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Spay Feasibility and On-Range Outcomes

Environmental Assessment
DOI-BLM-ORWA-B050-2019-0013-EA

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I. INTRODUCTION

This environmental assessment (EA) has been prepared to disclose and analyze the environmental consequences of a proposed Spay Feasibility and On-Range Behavioral Outcomes Assessment. The Burns District Bureau of Land Management (BLM) proposes to evaluate the safety, complication rate, and feasibility of ovariectomy via colpotomy (spay) on wild horse mares then assess the behavioral effects of having spayed mares on the range with untreated horses. The United States Geological Survey (USGS) has submitted a proposal to evaluate the on-range impacts of spaying on mare and band behavior, comparing treated and untreated portions of the Warm Springs Herd Management Area (HMA) herd.

A. Background

This spay study and on-range behavioral outcomes assessment would involve the horses gathered from Warm Springs HMA (Appendix A, Warm Springs HMA Vicinity Map) in October of 2018, currently being held at the Oregon Wild Horse and Burro Corral Facility.

On September 12, 2018, Burns District BLM issued a decision record (DR) for DOI-BLM-ORWA-B050-2018-0016-EA to gather and remove excess wild horses and burros from Warm Springs HMA and initiate a spay feasibility and on-range behavioral outcomes assessment study. Due to limited water availability in the HMA and deteriorating conditions of the natural surface roads being used for hauling water during late summer 2018, the portion of the September 12, 2018 DR to gather Warm Springs HMA became effective upon the signature date. From October 2–23, 2018, 845 horses, 2 mules, and 41 burros were gathered from the Warm Springs HMA and taken to the Oregon Wild Horse and Burro Corral Facility in Hines, Oregon. Approximately 30 horses and 30 burros remained on the range following the gather. The September 12, 2018 DR was challenged in the United States District Court for the District of Oregon and the District of Columbia, as well as in the Interior Board of Land Appeals (IBLA). A motion seeking a preliminary injunction (PI) was filed in the District of Oregon. On November 2, 2018, one court preliminarily enjoined implementation of the spay portion of the DR. On November 26, 2018, IBLA issued an order vacating the DR in its entirety.

Despite the DR being vacated, the conditions that prompted the BLM to determine that approximately 652 animals were excess and needed to be removed from the range remained present and warranted a decision for removal. To that end, the BLM prepared a determination of NEPA adequacy (DNA) to assess whether the 2018 EA adequately analyzed the environmental impact of permanently removing wild horses and burros from the Warm Springs HMA, the proposed return of horses to low appropriate management level (AML) for the HMA, and the treatment of mares to be returned to the HMA with porcine zona pellucida (PZP). The BLM signed a DR on the basis of the DNA on April 12, 2019. The DR authorized the proposed action of the DNA which included—

- the determination that approximately 779 horses, 2 mules, and 41 burros gathered in October 2018 were excess and should be permanently removed from the Warm Springs HMA;
- the return of male and female horses (50:50 sex ratio) to the low end of AML for the Warm Springs HMA in 2019; and
- the treatment of the female horses that would be returned to the HMA with PZP.

The DNA gave BLM discretion to "issue new management decisions pertaining to these horses that could rescind, nullify, set aside, supersede, or adopt this potential decision record in whole or in part." The DNA specified that a new management decision could affect, among other things: (1) whether, and when, horses are returned to the HMA; (2) BLM's excess determination; and (3) the population control measures that BLM chooses to utilize.

The BLM, through this EA, is now analyzing different approaches relating to the fertility treatment and return of some of the wild horses gathered in October 2018. Specifically, this EA analyzes two action alternatives where some of the mares are spayed and then returned to the HMA, along with the untreated mares and stallions whose return to the range was authorized by the April 2019 DR. Under both alternatives, the return of the horses to the HMA would be followed by an on-range behavioral outcomes assessment.

The high end of AML for wild horses and burros across the west is 26,715. The current estimated on-range wild horse and burro adult population is 88,090 (as of March 1, 2019). There are currently 49,194 wild horses and burros in BLM off-range facilities (as of April 21, 2019). Nationally, there is limited funding and space available for the care of 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. Options commonly used have included periodic removals and the application of temporary fertility control vaccines. The National Research Council (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. The BLM has been assisting in research 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.

The BLM continues to pursue implementation of the study of various sterilization techniques, including surgical sterilization, because of the consistent direction from both the National Wild Horse and Burro Advisory Board (Advisory Board) and Congress recommending the use of sterilization to curb wild horse population growth. Stakeholders and the BLM have engaged in discussions regarding permanent sterilization of wild mares and the possibility of BLM conducting this type of research for many years. At least seven years ago the 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 BLM has posted the agenda and minutes from these meetings online[1] to allow for public review for approximately two years. 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. The NRC (2013) Finding #7 explained, "The most promising fertility-control methods for application to free-ranging horses or burros are porcine zone pellucida (PZP) vaccines, GonaCon™ vaccine, and chemical vasectomy." In September 2013, the Advisory Board provided discussion and recommendations to BLM addressing the key findings in the NRC Review (2013). Particularly, in response to Finding #7, the Advisory Board recommended (#8), "no options for reproductive control be eliminated from consideration due to the conflicting data on immune-contraceptives such as IUDs, ovariectomy, and tubal ligation" (BLM 2013b). They continued on with an April 2015 recommendation (#4) that "BLM should increase dedicated funding for developing new methods of population growth suppression, and for methods currently available. All forms of population control should be considered for utilization" (BLM 2015). The Advisory Board's recommendations appeared more urgent in 2016 when they provided the following recommendation (#8), "The National Wild Horse and Burro Advisory Board would encourage aggressive use of all tools in the tool box as addressed in the Board's September 2015 Recommendation #16, which reads 'Prioritize use of currently available tools in the field to reduce population growth right now and implement promising new tools as quickly as they become available'" (BLM 2016). In October 2017 the Advisory Board recommended (#6) to "Maintain AML by using fertility control to slow population growth levels where removals equal the adoption demand" (BLM 2017).

Congressional committees have also consistently advised the BLM to continue studying and applying promising and effective population growth suppression tools as soon as possible. Preliminary language in June 2018 from the House Interior appropriations committee for the 2019 Interior Appropriations Act (House Report 115-765) requested "that the Bureau conduct an analysis that identifies factors for success, total funding requirements, and expected results on potential options that (1) remove animals from the range; (2) increase the use of sterilization; (3) increase the use of short-term fertility control; (4) provide an adoption incentive of $1,000 per animal; and either (a) allow animals older than 10 years of age to be humanely euthanized; or (b) prohibit the use of euthanasia on healthy wild horses and burros." The report also directed the "Bureau to immediately begin designing the regulatory framework and technical protocols for an

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

active sterilization program" and "ensure it considers the health and welfare of individual wild horses and burros and their populations and evaluates the costs of such a program" (June 19, 2018). Although this was not included in the 2019 Appropriations, the House Committee requested giving "the Bureau legislative authority to manage groups of wild horses and burros as non-reproducing or single sex herds, including through the use of chemical or surgical sterilization." The BLM responded in 2018 with their report to Congress titled *Management Options for a Sustainable Wild Horse and Burro Program* that included sterilization in all 4 options analyzed.

For its part, the Advisory Board, in October 2018, accepted option 1 of the BLM's report to Congress "as the preferred path forward to reach AML" (BLM 2018). Option 1 included the "use of all legal authorities contained in the Act (especially sale without limitation and euthanasia of unadopted or unsold animals), including the use of contraceptives and limited sterilization techniques." Also at their October 2018 meeting, the Advisory Board recognized "the value of and supports ongoing research and funding of humane permanent sterilization as one of many viable tools in our quest to achieve a thriving ecological balance in achieving and maintaining AML" (recommendation #7, BLM 2018). Finally, with the passage of the 2019 Interior Appropriations Act, the House Committee explained that, "The Bureau is expected to continue evaluating its internal policies, procedures, and regulations to reduce costs and administrative burdens, as well as researching and developing appropriate, humane protocols for fertility control methods, including sterilization, and improve its contracting for off-range holdings" (H.R. 116-9 (February 13, 2019)).

One objective of the Oregon Greater Sage-Grouse (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).

In concert with this Oregon GRSG ARMPA objective, in 2015 the BLM solicited the USGS, the Department of the Interior's research agency, to convene a panel of veterinary experts to assess the relative merits and drawbacks of several surgical ovariectomy techniques that are commonly used on domestic horses for potential application to wild horses. Following this panel discussion, a table summarizing and comparing several methods, along with the transcripts of the discussion, were received by BLM (Bowen 2015). Based on this expert summary (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 fertility management at 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 ovariectomy (spay) via colpotomy studies have already found only relatively low rates of surgical complications and no discernable behavioral changes on range. The BLM would like to quantify outcomes of the surgical sterilization procedure in greater detail and would like to use the procedure to support 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 to provide research related to wild horse and burro management. The BLM sent a Statement of Research Objectives (included in Appendix B) to USGS that included a request for a study design addressing: 1) surgery feasibility and outcomes assessment, and 2) an on-range behavior and outcomes assessment. Colorado State University (CSU), a USGS research partner that would have been involved in surgery feasibility and outcomes assessment, withdrew its participation from the earlier proposal associated with BLM-ORWA-B050-2018-0016-EA. As a result, USGS submitted a proposal (Appendix C, USGS Research Proposal, August 2018) that includes USGS involvement only with the study of the on-range behavioral outcomes. The proposed USGS behavioral study would take place using mares that BLM would spay as a management action.

B. Purpose and Need for Action

This action includes two primary purposes. The first purpose is to manage wild horses in a way that would allow BLM to reduce the wild horse annual population growth rate and reduce the frequency of gathers to remove excess animals (i.e., to extend the time between gathers). There is a need to manage this wild horse population within or near the established AML of 96 to 178 wild horses to 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).

The second purpose is to study the use of ovariectomy via colpotomy as a method to slow the wild horse population growth rate in Warm Springs HMA, 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 on-range outcomes (as discussed below) of this method to allow BLM to effectively make conclusions about the method's effects.

Enough evidence exists to conclude that application of the ovariectomy via colpotomy sterilization method would be appropriate to use in wild horse management. Ovariectomy via colpotomy is the specific surgical method for which additional observations would be informative because that method has been shown to work well in another herd of feral horses (Collins and Kasbohm 2016). Further study of this surgical method is needed to provide BLM more detailed quantification of the feasibility of this procedure as it relates to morbidity[2] and mortality rates. The BLM chose this method of spaying wild horse mares for further review for reasons described in the Background section above,

[2] 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.

including BLM's need to develop and apply fertility control methods that effectively reduce the number of animals removed from the range, BLM's receipt of a summary review of surgical mare sterilization techniques that preliminarily identified ovariectomy via colpotomy as the mare surgical sterilization method most likely to be used successfully 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).

Previous evidence from the Sheldon NWR (Collins and Kasbohm 2016) also supports the conclusion that spayed feral horses continue to exhibit behaviors that are typical of free-roaming horses. Further study of the effects of having spayed mares in a wild horse herd is needed to provide BLM more detailed quantification of the reduction of the annual population growth rate of a wild horse herd and to provide a more detailed quantification of behavioral outcomes on the range (i.e., social behaviors, body condition, and survival rate) when spayed mares are living with other treated and untreated animals.

The BLM's purpose and need is also supported by specific direction in the WHB Act to determine how best to maintain appropriate management levels of wild horses on the range, including through removals or other options, such as "sterilization." (16 USC 1333(b)(1)). This spay research will help to inform the BLM about the feasibility of ovariectomy via colpotomy as a method of sterilization. It is also consistent with the BLM's management direction relating to wild horses in the applicable land use plans.

C. Decision to be Made

The authorized officer will determine whether or not to proceed with the proposed spay feasibility action and whether that action either should or should not include the USGS on-range behavioral outcomes assessment. The decision would affect wild horses that are considered excess and were removed from Warm Springs HMA in October 2018 as well as those planned for return to the HMA to re-establish low AML.

The BLM authorized officer's decision would not set or adjust AML, nor would it adjust livestock use, as these were set through previous land use plan decisions.

The actions proposed in this EA meet BLM's needs to manage this wild horse population within or near the established AML in the Warm Springs HMA, reduce the annual population growth rate on the range, reduce (extend) the frequency of gathers to remove excess animals, and provide additional study and analysis of this surgical spay procedure. The surgical and on-range assessments represent a feasibility approach, and the results are not policy setting for BLM. Any future proposals by BLM to use the spay method analyzed in this EA would be subject to NEPA compliance and separate decisions.

D. Conformance with BLM Resource Management Plan(s)

The action alternatives are in conformance with the objectives, rationale, and allocation and management actions from the Three Rivers Resource Management Plan

(RMP)/Record of Decision (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 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.

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.

While the proposed action (alternative B) returns wild horses to the range at a number over the high AML, it is still in conformance with the GRSG ARMPA (2015), which updates the Three Rivers RMP/ROD (1992). Chapter II.C. Alternative B - Proposed

Action explains that, "[b]ecause this [the proposed action] is a research study, management above AML is temporary in nature. Following the completion of this study, additional future management actions would be needed in order for BLM to move toward a long-term plan for managing within AML. Future management actions are outside the analysis described in this alternative and would be subject to NEPA compliance and a separate decision." The proposed action specifically addresses the GRSG ARMPA objective MD WHB 9 by coordinating with USGS to evaluate the on-range impacts of spaying on mare and band behavior, comparing treated and untreated portions of the Warm Springs HMA herd. The surgical and on-range assessments will inform BLM about the feasibility of this approach and would, therefore, allow for more informed decision making on future AML management actions in Warm Springs HMA.

E. Consistency with Laws, Regulations, and Policies

The proposed action has been designed to conform to Federal regulations 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;

    None of the alternatives alter the ability of the wild horses being returned to the HMA to continue to be "wild free-roaming horses", as defined by the WHB Act.

    1333. Powers and duties of the Secretary.
    (b) Inventory and determinations; consultation; overpopulations; research study; submittal to Congress.
    (1) The Secretary shall … 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.

The proposed action includes the use of female sterilization to address achievement of appropriate management level. It also utilizes USGS to further BLM's knowledge of population dynamics of having sterilized animals in a wild horse herd.

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.…

Chapter III.B.1.b.(1) Effects Common to All Alternatives describes the WinEquus population modeling simulations conducted for each alternative analyzed. This section states how "[n]one 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."

> 4700.0-6(c). Management activities affecting wild horses and burros shall be undertaken with the goal of maintaining free-roaming behavior.

