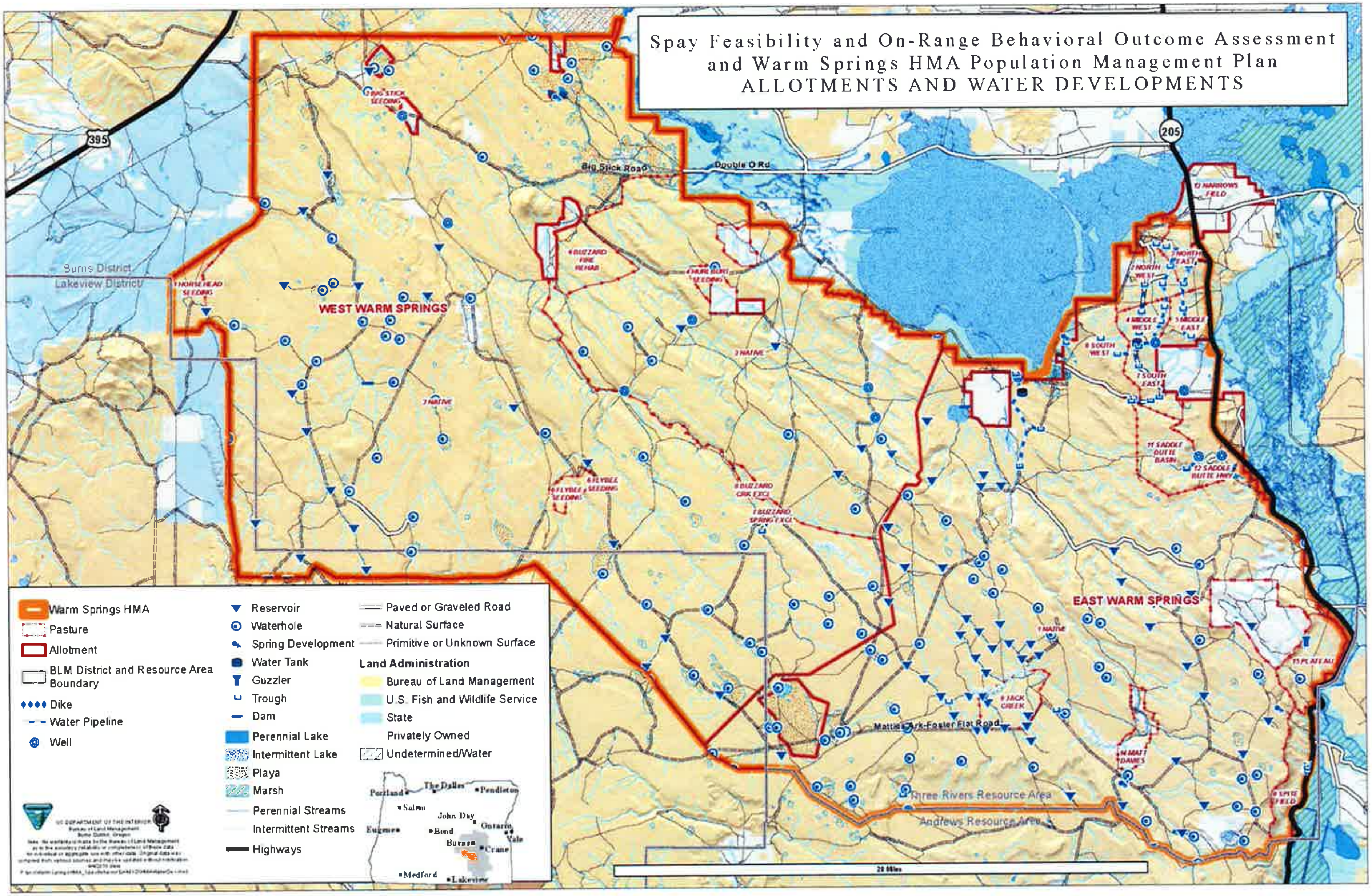
Turner, J.W., and J.F. Kirkpatrick. 2002. Effects of immunocontraception on population, longevity and body condition in wild mares (*Equus caballus*). Reproduction (Cambridge, England) Supplement, 60, pp.187-195.

Turner, J.W., I.K. Liu, D.R. Flanagan, A.T. Rutberg, and J.F. Kirkpatrick. 2007. Immunocontraception in wild horses: one inoculation provides two years of infertility. Journal of Wildlife Management 71:662-667.