"Free-roaming behavior" is not defined. However, "free-roaming" is defined in the BLM Wild Horses and Burros Management Handbook, H-4700-1 (June 2010) as, "WH&B are able to move without restriction by fences or other barriers within a HMA." None of the alternatives are proposing fences or other barriers within the HMA. Chapter III.B.1.b.(4) Alternative B - Proposed Action includes a section titled Movement, Body Condition, and Survival of Ovariectomized Mares that describes anticipated effects on these topics after mares are ovariectomized. The portion of this section discussing "movement" concludes with, "[d]espite 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."

> 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.

Chapter I.F.2. Issues Considered but Eliminated from Detailed Analysis addresses the issue of "minimum level" necessary.

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."

The land use plans (LUP), Three Rivers RMP/ROD (1992), and the GRSG ARMPA (2015) do not specify, nor do they forbid, having non-reproducing horses in Warm Springs HMA. The WHB Handbook definition of non-reproducing wild horses provides guidance that "LUPs *should* identify the HMAs to be managed for non-reproducing wild horses and the criteria for their selection." This section of the handbook (4.5.4.1) does not say *must* but *should*. This EA does not propose creating an entirely non-reproducing herd in Warm Springs HMA: it proposes the study of the feasibility of spaying and on-range behavioral outcomes in order to be better informed about available management actions using spaying as a method to reduce population growth rates and extend the duration between gathers. As indicated by Congress's inclusion of sterilization as an appropriate method for achieving AML, spaying is an approved method.

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)."

The proposed action includes the use of spaying by ovariectomy via colpotomy as a management tool and studying the feasibility of that procedure and on-range impacts. This proposed action is consistent with this part of the WHB Handbook.

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).

Alternatives B and C propose spaying (sterilizing) part of the wild horse mares to be returned to the Warm Springs HMA. Section 4.5.4.1 of the handbook does not say LUPs *must* but *should* identify HMAs to be managed for non-reproducing wild horses.

> 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."

The surgical and on-range assessments would further inform BLM about the feasibility of this approach and would therefore allow for more informed decision making on future AML management actions in Warm Springs HMA.

> 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."

Paragraphs 3 and 4 of the Purpose and Need section of this EA explain how BLM expects the proposed spay method to be safe, effective, and humane for use on wild horses.

4. ***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.

The surgical and on-range assessments will further inform BLM about the feasibility of this approach and would, therefore, allow for more informed decision making on future AML management actions in Warm Springs HMA. The Decision to be Made section also explains, "[a]ny future proposals by BLM to use the spay method analyzed in this EA would be subject to NEPA compliance and separate decisions."

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

The Common to All Alternatives section of chapter II describes how this IM would be used in all alternatives.

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

The Common to All Alternatives section of chapter II describes how this IM would be used in all alternatives.

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

The Common to All Alternatives section of chapter II describes how this IM would be used in all alternatives.

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

This IM is discussed in the Opportunity for Public Observation section of the description of the proposed action in chapter II.

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

The proposed action studies a management action that should slow wild horse population growth rates on the range and, therefore, aid BLM in management on the basis of multiple use and sustained yield as described in the FLPMA.

F. Scoping and Identification of Issues

As discussed in the Background section, surgical sterilization has been a topic of discussion at public Advisory Board meetings and through various NEPA processes for many years.

The 2018 EA (discussed in the Background section) analyzed, among other actions, an action similar in many respects to the action proposed here. That EA was released for two public comment periods. A scoping letter for the 2018 EA was sent to 127 interested individuals, groups, and agencies and posted to BLM's ePlanning website. Comment letters were received by BLM from 2,044 individuals, groups, and agencies during the scoping period. Following review of these letters, substantive public comments were incorporated into a draft EA and unsigned FONSI that were mailed to 105 interested individuals, groups, tribes, and agencies for a 30-day comment period. 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 on BLM's ePlanning website, and a notice was posted in the Burns Times-Herald newspaper for one week. A total of 8,326 comment emails, letters, and faxes (a majority of which arrived as form letters) were received during the 30-day public comment period on the 2018 EA. Those comments were addressed in the EA, and the EA went out for an additional 12-day public comment period. The updated EA was again posted on BLM's ePlanning website, and a notice of availability was posted in the Burns Times-Herald newspaper. A total of 10,104 comment emails, letters, and faxes (a majority of which arrived as form letters) were received during the additional comment period and substantive comments were incorporated into the final EA.

In addition to the public involvement for the 2018 EA, the same surgical procedure was proposed for application on wild horse mares in Oregon in a 2015 EA (DOI-BLM-OR-B000-2015-0055-EA) that was available for a 30-day public comment period.

Issues identified for analysis during public scoping and comment periods on previous proposals, during Advisory Board discussions, during BLM interdisciplinary team (IDT) and WHB Research Advisory Team discussions, and through contact with other agencies have given BLM a thorough understanding of issues raised by the public. The following issues represent issues raised both during public scoping for the previous EAs and by the BLM. These issues are analyzed in the Affected Environment and Environmental Effects section, Chapter III.

1. Issues for Analysis

a. Wild Horses

- *What are the anticipated complications and rate of complications associated with the ovariectomy via colpotomy procedure?*
- *Would the mare continue to have an estrus cycle following this procedure?*

- *What would be the anticipated long-term effects (i.e. body condition and survival rate) of the surgical procedure on mares?*
- *What are anticipated on-range effects on herd dynamics (such as, reproductive behaviors, harem band structure, and spatial ecology) following the release of spayed mares?*
- *What are the anticipated effects on bone histology after ovariectomy?*
- *What are the anticipated effects of PZP vaccine on the mare and her behavior?*
- *How would the alternatives contribute to achieving AML and affect the ability of the Warm Springs HMA wild horse herd to continue to grow?*
- *How would the alternatives contribute to the maintenance of genetic diversity of the 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 anticipated effects of each alternative on the population growth rate of wild horses in the Warm Springs HMA?*
- *How would the alternatives affect the frequency of gathers to remove excess animals?*

b. Rangeland Resources

Cultural Resources

- *What would be the effects of the 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 Greater Sage-Grouse habitat?*

Noxious Weeds

- *What would be the effects of the alternatives on the spread and introduction of noxious weeds?*

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

While many issues may arise during both internal and external scoping and comment periods, not all of the issues raised warrant analysis in an EA. BLM's NEPA Handbook (H-1790-1, 2008) provides that issues raised should be analyzed if:

- analysis of the issue is necessary to make a reasoned choice between alternatives.
- the issue is significant (an issue associated with a significant direct, indirect, or cumulative impact, or where analysis is necessary to determine the significance of impacts).

The following issues were identified but do not satisfy the above criteria for full analysis.

- *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 expressly contemplates "sterilization" as a method of population control.

- *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?*

  It is BLM's expectation that the most minimal feasible level of fertility control management is a safe, long-term efficacy, one-time treatment 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 a fertility control vaccine. Congress specified that sterilization is an acceptable management action (16 U.S.C. 1333.b.1) and BLM interprets this inclusion of sterilization in the WHB Act as sterilization being considered a minimal feasible management action.

  The results of the spay feasibility and on-range outcomes study would provide BLM with more details on the safety and feasibility of this one-time population growth suppression tool that shows substantial potential to curb wild horse population growth more effectively than other commonly used methods, while requiring less frequent handling at a lower risk to the horses. BLM's Wild Horses and Burros Management Handbook, H-4700-1, defines "Minimal Feasible Level of Management" as the "minimal *number of* habitat or population management tools or actions necessary to obtain the objectives" set out in management plans. (BLM Handbook H-4700-1, p. 58) (emphasis added). Currently, the BLM's primary population growth suppression tool is the application of vaccines that are typically effective for one year or less per injection, which requires frequently-recurring administration of these tools.

Gathering every mare on all rangelands managed by the BLM (currently approximately 40,000+ mares, when 2019 foals are included) 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. In an HMA where horses are not approachable for darting, recurrent temporary fertility control vaccine use requires much more animal handling than spaying does, therefore it is not the most "minimal" level of management. Repeat treatments of the Warm Springs HMA horses for fertility control vaccine application would require helicopter gathering all the animals in the HMA; stallions and foals as well because there is no safe way to separate mares from stallions and foals prior to capture. There is risk of injury and mortality associated with gathering of wild animals: gather-related mortality averages about 0.5 percent (Government Accountability Office, GAO-09-77, p. 49). The effects of gathering wild horses are provided in the 2018 EA (pp. 60–63); this section is incorporated by reference.

In sum, based on the information available to the BLM, the proposed action would be feasible in achieving the goals in BLM's direction for the HMA and would constitute more "minimal" management—that is, a lower "number of…population management…actions" than other available tools.

- *The BLM claims an overpopulation of wild horses on a national level and within individual HMAs; 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 in the Background section above, 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 88,090 adult animals (as of March 1, 2019). 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 described in BLM IM 2010-057, as updated by Lubow and Ransom (2016), for collecting data and using published population estimation techniques, primarily simultaneous double-observer surveys with sightability covariates (Lubow and Ransom 2016, Schoenecker and Lubow 2016), which allow for statistical analysis of observations and a better estimate of actual population size from survey data, as recommended in the NRC Review (2013).

Specific to Warm Springs HMA, simultaneous double-observer aerial surveys in 2016 and 2018 provided BLM a very good estimate of the amount of horses residing on the HMA prior to the October 2018 gather and those remaining on the range following the gather. These surveys also provide indication of the annual population growth (approximately 16 percent) within this HMA, which allows BLM to make projections for future population estimates. By comparing the estimated population from the June 2018 survey (694 adults and 158 foals = 852 total) with the number of wild horses actually on the range in October 2018 based on gather results (845 captured plus 30 remaining = 875), the result is that the estimated population size was approximately 23 horses less than the actual number on the range. As a percentage, this bias could be expressed as 23/845, or about 2.7 percent. So, while it is true that continuing to improve survey methods will provide BLM with the most accurate estimates of population size and population growth rates, current estimation methods appear to be quite accurate, relative to most wildlife aerial survey methods.

- *A previous BLM proposal to study ovariectomy via colpotomy and other female sterilization methods in DOI-BLM-OR-B000-2015-0055-EA stated that the results of the study were expected to aid BLM in determining the social acceptability of each procedure; however, the 2018 EA did not analyze the social acceptability of ovariectomy via colpotomy. In the decision making process for this EA, will BLM be analyzing the critical issue of social acceptability as it relates to this procedure?*

  The purpose of this EA is to analyze whether the proposed action and alternatives will result in significant impacts to the human environment, and thus whether it is necessary to prepare an environmental impact statement (EIS). (BLM NEPA Handbook H-1790-1, section 7.1; 40 CFR 1501.3-.4). Social and economic effects themselves do not ordinarily rise to the level of a significant impact on the human environment (40 CFR 1508.14). In the 2015 Mare Sterilization Research EA (DOI-BLM-OR-B000-2015-0055-EA) examining a similar proposed study, BLM exercised its discretion to voluntarily analyze the social and economic effects of that EA's proposed action and alternatives (pp. 45–54). Because there is no prospect that social and economic effects would rise to a level of significance here, and because examining those effects would not assist BLM in making a reasoned choice among alternatives, it declines to re-examine those issues here.

The term "social acceptability" was used in the above-referenced social and economics section of the 2015 EA. The BLM used the term only 4 times in the 145 page 2015 EA, and it was not described as a critical aspect of the study.

The BLM discussed social acceptability in the social and economic section of the EA in reference to an Australian thesis (Ballard 2005) that explained that studies in Australia noted that, where the highest population of feral horses exists, control methods for feral horses vary in their social acceptability, which must be weighed against logistic and economic constraints (Nimmo and Miller 2007). This statement was not specific to ovariectomy via colpotomy, but related to any method of population control. This reference was included in the 2015 EA to show that varying opinions exist on methods of wild horse population control. In the same section of the 2015 EA, BLM explained that:

> There are a multitude of opinions of how BLM should manage wild horse populations and at what levels of intensity. This is noted in the 2013 NRC Review with reference to Beever and Brussard (2000) noting that managers often cannot satisfy all interest groups, but they can help to shape public attitudes if they communicate research findings transparently. The BLM's intent with this proposed action is to research these methods of sterilization on a group of mares in the controlled setting of a corral, using only the number of mares necessary for statistically accurate comparisons of variables. BLM intends to release the results of these studies to the public. Depending on the results of these studies, BLM may or may not choose in the future to apply any of the three sterilization methods to wild horse mares on the range.

BLM concluded that "[r]esults from the studies under the proposed action would aid in determining the social acceptability of each procedure because the studies would quantify complication rates, effectiveness, and success rates of each technique." If read in its entirety, this statement explains that the *results* of the studies would aid in determining social acceptability. However, "social acceptability" itself was not analyzed as part of the NEPA effects analysis in the 2015 EA, nor could have been because the results would not be available until after the study concluded.

The BLM also mentioned social acceptability in the last paragraph of the Cumulative Effects section for Social and Economic Values. That section states:

> The results of this study are expected to aid BLM in determining the social acceptability of each procedure. In addition, Rock Springs Field Office [who was proposing a spayed mare behavioral research study at the time] would have further information on complication rates, effectiveness, and success rates of the ovariectomy via colpotomy procedure on pregnant mares which would allow for more informed decision making on the social acceptability of the procedure at various gestational stages.

An interested party previously claimed that in the 2015 EA BLM considered "social acceptability" as a critically important component of the project. To the extent social acceptability was considered, it was not in the context of any NEPA analysis (and was not required by any NEPA analysis), but rather just an information point for any subsequent discussion about the results of the three different spay procedures to be analyzed as part of the 2015 EA.

Social acceptability will not be analyzed in detail in this EA because the BLM does not believe it is an issue ripe for analysis. An analysis of social and economic values was voluntarily included in the 2015 EA but really should not have been based on additional Council on Environmental Quality (CEQ) guidance (40 CFR 1500.1(b) on the BLM's NEPA Handbook) which states, the BLM is tasked with analyzing issues if:

- analysis of the issue is necessary to make a reasoned choice between alternatives. (That is, does it relate to how the proposed action or alternatives respond to the purpose and need?)
- the issue is significant (an issue associated with a significant direct, indirect, or cumulative impact, or where analysis is necessary to determine the significance of impacts).

Here, social acceptability is not a component of the purpose and need for the proposed action nor is it a "significant" issue requiring analysis. This does not mean, however, that the BLM does not care about the public's views on the proposed action and its potential effects. The BLM has a responsibility to consider all comments received from the public. There are a subset of those comments that require analysis and, they have been termed "substantive." Substantive should not be construed as more or less important than other comments received. They simply require the BLM to prepare a documented response for the purposes of NEPA compliance.

Following is a more detailed explanation of BLM's interpretation of the term "significant" in the NEPA context.

Section 7.3 of the BLM's NEPA Handbook defines significance as effects of sufficient context and intensity that an environmental impact statement is required. The CEQ regulations refer to both significant effects and significant issues (40 CFR 1502.2(b)). The meaning of significance should not be interpreted differently for issues than for effects: significant issues are those issues that are related to significant or potentially significant effects.

Under the ten intensity considerations for significance, the BLM Handbook states the following:

> Public Health and Safety (40 CFR 1508.27 (b)(2). You must consider the degree to which the action would affect public health and safety which may require, for example, evaluation of hazardous and solid wastes, air and water quality. In the context of evaluating significance, consideration of these resource effects should describe their relation to public health and safety. **Economic or social effects are not intended by themselves to require preparation of an environmental impact statement (40 CFR 1508.14).** (Emphasis added.)

Following is the language from the CEQ regulations at 40 CFR 1508.14:

> Human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment. (See the definition of ''effects'' (§1508.8).) This means that economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment.

As social values are not intended, by themselves, to require preparation of an EIS, the BLM interprets this to mean that social values, on their own, do not rise to the level of significance (BLM Handbook H-1790-1, p. 71). If the BLM were preparing an EIS because the proposed action was thought to have significant effects to the natural and physical environment, and those effects were intertwined with social values, then the social values would be discussed and addressed by that analysis. In this situation, the BLM is preparing an EA, and the issue of social acceptability does not meet the BLM's interpretation of a "significant" issue requiring detailed analysis.

- *How would the extended holding of horses in captivity since the October 2018 gather affect the outcomes of the spay surgeries and on-range behavioral outcomes assessment?*

  The BLM is unaware of any peer-reviewed study on the impacts of captivity at a BLM holding facility on wild horses prior to being returned to an HMA. However, BLM routinely maintains at their holding facilities wild horses slated to be returned to the range for up to 2 years following wildfire within HMAs; this is done to allow for adequate rehabilitation of burned areas. For example, a wildfire burned through the Jackies Butte HMA in Oregon in 2012 and horses were removed to allow for rangeland rehabilitation. Horses were returned to Jackies Butte HMA in July 2014, allowing key forage species two full growing seasons of rest from wild horse utilization. Since their return to the HMA, BLM has observed no apparent differences in use patterns of wild horses in the HMA or general behavior of these animals. Based on this and other experiences, the BLM does not believe that the extended holding of horses following the October 2018 Warm Springs HMA gather would alter the behavior of the horses once returned to the HMA. Even if a slight change in behavior does occur following captivity, all animals returned to the HMA would have received the same captivity experience—both herd segments in the USGS study would have received equal experience with the exception of the spayed mares—and therefore be comparable.

- *How is BLM mitigating, monitoring and responding to pain the horses might experience during and after the ovariectomy via colpotomy procedure?*
- *Why is BLM not conducting pain management research, as was originally proposed in the June 2018 version of the 2018 EA?*

  The BLM has considered and sought to minimize any pain to horses in connection with these procedures. The BLM would only use licensed veterinarians with experience performing ovariectomy via colpotomy procedures and standing sedation on at least 100 ungentled, wild horse mares during the spay feasibility study. The veterinarians contracted by BLM would follow the same surgical protocol originally approved by the CSU Institutional Animal Care and Use Committee (IACUC). The veterinarians would monitor the mares both during and after surgery. Horses that have received surgery would be turned into an approximately half-acre pen for recovery from sedation where they will be monitored by the veterinarians for any signs of discomfort. As soon as the horses become alert, they will be moved into a larger pen where the veterinarians will be conducting observations three times per day for the first week of post-surgery monitoring.

  As was proposed in the June 2018 draft EA, the 2018 EA, and in this EA, the licensed veterinarians performing the procedures would also be observing and monitoring the effects of the procedure on the welfare of the horses and taking veterinary action when deemed necessary. The proposed action of this EA (under the portion titled Ovariectomy via Colpotomy Procedure) explains how mares would be assessed from a distance three times a day for a week by the veterinarians involved in the study. 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 additional postoperative antibiotics would be given because the long-lasting antibiotics given at the time of surgery are expected to provide adequate antimicrobial effect. 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.

Actions proposed for the management of pain during and after surgeries are described in the description of the proposed action in chapter II, under the section titled Ovariectomy via Colpotomy Procedure.

Separate and apart from the IACUC care protocol and BLM's many steps to minimize pain, CSU had originally proposed to study what were termed "Post-surgery Welfare Observations" in the draft EA of June 29, 2018. That monitoring on a limited subset of horses (20 treated mares and 20 control mares) was to have been conducted by a CSU animal welfare specialist experienced in observing, recording, and scoring based on a composite measure pain scale. To allow time for the effect of anesthetics, analgesics, and stress-induced analgesia to subside, the CSU researcher proposed to begin observations the morning after surgery. Therefore, pain measurements were never proposed during the surgery. The CSU proposed observations would carry on for 7 days after surgery; behavior observations were to be conducted for one hour in the morning and one hour in the afternoon and would include recording a score from a composite measure pain scale 3 times per day. The CSU researcher was attempting to quantify, using a composite measure pain scale scoring system developed for *domestic* horses, a measure of apparent discomfort in *wild* mares after surgery, as compared to untreated control mares who would not receive surgery. CSU's originally proposed "Post-surgery Welfare Observations" research project did not include any proposed veterinary treatments based on the pain measure scores recorded of treated or untreated mares. In other words, this researcher was capturing pain measurements but with no intention of taking action based upon those measurements. In this EA, BLM is not proposing to conduct the pain scoring research previously proposed by CSU because: (1) CSU researchers are not affiliated with this project, (2) that pain-scoring system CSU proposed for use was developed for domestic horses and its applicability for scoring wild horses is unknown, and (3) that pain-scoring research does not change the protocols BLM is using to assess and address any pain in connection with surgeries.

Because the pain scoring proposed by CSU did not respond to the welfare of the animals in this study, but merely recorded their pain scores, this part of the CSU proposal was never an integral part of BLM's spay study. Rather, it was an academic research project that CSU researchers requested as part of CSU's involvement in the project.

In sum, there are no differences in the pain management and post-surgical care proposed for treated mares with or without the pain scoring observations originally proposed by CSU in the June 2018 EA. There would be no added impacts to the treated mares due to the removal of those pain-scoring observations.

II. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

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

- Alternative A – No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA).
- Alternative B – Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment).
- Alternative C – Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment.

The action alternatives were 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 alternatives and to assess the effects of not conducting research for a potential wild horse population management tool.

A. Common to All Alternatives

1. Project Design Features

a. Monitoring

(1) Prior to returning horses to the range, hair follicle samples would be collected to assess genetic diversity of the herd, as outlined in Washington Office (WO) IM 2009-062, Wild Horse and Burro Genetic Baseline Sampling, or updated policy. Burns District BLM attempts to collect hair follicle samples for assessing genetic diversity of a herd at least each time a large proportion of an HMA is gathered. Hair follicle samples would be collected from a minimum of 25 percent of the post-gather population. Collecting DNA samples allows

BLM to closely monitor the genetic diversity of the herd and take appropriate management actions (i.e. translocation from other HMAs) when testing deems them necessary.

(2) Ongoing monitoring, by BLM, of forage condition and utilization, water availability, and animal health, as well as aerial surveys using the simultaneous double-observer method every 2–3 years, would continue on the Warm Springs HMA. A simultaneous double-observer method aerial survey is scheduled for June 2019. Population estimates for Warm Springs HMA would be updated as aerial population surveys are conducted in the future. 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.

b. Animal Handling

(1) Low stress handling techniques, as described in the BLM's Comprehensive Animal Welfare Program (IM 2015-151) or updated policy, would be used to ensure the safety of the animals and minimize stress to the extent possible during all activities where animals are handled including, but not limited to, routine processing, treatments, and transport.

(2) Decisions to humanely euthanize animals in field situations would be made in conformance with BLM IM 2015-070, Animal Health, Maintenance, Evaluation and Response.

B. Alternative A – No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA)

The no action alternative continues currently planned management for wild horses in Warm Springs HMA. Those management actions are provided for in the April 12, 2019 DR for the Warm Springs HMA Removals to AML DNA (DOI-BLM-ORWA-B050-2019-0009-DNA) and include returning wild horses to Warm Springs HMA to low AML (96 horses) with approximately a 50:50 sex ratio within calendar year 2019. This includes treating mares to be returned to the HMA with PZP-22 vaccine pellets, in accordance with BLM IM 2009-090, Population-Level Fertility Control Field Trials: Herd Management Selection, Vaccine Application, Monitoring and Reporting Requirements. PZP-22 vaccine pellets cost approximately $510 per mare treated. This includes the cost of one dose liquid primer (ZonaStat-H) and one dose time-release pellets, but does not include holding costs (approximately $5 per day per horse), application costs, or the cost to gather the horse for treatment.

An estimated 30 horses are currently on the range after the October 2018 gather. To reach low AML, approximately 66 horses would be returned in 2019. The BLM is scheduled to conduct a simultaneous double-observer method aerial survey of the HMA in June of 2019 to confirm the estimated number of horses remaining on the range and finalize the number of horses being returned to the HMA to reach low AML. Results of this survey would therefore influence the number of mares that would receive PZP vaccine; currently, that number is estimated at up to 33.

Aerial survey for population estimation would take place every 2–3 years following 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).

C. Alternative B – Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment)

The 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 herd behavior once returned to the range as compared with an untreated herd.

Under the proposed action, BLM is responsible for the care and selection of a candidate pool of horses for both the spay feasibility and on-range portions of the study. Selections would be made from wild horses captured during the 2018 Warm Springs HMA gather and currently being held at the Oregon Wild Horse and Burro Corral Facility. Horses would be randomly selected 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 gathered in October 2018 have received 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 have received a microchip implanted in a ligament in their neck for improved individual identification purposes. Those selected for return to the range 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 spay feasibility study would involve spaying 100 mares. The sample size of 100 was selected to increase the precision of the estimated mortality rate. The USGS on-range behavioral outcomes assessment would require two herd segments (control and treatment) with 100 total animals in each segment. See table 2.1 for the approximate age structure of both herd segments.

Table 2-1: Approximate age structure of control and treatment herd segments

Control side			
Age	**Female total**	**Male total**	**Total horses**
Foal	5	5	**10**
Yearling	6	6	**12**
2	3	3	**6**
3 to 5	13	13	**26**
6 to 10	13	12	**25**
11 to 15	7	8	**15**
>16	3	3	**6**
	50	**50**	**100**

Treatment side					
Age	**Treatment**	**Control**	**Female total**	**Male total**	**Total horses**
Foal	0	5	5	5	**10**
Yearling	0	6	6	6	**12**
2	0	3	3	3	**6**
3 to 5	11	2	13	13	**26**
6 to 10	10	3	13	12	**25**
11 to 15	5	2	7	8	**15**
>16	2	1	3	3	**6**
	28	**22**	**50**	**50**	**100**

NOTES: On the treatment side, 8 mares >3 years old across age classes will not be spayed to act as controls. All others (>3 years old) will be spayed.

Of the 100 mares treated in the spay feasibility study, approximately 28–34 would be returned to the range to make up the treated mare portion of the treatment herd segment. This alternative would require an on-range population of approximately 200 animals (control and treatment herd segments) plus the approximately 30 remaining on the range following the October 2018 gather (plus annual increase on these animals); the on-range population would be established at approximately 230 animals following the spay feasibility study. AML for wild horses in the Warm Springs HMA is 96 to 178. For accurate comparisons of the control and treatment herd segments in this on-range behavioral study, a sample size of 100 animals per group is necessary. Although this population would exceed high AML, this alternative utilizes returning sterilization as an action to move toward AML as provided for in the WHB Act. Because this is a research study, management above AML is temporary in nature and would occur for the duration of the study (at least 3 years). Following the completion of this study, additional future management actions would be needed in order for BLM to move toward a long-term plan for managing within AML. Future management actions would be subject to NEPA compliance and separate decisions.

To initiate the spay feasibility study, BLM would contract with an experienced veterinary team to conduct ovariectomy via colpotomy, and would monitor the mortality and morbidity rates of mares treated. BLM monitoring of the feasibility of the "spay" method would include, but not be 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 determining average surgery time.

The USGS would be responsible for radio collaring/tagging horses, studying herd genetics (with methods in addition to those identified in BLM's WO IM 2009-062, Wild Horse and Burro Genetic Baseline Sampling), and on-range behavioral observations. USGS's on-range behavior assessments would include, but not be limited to, topics such as 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 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 follow-up gathering 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 (with no treated (spayed) mares) and the other would be the treatment segment (with some treated mares present). Horses would be returned to the area of the HMA from which they were originally captured in order to discourage movement from one side to the other during the USGS on-range behavioral outcomes assessment. The horses gathered in October 2018 were marked based on which side of the HMA they were gathered from. This data was recorded when they were aged and freeze marked at the Oregon Wild Horse and Burro Corral Facility. Tracking the side of the HMA they came from was done to allow for the possibility that those animals selected for the study could be returned to their original home ranges. The terrain in this HMA 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.

1. BLM Spay Feasibility Action

This portion of the proposed action is considered the "off-range" portion and would take place at the Oregon Wild Horse and Burro Corral Facility in Hines, Oregon.

a. Objectives

(1) Determine the immediate outcomes of surgery, in terms of quantitative measures of surgery feasibility and success.

(2) Evaluate the immediate and short-term effects of the surgical procedure, in terms of morbidity and mortality, on free-roaming wild mares.
(3) Evaluate the short-term welfare impacts of the treatment on treated mares, using untreated mares for comparison.

b. Ovariectomy via Colpotomy Procedure

For the off-range portion of the study, BLM would contract veterinarians with the required experience of 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 related to the objectives related to the surgical portion of the project (described above).

Approximately 28–34 mares would receive ovariectomy treatment and, after recovery (at least 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 the same ovariectomy treatment in order to provide adequate statistical power to estimate the complication rate of this surgical procedure (in terms of morbidity and mortality) on wild horse mares with reliable accuracy and precision. The spayed mares in the second group would be observed and evaluated for 7 days for any complications from the treatment, but would not be returned to the HMA. These 70 spayed mares would remain at the Oregon Wild Horse and Burro Corral Facility and enter the adoption or sale program after the completion of the off-range portion of the study. All mares would receive veterinary care if needed while at the Oregon Wild Horse and Burro Corral Facility.

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.