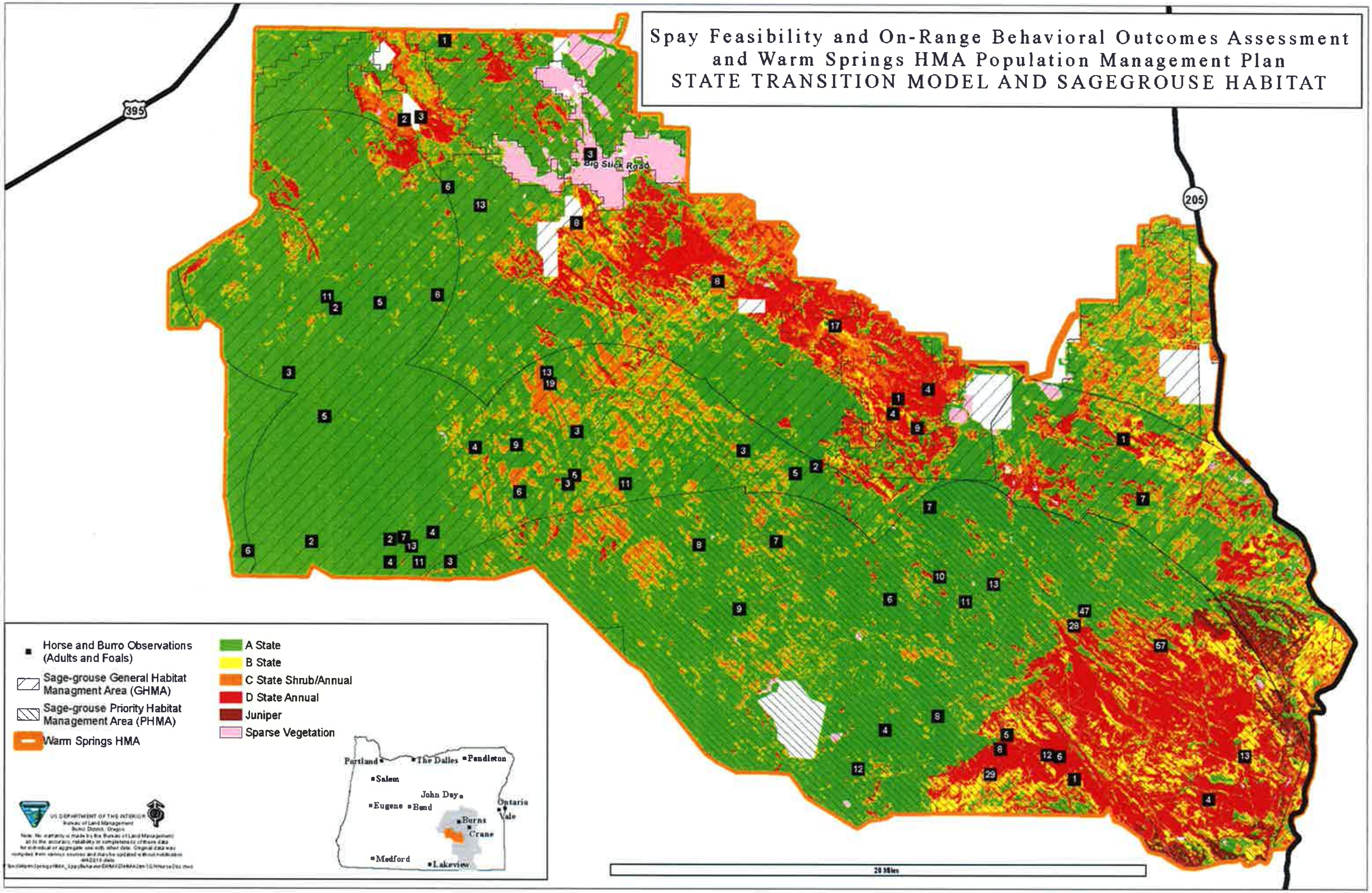
Turner, J.W, A.T. Rutberg, R.E. Naugle, M.A. Kaur, D.R.Flanagan, H.J. Bertschinger, and I.K.M. Liu. 2008. Controlled-release components of PZP contraceptive vaccine extend duration of infertility. Wildlife Research 35:555-562.

Wright, S. 1931. Evolution in Mendelian populations. Genetics 16:97-159.

Zoo Montana. 2000. Wildlife Fertility Control: Fact and Fancy. Zoo Montana Science and Conservation Biology Program, Billings, Montana.



Spay Feasibility and On-Range Behavioral Outcome Assessment and Warm Springs HMA Population Management Plan
ALLOTMENTS AND WATER DEVELOPMENTS
WEST WARM SPRINGS
EAST WARM SPRINGS
Big Stick Road
Double O Rd
Mattie Ark-Foster Flat Road
Burns District
Lakeview District
Three Rivers Resource Area
Andrews Resource Area
395
205
Warm Springs HMA
Pasture
Allotment
BLM District and Resource Area Boundary
Dike
Water Pipeline
Well
Reservoir
Waterhole
Spring Development
Water Tank
Guzzler
Trough
Dam
Perennial Lake
Intermittent Lake
Playa
Marsh
Perennial Streams
Intermittent Streams
Highways
Paved or Graveled Road
Natural Surface
Primitive or Unknown Surface
Land Administration
Bureau of Land Management
U.S. Fish and Wildlife Service
State
Privately Owned
Undetermined/Water
Portland
The Dalles
Pendleton
Salem
John Day
Eugene
Bend
Ontario
Burns
Crane
Vale
Medford
Lakeview


Spay Feasibility and On-Range Behavioral Outcomes Assessment
and Warm Springs HMA Population Management Plan
STATE TRANSITION MODEL AND SAGEGROUSE HABITAT
395
205
Big Stick Road
Horse and Burro Observations (Adults and Foals)
Sage-grouse General Habitat Managment Area (GHMA)
Sage-grouse Priority Habitat Management Area (PHMA)
Warm Springs HMA
A State
B State
C State Shrub/Annual
D State Annual
Juniper
Sparse Vegetation
Portland
The Dalles
Pendleton
Salem
John Day
Eugene
Bend
Burns
Crane
Ontario
Vale
Medford
Lakeview
US DEPARTMENT OF THE INTERIOR
20 Miles