The approximately 100 mares receiving treatment would be adult females, 3 years of age and older and spread over various age classes. Due to these mares having been held at the Oregon Wild Horse and Burro Corral Facility since the October 2018 gather they are either currently in the later months of pregnancy, have given birth, or are open (not pregnant). The mares have been held separate from stallions since capture. Mares selected to receive the surgical procedure as part of the study would be open. The overall sample size of about 100 is needed to provide adequate statistical power to estimate the complication rate (in terms of morbidity and mortality) with reliable accuracy and precision. A smaller number of approximately 50 mares that are not slated to be returned to the HMA will serve as control animals; these will not be surgically treated and will be monitored for morbidity and mortality outcomes. The sample size would allow for the ability to obtain accurate estimates of the complication rate typical for the procedure, 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 and morbidity rate due to the treatment, with an expected 95 percent confidence interval of between 0 and 10 percent if the estimated overall rate is 3 percent or lower.

For this study, BLM only plans to treat open mares because those mares captured in October from Warm Springs HMA are now entering the later stages of pregnancy or have a foal at their side. Treatments could begin around August 2019 once all mares selected to receive the surgery are open, and if they have a foal, the foals are at least 2 months of age.[3]

Sixty to seventy-five percent of adult mares (≥3 years old) that would be returned to the treatment herd segment would be spayed. This means that about 30 mares in total would be treated and returned to the range, depending on the age structure of the herd. This would leave about 8 unsterilized adult mares, plus approximately 6 female juveniles and 6 female foals in the treatment segment. As noted above, no juveniles or foals would be treated. The study categorizes mares in terms of age and body condition so that treated and control mares can be paired for behavioral outcome comparisons. Mares with (Henneke et al. 1983) body condition scores of ≤3 would not be spayed. Otherwise females would be randomly selected within blocks for treatment.

Mares 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 that 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 be administered further detomidine, Xylazine, or 100 mg of ketamine hydrochloride. Anti-inflammatory/analgesic (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. At that point,

[3] An August 2019 start date is estimated because approximately 50 percent of mares ultrasounded in November, following the October 2018 gather, were in the range of 4–5.5 months pregnant, about 34 percent were open, and the remaining 16 percent were between 1–3.5 months pregnant.

any mare that is determined to be pregnant would be removed from the pool of animals for surgery. For mares that are confirmed to be open (not pregnant), 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 as aseptic as practicable. 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 vaginal muscle fibers so the incision decreases in length when the tissues contract after the 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 anesthetic mixture injected into 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. Reducing blood flow at the site of the injection of the anesthetic mixture should prolong the effect of the local anesthetics at the surgical site and may reduce the risk of hemorrhage. The anesthetic preparation would be 1 ml of 1:1000 epinephrine for injection added to 100 ml of the lidocaine/bupivacaine mixture. 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, soaked in Chlorhexidine, and rinsed with sterile saline between procedures. 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.

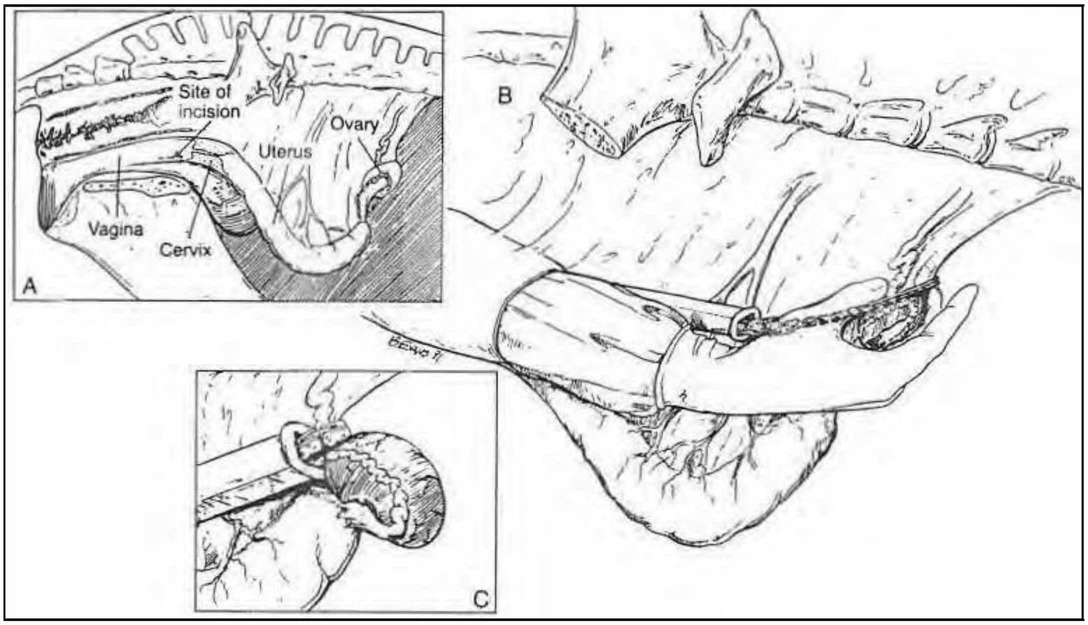

Figure II-1: (A) The site for the vaginal incision is located ventrolateral and caudal to the cervix. (B) After the ovarian pedicle is well anaesthetized, the chain loop of the ecraseur is positioned over the hand so that the ovary can be grasped and drawn inside the loop. (C) After ensuring that only the ovarian pedicle is within the loop, the anesthetized 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 for further observations until they are returned to the range or made available for adoption.

Short-term effects of the treatment on animal welfare would continue to be monitored for one week after surgery. 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. Control mares returning to the range would also be monitored three times a day for a week with the same indicators measured to have a comparison for the group of mares who received surgery. 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 additional postoperative antibiotics would be given because the long-lasting antibiotics given at the time of surgery are expected to provide adequate antimicrobial effect.

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. For animals that will return to the HMA, no further veterinary interventions would be possible after they have been released to the range.

c. Opportunity for Public Observation

At the Oregon Wild Horse and Burro Corral Facility in Hines, Oregon, visitors are 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 Wild Horse and Burro Corral Facility would be in accordance with IM ORB-000-2018-004, Oregon Wild Horse and Burro Corral Facility Access for Visitors (Appendix D).

Public viewing of collaring/tagging (described below) and surgery would be permitted and managed by BLM. Photos of the Oregon Wild Horse and Burro Corral Facility can be found in appendix E. The public may observe the collaring/tagging and ovariectomy via colpotomy procedures by complying with the following protocol and procedures:

(1) An observation area connected to an office space (historically not accessed by the public) adjacent to the working chute would be constructed to allow for public observation. The observation area would be within 15 feet of the working chute. Photographs of the working chute as seen from the location of the planned observation area, where public can safely observe, are shown below. Observers can also photograph/film from this location. This is a temporary observation area for the surgeries and collaring proposed in this EA.

Figure II-2: View from planned 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.
(5) To ensure the safety of animals, public observers, and BLM and veterinary staff, public observers would 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 would be removed and not allowed to return for the duration of the time when surgeries are conducted.
(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 a person expresses interest, the higher in the observation order that person's 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, the public would be allowed to observe these horses from the self-guided auto tour.

The BLM has an overriding interest in ensuring the safety of the horses that are undergoing the ovariectomy procedure, the public observing the procedures, the contracted veterinarians and assistants performing or assisting with the procedures, and BLM employees who are responsible for moving the horses into and out of the chute and working barn. The BLM also has an overriding interest in effectively and efficiently performing ovariectomy via colpotomy procedures on the horses.

The BLM has determined that the observation area described above will allow the public the opportunity to observe the procedures, while also furthering BLM's overriding interests. Regarding safety, in order for BLM to perform the ovariectomy procedures on the horses, BLM will need to move horses into and out of the barn and working chute. The process of moving wild horses into confined spaces can be dangerous for both the horses and anyone in the immediate vicinity. The observation area location was selected because it is adjacent to the chute and provides a very good vantage point of the procedure being performed, while also ensuring the safety of the observers during this process (i.e., if horses were to break lose or become agitated they would not injure the observers).

Moreover, keeping the observers at a safe distance allows BLM employees and contractors to focus on their own safety and the safety of the horses without the added distraction of worrying about observers' safety. Having observers inside the designated observation area would also reduce any additional human-induced stress to the horses prior to or during the procedure. Additional stress to the horses could cause them to become agitated, which would be more dangerous for both the horses and the BLM employees and contractors near the horses.

The designated observation area would allow BLM to perform the ovariectomy procedures both effectively and efficiently because it would reduce interference (intentional or unintentional) with the procedures and distraction of BLM employees or contractors. Therefore, BLM employees and contractors would be able to focus on moving the wild horses into the barn and working chute as quickly as possible, providing the horses with focused and conscientious care during the procedures, and helping the horses leave the working chute and enter the corrals for their recovery time. The BLM's overriding interests and explanation for its proposed observation area outlined above also apply to the collaring and tagging portions of this proposal.

2. USGS On-Range Behavioral Outcomes Assessment

a. Objectives

With cooperative assistance from BLM, USGS would be responsible for addressing the following research objectives.[4]

(1) 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.
(2) 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.
(3) 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 segment females, 22 control herd segment females, and 12 stallions from each herd segment) within treatment and control herd segments of the population throughout the year.
(4) 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.

b. Radio Collaring/Tagging

In addition to BLM's IM 2012-151, animal handling for radio collaring/tagging 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).

USGS would be responsible for the radio collaring/tagging 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.

The cost of radio collars, emergency drop-off mechanisms and replacements, radio tags, 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.

[4] Not all wild horses were collected during the October 2018 gather and approximately 30 animals remain on the range. 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 actively observing the animals that have been returned to the HMA.

See Appendix C, USGS Research Proposal (August 2018), for the budget breakdown.

At the Oregon Corral Facility, a sample of up to 100 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, greater than or equal to 3 years old, selected for GPS location monitoring would receive radio collars, while stallions selected for location monitoring would be tracked with radio tags braided into their 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 would be stratified by adult age class (3–5, 6–10, 11–15, >16 years old). A body score of 4 or greater 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 tail 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 any body condition. However, such animals would likely not be selected by BLM as candidates for return to the range and would therefore not be included in the study. The forty stallions (20 per herd segment) to be fitted with tail tags would be selected randomly but stratified by the same adult age classes.

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 the effects on horse welfare of wearing a radio collar, 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. Tail tags are expected to drop off the animal as the tail hair grows out, in 6 to 18 months. Collars are designed to be removed without having to recapture the animals. In addition to having a drop-off mechanism with a release date scheduled to coincide with the end of the study (about October 2022), 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 other appropriate methods, depending on the best option for the specific situation.

c. Herd Genetics

The BLM would submit a sample of hair follicles for standard genetic monitoring, in keeping with IM No. 2009-062. The USGS would be responsible for portions of the proposed action related to additional genetic analyses. While horses are at the BLM facility, USGS would collect hair follicles from all individuals that would be returned to the range. Also, fecal samples from foals born after animals are released back to the HMA, and from any individuals that were not captured during the 2018 gather, would be collected throughout the study. DNA from these hair follicle and fecal samples would be analyzed to form an estimated pedigree of both herd segments, enabling USGS 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 parentage rate of non-harem holding stallions, and could contribute to estimates for the age of first reproduction for mares. These parameters could be used in future population dynamics modeling for this herd.

d. On-Range Behavioral Observations

The BLM would return animals to the control and treatment herd segments (100 to each) as soon as possible following the 7-day post-surgery monitoring. All horses to be returned to the range would be returned in the same general time period.

USGS would then begin animal welfare checks at least once per month, to monitor the welfare of animals with radio collars. Observations recorded during these welfare checks would also allow for comparisons of treated and untreated mare body condition scores. On-range behavioral observations would be conducted during the breeding season (March to September) each year, beginning the March after animals are returned to the range. Waiting to begin intensive behavioral observations until March allows time for social groups to re-establish over the winter after the release is completed.

Behavioral observation data would allow researchers to test whether spaying affects social behavior of treated mares and the animals they associate with. Individual horses would be referred to by the last four digits of their unique BLM numeric identifier. Behavioral observations would be conducted on focal[5] animals

[5] 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

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 focal 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). The identity of 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 untreated 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, USGS intends 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 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-scale 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

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.

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), affiliative behavior (e.g., mutual grooming, touch), and reproductive behavior (e.g., estrous 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.

e. Population Level Effects

Aerial surveys for population estimation would take place in June 2019 across both herd segments before horses selected to be returned to the range are released and then once or twice annually for the remainder of the study. Population estimation would follow 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 ground observers that visually observe 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.

f. Schedule

Year 1 (September 2019–September 2020)

(1) June 2019: Conduct aerial survey of the HMA to reassess the number of adult horses remaining on the range following the 2018 gather.
(2) ~ July to August 2019: Place radio tags on up to 20 adult males and radio collars on up to 30 females in treatment herd segment and the same number in the control herd segment. Collect tail hair follicle samples from every individual that would be returned to the HMA (200 total) for genetic analysis.
(3) ~ August 2019, depending on availability of mares. 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 following 7-day surgery recovery period and initiate field study. Begin locating radioed individuals 1–2x per month to check welfare effects of collars or tags, body condition, and presence of foals. Throughout winter 2019/2020, 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 2019/2020, fly aerial surveys in both treatment and control segments of the HMA.

(8) March to September 2020, 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 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 per month to check welfare effects of 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.

Year 3 (October 2021–September 2022)

(1) Winter 2021/2022, fly aerial surveys in both treatment and control segments of the HMA.
(2) Continue the field study; locate radio-collared individuals 1–2x per month to check welfare effects of collars, body condition, and survival, and record presence of foals.
(3) March to September 2022, 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 2022), BLM will open the gates in the fence that separates the two segments of the HMA.

Year 4 (October 2022–August 2023)

(1) USGS will conduct data analyses and publish papers on the on-range behavioral outcomes assessment.
(2) The BLM will consider management actions to return the Warm Springs HMA to AML.

g. 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).

D. Alternative C – Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment.

Under alternative C, BLM would conduct the spay feasibility action, the same as outlined in Alternative B – Proposed Action, and conduct a limited on-range behavioral outcomes assessment with an on-range population at low AML (96 horses). Horses returned to the HMA would not be divided into two herd segments, but rather would have access to the entire HMA. USGS would not be involved in this assessment, and the BLM would not expend funds for this specific research project.

1. BLM Spay Feasibility Action

The same objectives, ovariectomy via colpotomy procedure, and opportunity for public observation described in the section titled BLM Spay Feasibility Action of the proposed action alternative would be followed under this alternative.

Just as described in the proposed action, under this alternative a total of up to 100 mares would be spayed using ovariectomy via colpotomy. Up to 33 mares would be treated and returned to the HMA, while an additional 70 mares (not returning to the HMA) would be treated in order to provide adequate statistical power to estimate the complication rate of this surgical procedure on wild horse mares with reliable accuracy and precision. As described in the proposed action, these 70 spayed mares (not returning to the HMA) would remain at the Oregon Wild Horse and Burro Corral Facility and enter the adoption or sale program after the completion of the off-range portion of the study. Despite the difference between returning to low AML (alternative C) as compared to the USGS on-range assessment (alternative B), where 200 animals plus those remaining on the range following the 2018 gather (approximately 30 horses) would establish the on-range population, the same number of mares would be spayed under this alternative. Therefore, the same objectives of the BLM spay feasibility action described in alternative B would apply in this alternative.

***Calculation for treating and returning 33 mares*:The low end of AML for wild horses in the HMA is 96 animals. It is assumed that a 50:50 sex ratio of the 30 adult horses remaining on the range exists. Therefore, a 50:50 ratio of the remaining 66 animals to reach low AML would be returned to the range. This means up to 33 mares (up to 68 percent of the adult mare population) would be spayed and returned to the range. Up to 33 adult stallions would also be returned to the HMA. The number and estimated sex ratio remaining on the range may be adjusted following the scheduled June 2019 aerial survey; however, BLM would aim for a goal that no more than 68 percent of the adult mare population on the range after horses are returned would be treated.

Differences from Alternative B – Proposed Action:

- Only spayed mares (no stallions or untreated mares) would receive the freeze mark on their left hip with the last four numbers of their BLM identifier.
- No horses would be radio collared or tagged under this alternative.
- No further herd genetics monitoring would occur beyond BLM’s standard assessment following guidance in WO IM 2009-062, Wild Horse and Burro Genetic Baseline Sampling, or updated policy.
- Foals would not be returned to the range, in keeping with typical practice during most selective, AML gathers in Oregon. Animals returned to the range would be selected to represent all age classes, with the exception of foals.

- Less information would be collected related to on-range behavioral outcomes, as described below.

2. Limited On-Range Behavioral Outcomes Assessment

a. Objectives:

(1) Record observations that may inform whether or not spayed mares are always present in harem bands.
(2) Using the Henneke and others (1983) body condition scoring system, determine whether or not spayed mares differ in body condition scores, compared to non-treated mares.
(3) Estimate apparent survival rate of treated mares compared to untreated mares during future gather events and opportunistic ground-based observations.
(4) Estimate annual population growth rates for the herd based on annual surveys from 2019–2022, and then every 2–3 years after that.

b. Herd Genetics

As described in the section titled Common to All Alternatives, BLM would collect hair samples from horses returning to the range to assess genetic diversity of the herd, as outlined in WO IM 2009-062, Wild Horse and Burro Genetic Baseline Sampling, or updated policy. Collecting DNA samples allows BLM to closely monitor the genetic diversity of the herd and take appropriate management actions (i.e. translocation from other HMAs) when testing deems them necessary.

c. On-Range Behavioral Observations and Population Level Effects

The BLM would return all animals selected to be returned to the HMA to re-establish low AML as soon as possible following the 7-day post-surgery monitoring period. All horses to be returned to the range would be returned in the same general time period.

Collection of data to achieve all on-range objectives would occur during opportunistic observations of horses during normal HMA monitoring activities and during aerial inventories. Treated mares would have received a four digit freeze brand on their left hip to aid in identification on the range. This would allow BLM to determine if treated mares are being accepted as part of harem bands. Observations of treated and untreated mares would be made opportunistically, allowing for comparisons of body condition scores. Estimates of apparent annual survival rate for treated mares would be possible, based on observations of numbered animals that are observed opportunistically during ground-based observations. In contrast to known fate survival analyses for animals with radio telemetry devices, analyses based on marked mares will need to account for imperfect detection rates, using a mark-recapture analysis framework (White and Burnham 1999). Comparisons of relative survival rates for treated versus untreated mares may also be possible based on capture rates during future gathers (Collins and Kasbohm 2016). Aerial surveys of the entire HMA would occur in 2019 (prior to returning horses to the HMA), in 2020 (the spring after surgeries and release to the HMA), in 2021, and in 2022. Population estimation would follow set BLM guidelines for counting wild horses using the simultaneous double-observer method (Lubow and Ransom 2016) recommended by BLM policy (BLM 2010, IM 2010-057, or updated policy). Estimated herd size values from these aerial surveys would allow BLM to estimate 1-year values for population growth rate for 2019–2020, 2020–2021, and 2021–2022. After the 2022 inventory, this HMA would return to the every 2–3 year cycle typically conducted on Oregon HMAs. From that point on, growth rate estimates would be based on aerial surveys that take place every other year (or every third year). Where there are two years between surveys, estimated average annual growth rate (λ) is the square root of the ratio, $\widehat{N}_{t+2}/\widehat{N}_t$, where $\widehat{N}_t$ is the estimated herd size in any given year, and $\widehat{N}_{t+2}$ is the estimated herd size two years later. Similarly, where there are three years between surveys, estimated average annual growth rate (λ) is the cube root of the ratio, $\widehat{N}_{t+3}/\widehat{N}_t$. As a percentage, annual growth rate is 100 times (λ-1); for example, if λ=1.15, then the growth rate as a percentage is 15 percent.

d. Schedule

Year 1 (April 2019–December 2019)

(1) June 2019: Conduct aerial survey of the HMA to reassess the number of adult horses remaining on the range following the 2018 gather.
(2) ~July to August 2019: Collect hair samples to assess genetic diversity of the herd, as outlined in WO IM 2009-062, Wild Horse and Burro Genetic Baseline Sampling, or updated policy.
(3) ~July–August 2019: Depending on availability of selected mares based on when they foaled, conduct ovariectomy surgery on up to 33 mares to be returned to the HMA. Conduct ovariectomy surgery on an additional 70 mares that would not be returned to the range.
(4) Conduct post-surgery recovery assessments.
(5) Return all mares and stallions to the HMA following the post-surgery recovery period. Continue normal on-range monitoring activities including recording observations of body condition for treated and untreated animals, presence or absence of treated mares in harem bands, and general animal welfare.

Year 2 (January 2020–December 2020)

(1) Continue normal on-range monitoring activities including recording observations of body condition for treated and untreated animals, presence or absence of treated mares in harem bands, and general animal welfare.
(2) June 2020: Conduct aerial survey to estimate population and observe presence or absence of treated mares in harem bands as well as general animal welfare, including body condition.

(3) The BLM would conduct data analyses and write up results for effects of the surgery feasibility assessment.

Year 3 (January 2021–December 2021)

(1) Continue normal on range monitoring activities including recording observations of body condition for treated and untreated animals, presence or absence of treated mares in harem bands, and general animal welfare.
(2) June 2021: Conduct aerial survey to estimate population and observe presence or absence of treated mares in harem bands as well as general animal welfare, including body condition.

Year 4 (January 2022–December 2022)

(1) Continue normal on-range monitoring activities including recording observations of body condition for treated and untreated animals, presence or absence of treated mares in harem bands, and general animal welfare.
(2) June 2022: Conduct aerial survey to estimate population and observe presence or absence of treated mares in harem bands as well as general animal welfare, including body condition.
(3) December 2022: The BLM would conduct data analyses related to assessments of treated mare apparent survival rates, annual herd growth rates, and on-range behavioral outcomes.

E. Alternatives Considered but Eliminated from Detailed Analysis

The BLM is currently investing in a diverse portfolio of research projects to develop new technologies and methods for wild horse and burro management. Research is being conducted by scientists from universities, State agencies, non-governmental organizations, and the USGS in cooperation with the BLM. A brief description of on-going and recently completed BLM-funded research can be found at https://www.blm.gov/programs/wild-horse-and-burro/herd-management/science-and-research. The BLM-funded studies related to population growth suppression include, but are not limited to, multiple studies for further development and application of long-lasting PZP and GonaCon vaccines, feasibility of dart-based PZP application in burros, evaluating behavior of neutered males among a breeding herd, and evaluating the use of contraceptive intrauterine devices in mares.

There are a number of techniques for the surgical and non-surgical, temporary contraception or permanent sterilization of a mare. However, only a handful of methods have been considered for use in wild horse mares due to the constraints of working with wild animals in non-clinical settings and the potential efficacy of treatment. Below are alternatives that have been considered but eliminated from detailed analysis.

1. 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 when discussed in Bowen (2015), it is a method that would not appear to be logistically applicable for wide-scale application in BLM-managed 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 making 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 costs at least $450–$500 per mare (Bowen et al. 2015), but with inflation since 2015 may be higher. The procedure involves three small incisions on each flank of the animal, through which three cannulas (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. Flank laparoscopy may leave three small (<5 cm), visible scars on each side of the horse's flank, which would be subject to infection and dehiscence. It may be possible to access both ovaries from one side of the animal, using longer surgical tools. Because of the three or six external wounds, domestic 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 that prevent them from rolling or interacting with other horses. Restraint for long periods of time (days) would induce additional stress on a wild animal as well as added risk when the treated animals would fight the restraint. Fowler (2008) cautioned that, "Animals may become overstimulated with an epinephrine rush during restraint procedures. They may be inclined to and capable of, feats of athleticism beyond imagination"; such struggles could cause unnecessary injury. Furthermore, rolling on the ground is not conducive to external 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. However, as noted above, preventing (by restraint) wild horses from rolling is not expected to be safe for the animal.

Previous use of flank laparoscopy, or other flank approaches, for ovariectomy on ungentled mares is unknown to BLM. Therefore BLM must reach out to experts, as was done through Bowen (2015), for interpretation of the potential applicability of this technique on wild horses. The above discussions indicate to BLM that until adjustments are made to this technique showing that this method can be successfully demonstrated in conditions that are comparable to those expected for wild horse mares, spaying via flank laparoscopy may be technically infeasible for application due to the higher risk of infection at external incision sites, the time required to perform each surgery, and the post-surgical care requirements. This method also would not respond to the purpose and need for action described above, which is specific to ovariectomy via colpotomy.

2. Laparoscopic-Assisted Colpotomy for Ovariectomy

This alternative proposes the use of a laparoscope to assist with visualization of the ovaries during an ovariectomy via colpotomy. The rationale for why laparoscopic-assisted colpotomy was not considered and analyzed further is comparable to that described in "Spaying via Flank Laparoscopy" (above). This procedure conducted on domestic horses in a veterinary teaching hospital costs approximately $2,500 per mare (including two nights' board). To BLM's knowledge, this procedure has never been conducted on ungentled mares and, therefore, best estimates for costs in a field setting and in larger quantities of wild mares would be approximately $750 to $1,500 each. This procedure does allow the surgeon to visualize the ovaries prior to removal, which has potential to reduce risks associated with transection of the ovary and associated bleeding at that location. However, the inclusion of laparoscopy requires an increased duration (at least 20–30 minutes for bilateral ovariectomy as per Tate et al. 2012), which adds stress to an already stressed animal; requires insufflation of the abdomen, which can cause post-laparoscopic pain due to the pneumoperitoneum created (Devick et al. 2018); and requires external (flank) incisions for insertion of the laparoscope, which necessitates post-operative restraint and increases the risk of infection (discussed above). In the transcript of Bowen (2015, p. 17) it was discussed that a laparoscope could be used to train veterinarians in ovariectomy via colpotomy, but it would not likely be preferred for field conditions and wild horses due to the reasons described above.

3. 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. The BLM received a proposal to study these techniques in 2015, and in 2016 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 estimated cost of treatment per animals was $150–$250 and $75–$125, respectively. 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 in Oregon, and the study proposed to have taken place in 2016 did not take place. Expected outcomes of these techniques remain speculative because they have not been tested on wild horse mares. In addition, there have been no proposals submitted to BLM to test these techniques since the withdrawal of the 2016 study. 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 successfully in feral mares (Collins and Kasbohm 2016). Neither tubal ligations nor laser ablation of the oviduct papilla would respond to the purpose and need for action described above because the purpose and need was specific to ovariectomy via colpotomy and the on-range behavioral response after removing ovaries from the mare.

4. Medical Cyanoacrylate Glue to Block Oviduct

This alternative would be predicated on the use of medical cyanoacrylate glue to block the oviducts and prevent pregnancy in the mare: a non-surgical option for sterilization. The objective of the method is to sterilize mares non-surgically and allow continued normal estrus cycling post treatment. Currently there is a pilot project that made use of this type of adhesive on six domestic mares. This pilot project included treatment of six mares and has shown that after three years of breeding by a fertile stallion, all six mares failed to become pregnant (Dr. I. Liu, UC Davis Emeritus Professor, personal communication to BLM). The procedure also takes only 15 to 20 minutes per mare. This technique does show promise yet has some limitations when being considered for use in wild horse mares. These limitations include:

- It can only be applied in open (non-pregnant) mares. Because a majority of mares gathered by BLM are pregnant, there would be limited applicability for wild horse mares.
- Current estimated costs per mare range from $750–$1,000.
- A three person team of experts is required to manipulate and operate an endoscope monitor, insert and hold the endoscope, manipulate and position a fine-tipped catheter into the oviduct, and infuse the fluid into the oviduct. Such teams are not expected to be widely available. Only a handful of theriogenologists in the world have adequate expertise to use this method successfully, and there would be a steep learning curve for others interested in applying the technique. The difficulty of the method and the small number of practitioners worldwide who might consider it stand in contrast to ovariectomy via colpotomy, which is a long-established technique practiced by more veterinarians in the United States.

There have been no formal research proposals submitted for BLM review for research that would test this technique on wild horse mares. Unlike the application of ovariectomy via colpotomy, this technique has never been demonstrated to be safe or effective in feral horses. This method would not respond to the purpose and need for action described above, which is specific to ovariectomy via colpotomy and the on-range behavioral response after removing ovaries from the mare.

5. PZP Vaccine for Population Growth Suppression

This alternative would begin with a helicopter gather to capture up to 100 percent of the animals in the HMA (such as the one conducted in October 2018) in order to identify and document mares, and treat some mares with PZP immunocontraceptive vaccine prior to returning them to the range. Up to 90 percent of the mares released following the gather would be treated with the 2-injection liquid PZP vaccine (ZonaStat-H; Science and Conservation Center, Billings, Montana) or the PZP-22 vaccine pellets.

The cost of liquid PZP is approximately $35 per dose. The cost of PZP-22 is approximately $510 per dose. This includes the costs of one dose liquid primer and one dose time-release pellets. Holding and application costs—approximately $5 per day per horse—are in addition to those costs. By far the greatest cost of the method is the cost to capture the animals. Wild horses in Warm Springs HMA are not approachable enough to be darted.

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 foaling 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 for most treated mares (Turner et al. 1997). Some mares given the standard 2-injection liquid PZP vaccine protocol will become fertile the second breeding season following the treatment but some will remain infertile for another year or even 2 years, thus, there should be some marginal 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 reliably 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 contraceptive would be more desirable for long-term (3–5 years) population management, specifically in HMAs where wild horses are inaccessible. No such PZP vaccine formulation is currently available. 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, but that a single PZP booster administered 2–3.2 years later effectively reduced fertility to some extent across 3 consecutive years (Rutberg et al. 2017). Whether delivered by dart or by hand, PZP vaccine boosters reduced foaling rates in treated mares by roughly 65–72 percent relative to untreated control mares over 3 years (Rutberg et al. 2017). The authors interpreted these results to be indicative of a certain flexibility in the timing of booster application after initial treatment with PZP-22, because their data suggested that the interval between initial and booster treatments (2–3.2 years) did not decrease the effectiveness or longevity of the booster (Rutberg et al. 2017). Their findings provide evidence of a double-treatment, multi-year contraceptive, which has been interpreted by some to be a step toward improving vaccine longevity. While the contraceptive efficacy from this PZP-22 then PZP booster treatment protocol may be effective at slowing herd growth rates, the levels of fertility reduction shown in Rutberg and others (2017) would not be effective enough to substantially reduce herd growth rates, even if 100 percent of mares were to be treated. The study by Rutberg and others (2017) involved a booster dose of PZP-22 that was remotely delivered, but 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.

In order to maintain low population growth rates on the range in the long term, it is expected that the great majority of mares would need to be treated with annual remote darting with 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 exceptional HMAs 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 for the Warm Springs HMA, but it could be useful in some scenarios in other HMAs (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 (nearly 500,000 acres), and mares there are not easily approachable. The BLM has demonstrated its support for the development and testing of different methods and techniques for long-term population growth suppression, including surgical sterilization, which could be applied to horses in HMAs with limited access and other constraints. Given the current logistic constraints, it is expected that intensive fertility control using PZP to remotely dart horses would be ineffective and technically infeasible for population control in this HMA. This alternative would not respond to the purpose and need for action described above because that was specific to ovariectomy via colpotomy and the on-range behavioral response after removing ovaries from the mare.

6. Population Growth Suppression with GonaCon.

GonaCon is an immunocontraceptive vaccine that has been shown to provide multiple years of infertility in several wild ungulate species, including horses (Killian et al., 2008; Gray and Cameron 2010). GonaCon uses the gonadotropin-releasing hormone

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

This alternative would begin with a helicopter gather to capture up to 100 percent of the animals in the HMA in order to identify and document mares and treat with GonaCon-Equine prior to returning them to the range. Up to 90 percent of the 2 year old or older mares released following the gather would be treated. Future treatments with GonaCon would be required to maintain effective population growth suppression in order to reduce the interval between necessary gathers and removals once AML is exceeded.

The cost of GonaCon is approximately $50 per horse dose (2 mL @ $25 per mL). Holding and application costs—approximately $5 per day per horse—are in addition to those costs. By far the greatest cost of the method is the cost to capture the animal, because wild horses in Warm Springs HMA are not approachable enough to be darted.

GonaCon-Equine has been used on feral horses in Theodore Roosevelt National Park (Baker et al. 2018) and on wild horses by BLM (BLM 2015). GonaCon-Equine can be remotely administered in the field in cases where mares are relatively approachable, using a customized pneumatic dart (McCann et al. 2017). Use of remotely delivered (dart-delivered) vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached within 50 meters (BLM 2010).

The NRC (2013) review pointed out that, in horses, single doses of GonaCon-Equine do not typically lead to high rates of initial effectiveness, or long duration. Initial effectiveness of one dose of GonaCon-Equine vaccine appears to be lower than for a combined primer plus booster dose of the PZP vaccine Zonastat-H (Kirkpatrick et al. 2011), and the initial effect of a single GonaCon dose can be limited to as little as zero or one breeding seasons, although in some mares a single dose can cause contraceptive effects for longer than one year. However, preliminary results on the effects of boostered doses of GonaCon-Equine indicate that it can have high efficacy and longer-lasting effects in free-roaming horses (Baker et al. 2018) than the one-year effect that is generally expected from a single booster of Zonastat-H. GonaCon formulations were consistently good at causing loss of fertility in a statistically significant fraction of treated mares for at least one year (Killian et al. 2008, Gray and

Cameron 2010, Baker et al. 2013). GonaCon effectiveness in free-roaming populations resulted in infertility rates consistently near 60 percent for 3 years after a single dose in 1 study (Gray and Cameron 2010) and annual infertility rates decreasing over time from 55 percent to 30 percent to 0 percent in another study with 1 dose (Baker et al. 2017). Baker and others (2018) observed a return to fertility over 4 years in mares treated once with GonaCon, but then noted that fertility rates reduced by 100 percent in the first year after mares were given a booster dose 4 years after their primer dose, then approximately 85 percent for the following 3 years. These are extremely promising preliminary results from that study in free-roaming horses; a fifth year of post-booster monitoring is ongoing in summer 2019, and researchers on that project are currently determining whether the same high-effectiveness, long-term response is observed when GonaCon is boostered after 6 months, 1 year, 2 years, or 4 years after the primer dose.

Application of a single dose of GonaCon-Equine to gathered or remotely-darted wild horses could be expected to prevent pregnancy in perhaps 30 percent to 60 percent of mares for one year, 20 to 30 percent in the second year, and less still for a third year. Applying 1 booster dose of GonaCon to previously-treated mares should lead to 4 or more years with relatively high rates (80+ percent) of additional infertility expected, with the potential that some as-yet-unknown fraction of boostered mares may be infertile for several to many years. There is no data to support speculation regarding efficacy of multiple boosters of GonaCon-Equine; however, given it is formulated as a highly immunogenic long-lasting vaccine, it is reasonable to hypothesize that additional boosters would increase the effectiveness and duration of the vaccine.

Nevertheless, Warm Springs HMA is a large HMA (nearly 500,000 acres), and mares there are not easily approachable. Due to the limited approachability of the horses and limited access within the HMA, horses would likely need to be gathered once again for application of any booster doses of GonaCon.

The BLM is currently funding the re-immunization of free-ranging horses with GonaCon vaccine study cited above by Baker and others (2018) and is anxious to see final results after summer 2020. Despite promising early results, BLM manages wild horses in an array of HMAs with access limitations and with horses of varying approachability and, therefore, must continue to explore the use of different methods and techniques for long-term population growth suppression.

This alternative would not respond to the purpose and need for action described above because it was specific to ovariectomy via colpotomy and the on-range behavioral response after removing ovaries from the mare.

7. Male Based Population Growth Suppression using Vasectomy or Gelding

Vasectomy is a method of fertility control that could be effective in reducing wild horse and burro reproductive rates in some circumstances. In principle, this method could be used as a part of herd management by itself or in conjunction with other fertility control methods. The use of vasectomy in wild or feral horses has been addressed in peer-reviewed scientific papers (e.g., Asa 1999, Scully et al. 2015, Collins and Kasbohm 2016). Previous work has shown that vasectomizing feral horses contributed to some degree of reduction in female fertility (Collins and Kasbohm 2016). However, a general concern with male-based fertility control for wild horses is the expectation that female fertility rates will not decline in direct proportion to the fraction of males treated (Garrott and Siniff 1992). Although sterilization of dominant males may be an effective treatment to reduce foaling in a small sample of bands selected from a population, this treatment might not limit population growth (Eagle et al. 1993). That is to say, mares in bands with a vasectomized or gelded stallion can mate with multiple stallions and still get pregnant. In contrast, female-based fertility control (especially via spaying) leads to a direct reduction in the expected number of foals produced by a herd. In terms of the number of animals that would need to be sterilized to lead to a given reduction in growth rates, spaying is expected to be a more effective form of fertility control than vasectomy or gelding.

Gelding could be a technique used in other HMAs. In fact, a similar on-range behavioral outcomes study where a portion of the stallions were gelded is currently being conducted in Utah (BLM Utah 2016). Therefore, vasectomy and gelding are not being considered further in this EA because they would have substantially similar effects to a study that is already in progress. Studying gelding or vasectomy of stallions would not meet the purpose and need of this EA.

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 in this EA, the wild horse apparent annual population growth rate using 2016 and 2018 simultaneous double-observer survey data was 16 percent. 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 wild horses in this EA, results from the modeling exercise for alternative C, "…provide a median average population growth rate in 5 years of 5.8 percent with a total population of 132 horses by 2025. This means that by spaying up to 33 mares (~68 percent of the adult mare population), the population growth rate would drastically decrease from the estimated 16 percent described in the Wild Horses affected environment section...."

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. There are no known RFFAs outside of routine maintenance and regularly permitted activities planned within Warm Springs HMA.

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 public scoping and comment periods on previous proposals, the BLM Burns District IDT has reviewed and identified issues affected by the alternatives.

1. Wild Horses

The following issues are addressed in this section.

- *What are the anticipated complications and rate of complications associated with the ovariectomy via colpotomy procedure?*
- *Would the mare continue to have an estrus cycle following this procedure?*
- *What would be the anticipated long-term effects (i.e. body condition and survival rate) of the surgical procedure on mares?*
- *What are anticipated on-range effects on herd dynamics (such as, reproductive behaviors, harem band structure, and spatial ecology) following the release of spayed mares?*
- *What are the anticipated effects on bone histology after ovariectomy?*
- *What are the anticipated effects of PZP vaccine on the mare and her behavior?*
- *How would the alternatives contribute to achieving AML and affect the ability of the Warm Springs HMA wild horse herd to continue to grow?*

- *How would the alternatives contribute to the maintenance of genetic diversity of the 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 anticipated effects of each alternative on the population growth rate of wild horses in the Warm Springs HMA?*
- *How would the alternatives affect the frequency of gathers to remove excess animals?*

a. Affected Environment – Wild Horses

Herd Management Planning and Land Use Plan Allocations

In 1979, the first Warm Springs Equine Herd Management Area (HMA) Plan was written to "protect, manage, control, and maintain a viable population of wild horses 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 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" (pp. 10–11). The plan recommended an objective to maintain a herd of 111 to 202 horses (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" (p. 3).

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." When discussing burro management, the procedures to implement portion of this same RMP section states, "the minimum management number will be maintained at 15." This allocation of 15–24 burros within the total AML allocation provides a wild horse AML of 96–178.

Wild Horses of Warm Springs HMA

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

Inventories and Estimated Annual Population Growth Rates

From 1978 to present, 18 inventories of the HMA have been completed (Appendix F: Inventory, Gather and Release History since 1972). 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, pp. 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 G, June 2018 Warm Springs HMA Survey, USGS unpublished data).

Warm Springs HMA was also surveyed in 2016 (Appendix H, Statistical Analysis for Warm Springs Horse Survey, Lubow 2016) using the simultaneous double-observer method. The 2016 survey estimated 513 adult horses in October 2016. The June 2018 survey estimated 694 adult horses. Using the results from each of these surveys, calculations of apparent annual population growth rate indicate a rate of 16 percent. This growth rate is based on only 2 years of data and only 2 years of growth and, therefore, could vary over time as climatic and environmental conditions change. For example, drought could impact population growth rates when water and forage availability is limited, causing adults and young foals to travel longer distances to water, which often reduces body conditions and influences maintenance of pregnancy and foal survival rates (Dawson and Hone 2012). Pregnancy status of mares was collected by ultrasound and palpation following the October 2018 gather and is a perfect example of this. The 2018 Warm Springs HMA Gather Summary noted observed apparent body condition scores for horses captured stating, "[h]orses from East Warm Springs [allotment] were generally closer to BCS 4–6, while horses from West Warm Springs [allotment] were closer to 3–5. This is assumed to be due to distances travelled to water as there is ample feed in both allotments but with fewer water sources on the west side." Based on water monitoring events during the summer of 2018, it was apparent that horses on the west side of the HMA were travelling greater distances to the limited water sources available. During the October 2018 gather, horses captured were marked to indicate which general area of the HMA they were gathered from; east, middle, or west. The table below provides data by HMA location showing results of pregnancy status checks.

Table III-1: Pregnancy status checks by HMA location

Location in HMA During October 2018 Gather	Pregnancy Rate		
	# Pregnant	Total Mares	% Pregnant
East	84	115	73%
Middle[1]	48	75	64%
West	71	124	57%

[1] *Middle* means horses found within +/-3 miles of the East and West Warm Springs Allotment division fence.

Most wild horse HMAs have estimated annual population growth rates at 20 percent or higher as acknowledged in the NRC review (2013) that recognized that adequate studies conducted on the population growth rate of free-roaming horses on western rangelands have "clearly demonstrated that growth rates approaching 20 percent or even higher are realized in many horse populations" (p. 65). This HMA typically has ample forage available year-round and there are very few natural predators in the area, periods of drought causing limited water are the main limiting factor in the HMA. During periods without drought, it would be anticipated that the annual population growth rate would be higher than the 16 percent calculated from only 2016 to 2018 when drought was present.

Habitat Components

Warm Springs HMA lies in the northern Great Basin with dominant plant communities consisting of, but not limited to, *Artemisia tridentata tridentata* (basin big sage), *Artemisia tridentata wyomingensis* (Wyoming big sage), *Artemisia arbuscula* (low sage), *Pseudoroegneria spicata* ssp. *spicata* (bluebunch wheatgrass), *Festuca idahoensis* (Idaho fescue), *Elymus elymoides* (squirreltail), *Poa secunda* (Sandberg bluegrass), *Achnatherum thurberianum (*Thurber's needlegrass*)*, *Leymus cinereus (*basin wildrye), and a multitude of forb species. 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.

Habitat for wild horses 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). 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). Within the Great Basin, drought conditions are common and, as discussed above, water is the main limiting factor within Warm Springs HMA. In Oregon in 2009, 2014, and 2018, 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 Springs Allotment portion of the HMA; this action is thought to have saved approximately 80 horses. In late summer 2018, water became inadequate to support a subset of the wild horse population in the western portion of Warm Springs HMA causing BLM to haul water to sustain a population of approximately 236 animals to prevent loss. 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 horses "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 (as great as 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 7 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, because 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).

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 native 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 Oregon Department of Fish and Wildlife's (ODFW) 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.

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.

The information provided above related to forage and water resources and the effects to wild horses and other species using these same, sometimes limited, resources describes the primary need for long-term management of large ungulate populations (including wild horses) within appropriate management levels. For wild horses, management techniques that slow annual population growth allowing for an extension of the period between events when additional management actions are necessary to maintain a thriving natural ecological balance and multiple-use relationship on public lands are critical for long-term management of the species.

Gathers and Current Population Estimate

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 15 times since 1978, most recently in 2018 (see Appendix F, Inventory, Gather and Release History since 1972). The October 2018 gather captured a total of 845 horses, leaving an estimated 30 remaining on the range uncaptured.

A majority of the horses gathered in 2018 exhibited saddle horse conformation with color phases including many appaloosa, roans, appy-roans, buckskins, duns, bays, sorrels, blacks, and pintos. Horses gathered ranged from very thin to fleshy body condition (body condition scores 2–7, Henneke 1983).

It is worth noting here that more recent surveys (i.e. 2016 and 2018) likely provide the more accurate estimates of herd size. The BLM used the results from the simultaneous double-observer surveys conducted in 2016 and 2018. If one compares the estimated population from the 2018 survey with the number of wild horses actually on the range in October 2018 based on gather results (845 captured plus 30 remaining = 875), the result is that, in fact, the estimated population size was approximately 23 horses fewer than the actual number on the range. As a percentage, this bias could be expressed as 23/845, or about 2.7 percent. Current estimation methods appear to be quite accurate, relative to most wildlife aerial survey methods.

Genetic Analysis

Genetic analysis of the Warm Springs wild horse herd has not yet been completed with samples collected following the 2018 gather. Past genetic analysis has been 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-2 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-2 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-2: Warm Springs HMA 2001 and 2010 genetic diversity measures comparison

Warm Springs HMA - Genetic Diversity 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 diversity 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 diversity 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 diversity. 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.

Other available information also points to the conclusion that the wild horse herd in the Warm Springs HMA contains adequate levels of genetic diversity, and that the genetic information there is shared with a number of other BLM-managed herds. A large-scale assessment of relatedness between BLM-managed herds, based on Fst values from a very large sample of wild horses in a majority of HMAs, indicated that the herd in the Warm Springs HMA is not highly distinguishable from other BLM-managed herds in Oregon, with pairwise Fst values being 0.15 or lower (Appendix F of NRC Review 2013). Such low Fst values are indicative of low genetic differentiation between herds, which could be a result of shared ancestry and/or recent genetic interchange. In a study of genetics in the U.S. Forest Service (USFS) managed Big Summit Wild Horse Territory (Deshpande et al. 2019), five privately-owned mustangs that were originally from Warm Springs HMA had genotypes indicating a high level of mtDNA diversity in the sample. In that study, inbreeding coefficient (Fis) values were low for all BLM-managed HMAs that were sampled (Warm Springs HMA, Beatys Butte HMA, Jackies Butte HMA, South Steens HMA, Kiger HMA), and for the Murderers Creek Joint Management Area, based on limited samples of privately-owned mustangs from those areas (Deshpande et al. 2019).

b. Environmental Consequences – Wild Horses

(1) Effects Common to All Alternatives

<u>Results of WinEquus Population Modeling</u>

WinEquus Wild Horse Population Model (Jensen 1993) is the modeling program currently available to BLM. Permanent infertility (e.g. spaying) is not an option in the current modeling program, which only allows for 4 years of fertility control treatment before the effectiveness wears off. For this reason, and in order to compare results of treatments in the three alternatives, each alternative was modelled only through 2025. The attached Appendix I, Warm Springs HMA WinEquus Simulations, explains the WinEquus parameters for models run for each alternative. Results of these modeling simulations provide estimates of average population growth rate, projected year of next gather, and estimated population in 2025 for each alternative. This is all important information, specifically the *Average Growth Rate in 5*

Years—a 1 or 2 percent difference between alternatives can translate into a big difference on the ground over time.

The Wild Horse and Burro Management Handbook (H-4700-1, 2010, p. 28) explains that an objective of the modeling 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-3: WinEquus population modeling comparison table

		Avg. Growth Rate in 5 Years (%)	Next Projected Gather	Est. Pop. Size in 2025
Alternative A: No Action (2020–2025)		18.6	2024	226
Alternative B: Proposed Action				
USGS On-Range Study, 2020–2022	Control Segment	23.7	n/a	n/a
	Treatment Segment	14.2	n/a	n/a
Post Study, 2023–2025	Herd Segments Combined	14.7	2023[a]	432
Alternative C (2020–2025)		5.8	2027–2028[b]	132
[a] End of USGS on-range behavioral study that began over high AML to accommodate study design.				
[b] Alternative C does not exceed high AML (178) until after 2025, likely between 2027–2028.				

Transport

Each alternative requires the sorting, handling, and transport of wild horses back to the HMA. During transport, potential effects to individual animals can include stress, as well as slipping, falling, kicking, biting, or being stepped on by another animal. The intensity of these effects varies by individual and is indicated by behaviors ranging from nervous agitation to physical distress. It is rare for horses to be seriously injured or die during transport, especially when BLM has selected individuals in good health and body condition to be returned to the HMA. In the event that an animal is seriously injured, they would be humanely euthanized using methods under the guidelines in IM 2015-070, or updated policy.

To minimize potential for injuries from fighting during transport, horses are typically transported with stallions separate from mares, or with only one stallion with several mares. Transport back to various locations in Warm Springs HMA should take 3–4 hours, with the potential for short delays caused by instances such as flat tires.

(2) Alternative A: No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA)

WinEquus Simulation

A simulation was run in the WinEquus population modeling program for the no action alternative, which includes treatment of mares with PZP vaccine before release. Results from this modeling exercise provide a median average population growth rate of 18.6 percent with a total population of 226 horses by 2025. The model shows AML being exceeded in 2024. These results indicate the need for a gather to remove excess wild horses approximately 4 to 5 years following the re-establishment of AML on the range and PZP treatments. This alternative does not reduce the frequency of gather events.

Porcine Zona Pellucida (PZP) Vaccine

Up to 33 mares would be released to the HMA after being treated with PZP vaccine, in accordance with BLM IM 2009-090, Population-Level Fertility Control Field Trials: Herd Management Selection, Vaccine Application, Monitoring and Reporting Requirements. Mares would be treated with the 2-injection liquid PZP (ZonaStat-H; Science and Conservation Center, Billings, Montana) or the PZP-22 vaccine pellets.

PZP vaccines have been used on dozens of horse herds by the National Park Service, USFS, BLM, 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 NRC (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). Native PZP produced at different times or in different laboratories may vary in the strength of immune response they elicit (Turner 2018). Recombinant ZP proteins may be produced with molecular techniques (Gupta and Minhas 2017, Joonè et al. 2017a, Nolan et al. 2018a). It can easily be remotely administered in the field in cases where mares are relatively approachable. Use of remotely delivered (dart-delivered) vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached within 50 meters (BLM 2010).

Under this alternative, the BLM would apply PZP-22 and/or ZonaStat-H to mares returned to the HMA. Both forms of PZP can safely be reapplied as necessary to control the population growth rate, although a second treatment is not proposed under this alternative. Nevertheless, 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). Once the population is at AML and population growth seems to be stabilized, BLM could use population planning software (WinEquus II, currently in development by USGS Fort Collins Science Center) to determine the required frequency of re-treating mares with PZP.

The BLM currently uses two PZP formulations for fertility control of wild horse mares, ZonaStat-H (PZP Native) and PZP-22. 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. The procedures to be followed for application of PZP are detailed in the standard operating procedures for population-level Porcine Zona Pellucida fertility control treatments in IM 2009-090, Population-Level Fertility Control Field Trials: Herd Management Area Selection, Vaccine Application, Monitoring and Reporting Requirements (Appendix J).

For the administration of the PZP-22 formulation, each released mare 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. Although PZP-22 pellets have been delivered via darting in trial studies (Rutberg et al. 2017), BLM does not plan to use darting for PZP-22 delivery in this HMA until there is more demonstration that PZP-22 can be reliably delivered via dart. Therefore, wild horses 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, Nolan et al. 2018b). Antibodies specific to PZP protein do not cross-react with tissues outside of the reproductive system (Barber and Fayrer-Hosken 2000).

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

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

Table III-4: Results for single application liquid PZP along with PZP pellets

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).

Table III-5: Results of treatment with PZP-22 pellets followed by a booster dose

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 percent efficacy in years 2 and 3 after immunization, such as Fonner and Bohara (2017).

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

Reversibility and Effects on Ovaries

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

The purpose of applying PZP treatment is to prevent mares from conceiving foals, but BLM acknowledges that long-term infertility, or permanent sterility, could be a result for some number of wild horses receiving PZP vaccinations. The rate of long-term or permanent sterility following vaccinations with PZP is hard to predict for individual horses, but that outcome appears to increase in likelihood as the number of doses increases (Kirkpatrick and Turner 2002). Permanent sterility for mares treated consecutively 5–7 years was observed by Nuñez and others (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 (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 and others (2017a) noted reversible effects on ovaries in mares treated with one primer dose and booster dose. Joonè and others (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 and others (2013) found that ovarian function was affected by the SpayVac PZP vaccination, but that there were no effects on other organ systems. Mask and others (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 and others (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 and others (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 seven 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). Bagavant and others (2002) demonstrated T-cell clusters on ovaries, but no loss of ovarian function after ZP protein immunization in macaques. Skinner and others (1984) raised concerns about PZP effects on ovaries, based on their study in laboratory rabbits, as did Kaur and Prabha (2014), though neither paper was a study of PZP effects in equids.

Effects on Existing Pregnancies, Foals, and Birth Phenology

If a mare is already pregnant, the PZP vaccine has not been shown to affect normal development of the fetus or foal, or the hormonal health of the mare with relation to pregnancy (Kirkpatrick and Turner 2003). It is possible that there may be transitory effects on foals born to mares or jennies treated with PZP. In mice, Sacco and others (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 was 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. "Foal stealing," where a near-term pregnant mare steals a neonate foal from a weaker mare, is unlikely to be a common behavioral result of including PZP treated mares in a wild horse herd. McDonnell (2012) noted that "foal stealing is rarely observed in horses, except under crowded conditions and synchronization of foaling," such as in horse feed lots. Those conditions are not likely in the wild, where pregnant mares will be widely distributed across the landscape, and where the expectation is that parturition dates would be distributed across the normal foaling season. Similarly, although Nettles (1997) noted reported stillbirths after PZP treatments in cynomolgus monkeys, those results have not been observed in equids despite extensive use in horses and burros.

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. Ransom and others (2013), though, identified a potential shift in reproductive timing as a possible drawback to prolonged treatment with PZP, stating that treated mares foaled on average 31 days later than non-treated mares. Results from Ransom and others (2013), however, showed that over 81 percent of the documented births in this study were between March 1 and June 21 (i.e., 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 3 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 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). The 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 (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 and others (2017a) found that injection site reactions had healed in most mares within 3 months after the booster dose and that they did not affect movement or cause fever. The longer term nodules observed did not appear to change any animal's range of movement or locomotor patterns and, in most cases, did not appear to differ in magnitude from naturally occurring injuries or scars.

Indirect Effects

One expected long-term, indirect effect on wild horses treated with fertility control would be an improvement in their overall health (Turner and Kirkpatrick 2002). Many treated mares would not experience the biological stress of reproduction, foaling, and lactation as frequently as untreated mares. The observable measure of improved health is higher body condition scores (Nuñez et al. 2010). After a treated mare returns to fertility, her future foals would be expected to be healthier overall, and would benefit from improved nutritional quality in the mare's milk. This is particularly to be expected if there is an improvement in rangeland forage quality at the same time, due to reduced wild horse population size. Past application of fertility control has shown that mares' overall health and body condition remains improved even after fertility resumes. PZP treatment may increase mare survival rates, leading to longer potential lifespan (Turner and Kirkpatrick 2002, Ransom et al. 2014a) that may be by as much as 5–10 years (NPS 2008). 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 (Turner and Kirkpatrick 2002, Roelle et al. 2010), with a greater prevalence of older mares in the herd (Gross 2000, NPS 2008). Observations of mares treated in past gathers showed that many of the treated mares were larger than, maintained higher body condition than, and had larger healthy foals than untreated mares.

Following resumption of fertility, the proportion of mares that conceive and foal could be increased due to their increased fitness; this has been called a "rebound effect." Elevated fertility rates have been observed after horse gathers and removals (Kirkpatrick and Turner 1991). More research is needed to document and quantify these hypothesized effects in PZP-treated herds. If repeated contraceptive treatment leads to a prolonged contraceptive effect, then that may minimize or delay the hypothesized rebound effect.

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 (NPS 2008). 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.

To the extent that PZP treatment is successful, reduced population growth rates and smaller population sizes could also allow for continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse habitat quality. As the population nears or is maintained at the level necessary to achieve a thriving natural ecological balance, vegetation resources would be expected to recover, improving the forage available to wild horses and wildlife throughout the HMA. With rangeland conditions more closely approaching a thriving natural ecological balance, and with a less concentrated distribution of wild horses across the HMA, there should also be less trailing and concentrated use of water sources. Lower population density would be expected to lead to reduced competition among wild horses using the water sources and less fighting among horses accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild horses. Wild horses would also have to travel less distance back and forth between water and desirable foraging areas. However, 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, and that frequency and rate of treatment is not expected to be at all practicable in the Warm Springs HMA.

Behavioral Effects

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

Ransom and Cade (2009) delineate behaviors that can be used to test for quantitative differences due to treatments. Ransom and others (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 and others' (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 and others (2009) and Ransom and others (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 estrous behavior while contracepted (Shumake and Killian 1997, Heilmann et al. 1998, Curtis et al. 2001, Duncan et al. 2017). There was no evidence, though, that mare welfare was affected by the increased level of herding by stallions noted in Ransom and others (2010). Nuñez's later analysis (2017) noted no difference in mare reproductive behavior as a function of contraception history.

Ransom and others (2010) found that control mares were herded by stallions more frequently than PZP-treated mares, and Nuñez and others (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 and others (2010) and Knight (2014) found this infidelity was also evident during the breeding season in the same population that Nuñez and others (2009, 2010, 2014, 2017, 2018) studied. Nuñez and others (2014, 2017, 2018) concluded that PZP-treated mares changing bands more frequently than control mares could lead to band instability. Nuñez and others (2009), though, cautioned against generalizing from that island population to other herds. Nuñez and others (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 and others (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 and others (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 and others (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 WHB Act of 1971. It is also notable that Ransom and others (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 and others (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 and others (2009, 2010) into the broader context of all of the available scientific literature, and cautions, based on its extensive review of the literature that:

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

Genetic Effects of PZP Vaccination

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

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

Even if it is the case that repeated treatment with PZP may lead to prolonged infertility, or even sterility in some mares, most HMAs have only a low risk of loss of genetic diversity if logistically realistic rates of contraception are applied to mares. Wild horses in most herd management areas are descendants of a diverse range of ancestors coming from many breeds of domestic horses. As such, the existing genetic diversity in the majority of HMAs does not contain unique or historically unusual genetic markers. Past interchange between HMAs, either through natural dispersal or through assisted migration (i.e., human movement of horses), means that many HMAs are effectively indistinguishable and interchangeable in terms of their genetic composition. Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Their results show that only in the most extreme circumstances (where all of the following conditions are met: low initial genetic diversity, low population growth rate, high proportion of mares treated, and no change in management for 50 years) would there likely be any noticeable effect on genetic diversity or a significant probability of extirpation of a herd. Monitoring and adaptive management would reduce the probability of unacceptable results even further, which has been standard operating procedure for management of Oregon HMAs for years. According to the WinEquus population model trial for this alternative, the health of individual animals or the herd would not be threatened because between 2020–2025 the estimated annual population growth rate under this alternative would be 18.6 percent (refer to Table III-3, WinEquus Comparison Table and Appendix I, Warm Springs HMA WinEquus Simulations).

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

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 and others (2003) 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.

The BLM is not aware of any studies that have quantified the heritability of a lack of response to immunocontraception such as PZP vaccine 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.

(3) Effects Common to Alternative B and C

<u>Adoption or Sale with Limitations, Transfer, and Long-Term Pasture</u>
Under alternatives B and C, an additional 70 mares would receive ovariectomy via colpotomy in order to provide adequate statistical power to estimate the complication rate of this surgical procedure on wild horse mares with reliable accuracy and precision. These mares would not be returned to the HMA but would go into the adoption or sale program.

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. 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 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. A sale-eligible wild horse 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 would be conducted in accordance with BLM policy under IM 2014-132 or any future BLM direction on sales.

Potential direct effects to animals from transport to adoption, sale, transfer, or long-term holding are similar to those previously described.

Animals may be transported for a maximum of 24 hours at a time. 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. 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 35,396 wild horses (as of April 1, 2019), 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).

(4) Alternative B - Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment)

<u>WinEquus Simulation</u>

A simulation was run in the WinEquus population modeling program for the proposed action alternative. For comparison of the results of each alternative, simulations were run through 2025 despite the on-range outcomes assessment being complete in 2022. The median average population growth rates for the control segment and the treatment segment were 23.7 and 14.2, respectively. At the completion of the on-range assessment (2022), the gates in the fence line between the two herd segments would be opened and the two herd segments would be combined. The post study median average population growth rate would be 14.7 percent. To accommodate study design, this alternative would begin at approximately 230 horses as opposed to alternatives A and C, which would begin with 96 horses. Because the starting population would be greater, and because over half of the population would be untreated, the population growth rate would be high and the estimated population size by 2025 is 432 horses. It is important to note that despite the elevated starting population and a smaller percentage of mares treated, the median average population growth of 14.7 percent is still less than under alternative A. A need to gather with removals would exist at the end of this study because the population would be over high AML; however, it would marginally reduce the average annual population growth rate below 16 percent (estimated from survey data from 2016 and 2018) for Warm Springs HMA.

<u>Ovariectomy via Colpotomy Procedure</u>

The anticipated effects of the spay treatment (ovariectomy via colpotomy) 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. 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 (2013) 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 associated with the procedure. Although gestational stage was not recorded, many of the mares treated were pregnant (Gail Collins, US Fish and Wildlife Service (USFWS), pers. comm.). 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 Complications and Complication Rates Associated with Ovariectomy via Colpotomy

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). As stated previously, gestational stage was not recorded, but a majority of the mares were pregnant in the Sheldon NWR study. Only a small number of mares were very close to full term (Gail Collins, USFWS, pers. comm.). 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.). Similar to these findings, Prado and Schumacher (2017) reported observation of "… only two surgical complications after performing over 100 ovariectomies by colpotomy."

The proposed action does not include treatment of pregnant mares. It is unknown if the reported less than 2 percent mortality rate from the Collins and Kasbohm (2016) study was associated with pregnancy status; however, treating only open (non-pregnant) mares may reduce additional risks associated with the maintenance of a pregnancy.

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. Prado and Schumacher (2017) added hemorrhage from the ovarian pedicle as a potential complication. Shock is also a possibility that could be associated with any surgery. Most horses, however, tolerate ovariectomy via colpotomy with very few complications, as reported by Prado and Schumacher (2017), including feral horses (Collins and Kasbohm 2016). In the two out of 100 horses observed to have surgical complications from ovariectomy via colpotomy, Prado and Schumacher (2017) stated one mare experienced severe hemorrhage at the ovarian pedicle and the other strained after surgery, presumably because of vaginitis induced by an unsuccessful attempt to suture the colpotomy. Both mares survived, however the mare experiencing severe hemorrhage required multiple blood transfusions. Blood transfusions are not possible when applying this procedure to wild horse mares as blood from acceptable donors would not be available. Measures are in place, described in the proposed action, to minimize the risk of hemorrhage at the ovarian pedicle. A complication of the colpotomy itself is fatal hemorrhage cause by inadvertent perforation of the vaginal artery with a scalpel blade, "but this artery is avoided if it is located by palpation before the fornix of the vagina is incised and if the incision is created at the proper location (Embertson 2009, Prado and Schumacher 2017)." Prado and Schumacher (2017) also 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 received by 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

[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.

than the 1% reported in the literature…and quoted in the protocol, which is based on domestic mares." The NRC did not 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 estrous 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 estrous 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 estrous 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 were similar to intact mares during

[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.

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 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 to which the mare was most recently attached. Overall, the BLM anticipates that some spayed mares may continue to exhibit estrous 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 estrus. This may help to explain why treated mares at Sheldon NWR continued to be accepted into harem bands, in that they may have been behaving similarly to 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 hypothesized 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 may only lead 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 new, permanent physical barriers being proposed. However, the on-range behavioral study would document the movement patterns of both herd segments to determine whether there are any differences in use areas and distances travelled as a function of treatment status.

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 free from the energy demands of lactation may imply they could 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). The result that treated females in that study maintained group associations suggests that wild mare movement patterns and travel distances may not change due to spaying.

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 internally-motivated 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 temporarily contracepted or 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

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

“[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, 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 Colorado State University (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, is 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 measurements (Cothran 2002, 2011), 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. 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 trial for this alternative, the health of individual animals or the herd would not be threatened because between 2020–2025 the estimated annual population growth rate would be 14.2 to 23.7 percent (refer to Table III-3, WinEquus Comparison Table and Appendix I, Warm Springs HMA WinEquus Simulations).

In HMAs with adequate levels of genetic diversity (i.e., well above the critical value for observed heterozygosity), or which 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. 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 with regards to effects on genetic diversity of the herd because the proposed action incorporates BLM's management plan for genetic monitoring and maintenance of genetic diversity.

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; if fertile mares also have increased longevity as a result of improved resource conditions, 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.

There would be little concern for effects to genetic diversity of the Warm Springs wild horses because the proposed action incorporates BLM's management plan for genetic monitoring and maintenance of genetic diversity. 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 only in the most extreme circumstances (where all of the following conditions are met: low initial genetic diversity, low population growth rate, high proportion of mares treated, and no change in management for 50 years) would there likely be any noticeable effect on genetic diversity or a significant probability of extirpation of a herd. Monitoring and adaptive management would reduce the probability of unacceptable results even further, which have been standard operating procedures for management of Oregon HMAs for years. Roelle and Oyler-McCance (2015) conclude that nothing in their results indicates wild horse managers should steer away from permanent contraceptive techniques, as long as results are monitored and adjustments are made if necessary.

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 4 years USGS researchers have reported only minor rubbing abrasions from collars and a few instances of the collar going over the ears of horses (and then being removed using the remote release mechanism), the following effects are possible:

- Collar going over the ears: In current BLM-funded studies in Wyoming and Utah, radio collars have been observed to go over mares' ears, and over burro jenny ears in a study in Arizona. In other equid species this has been observed to happen in males (G. Collins, USFWS and P. Kaczensky Vetmeduni Vienna, pers. comm.), who would therefore be fitted with tags rather than collars in this study. 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 a mare, 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 other BLM-funded studies. 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 Arizona, 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 braided tail. In this case, the tag would be ultimately expected to rip out of the hair (leaving no injury) as the horse rubs it.

(5) Alternative C (Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment)

WinEquus Simulation

A simulation was run in the WinEquus population modeling program for alternative C. Results from this modeling exercise provide a median average population growth rate in 5 years of 5.8 percent with a total population of 132 horses by 2025. This means that by spaying up to 33 mares (~68 percent of the adult mare population), the population growth rate would drastically decrease from the estimated 16 percent described in the Affected Environment - Wild Horses section of chapter III. To be comparable to population models for the other alternatives, this model was only run through 2025 and shows a median trial population size in 6 years of 132 animals. Over the years, the foals of untreated mares would become old enough to reproduce and therefore cause an increase in the population growth rate. This would lead to a more rapid increase toward high AML and having excess animals on the range, but not until about 2027 or 2028. These results indicate the need for a gather to remove excess wild horses approximately 8+ years following the re-establishment of AML. This alternative extends the normal 4–5 year gather cycle to 8+ years.

Direct and Indirect Effects

The anticipated effects of the ovariectomy via colpotomy procedure, including the anticipated complications and complication rates described in alternative B are the same under this alternative. The same amount of mares would be treated under both alternatives B and C. The same procedure and monitoring of short-term, off-range effects would be conducted under this alternative.

The anticipated effects on mare health and behavior on the range; movement, body condition, and survival of ovariectomized mares; estrous cycle; and bone histology would be the same as those described under alternative B. Alternative B proposes to return between 28 and 34 spayed mares to the range while alternative C proposes up to 33. A very similar number of mares would experience direct effects of the treatment; however, under this alternative there would be fewer untreated mares on the HMA, as well as fewer stallions, because the population would be returned to the low AML of 96 horses.

Effects on genetic diversity would be similar to those described in alternatives A and B. Each alternative incorporates the use of BLM's management plan for genetic monitoring and maintenance of genetic diversity. Prior 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 transport of horses) has led to a herd that is of highly mixed origin, which has genetic attributes that are similar to a number of other wild horse herds in Oregon.

Oregon BLM has consistently conducted genetic monitoring and analysis for each of its HMAs, some of which have relatively small AMLs, and has effectively maintained adequate to high genetic diversity through close monitoring and translocation of horses from other HMAs in times when genetic results indicate the need. This model is consistent with recommendations by Mills and Allendorf (1996) that a minimum of 1 and a maximum of 10 migrants per generation would be an appropriate general rule of thumb to maintain genetic diversity. The model by Roelle and Oyler-McCance (2015) shows that only in the most extreme circumstances (where all of the following conditions are met: low initial genetic diversity, low population growth rate, high proportion of mares treated, and no change in management for 50 years) would there likely be any noticeable effect on genetic diversity or a significant probability of extirpation of a herd. Monitoring and adaptive management would reduce the probability of unacceptable results even further; such monitoring and management has been standard operating procedure for management of Oregon HMAs for years. Roelle and Oyler-McCance (2015) conclude that nothing in their results indicates wild horse managers should steer away from permanent contraceptive techniques, as long as results are monitored and adjustments are made if necessary.

The WinEquus population model trial for this alternative shows the long-term health of the herd would not be threatened because from 2020–2025 the annual population growth rate would be 5.8 percent with an anticipated climb in annual population growth rate after the foals of untreated mares become part of the breeding population and contribute offspring. This alternative successfully reduces the wild horse annual population growth rate and reduces (extends) the frequency of gathers to remove excess animals.

There would be no effects associated with radio collaring because they would not be used.

<u>On-Range Outcomes Monitoring</u>
This alternative incorporates only limited on-range monitoring of having spayed mares in a wild horse population. As compared to the proposed action where USGS would follow an intensive on-range behavior monitoring protocol through 2022, this alternative would gather data during annual simultaneous double-observer surveys through 2022 and opportunistic ground-based observations. The objectives of the on-range behavioral outcomes assessments for both alternatives are listed in the table below for comparison of what questions would be subject to evaluation with recorded data.

Table III-6: On-range behavioral outcomes assessment objectives for alternatives B & C

On-Range Behavioral Outcomes Assessment Objectives	
Proposed Action	**Alternative C**
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.	Record observations that may inform whether or not spayed mares are always present in harem bands.
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.	Using the Henneke and others (1983) body condition scoring system, determine whether or not spayed mares differ in body condition scores, compared to non-treated mares.
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 segment females, 22 control herd segment females, and 12 stallions from each herd segment) within treatment and control herd segments of the population throughout the year.	Estimate apparent survival rate of treated mares compared to untreated mares during future gather events and opportunistic ground-based observations.
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.	Estimate annual population growth rates for the herd based on annual aerial surveys from 2019–2022, and then every 2–3 years after that.

2. Cultural Resources

The following issue is addressed in this section.

- ***What would be the effects of the alternatives on cultural resources?***

a. Affected Environment - Cultural Resources

For the purposes of this analysis, the geographic extent of the analysis area for cultural resources is the area within the HMA boundary, and the temporal scale of the analysis is five years.

The affected cultural resources in the HMA have not measurably changed since the issuance of The Spay Feasibility and On-Range Behavioral Outcomes

Assessment and Warm Springs HMA Population Management Plan EA (DOI-BLM-ORWA-B050-2018-0016-EA) and the October 2018 gather of 845 wild horses. While rangeland resources are generally slow to show change and do not measurably respond to reduced disturbance in a matter of months, it is anticipated that the reduction of 845 wild horses in October 2018 will cause a reduction in impacts to 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. However, since 21 percent of known sites are within 200 feet of water sources, they have likely been trampled by livestock, horses, burros, wildlife, and humans.

In October 2018, the BLM, through a gather, reduced the amount of wild horses in the HMA by 845. It is assumed that this reduction in animals will result in reduced sizes of congregation areas near man-made or natural water sources and, thereby, reduce the potential for impacts to cultural resources.

b. Environmental Consequences - Cultural Resources

Analysis Assumptions

Continued management of wild horse populations in excess of AML could expand the size of existing congregation areas and result in the development of additional congregation areas.

“Generalized” grazing (i.e. grazing away from congregation areas) is not believed to affect archaeological sites when grazing animals are managed at or near appropriate management levels because there is generally minimal trampling.

Alternative A - No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA)

Under the no action alternative, the wild horse population would be returned to low AML (96), including treating mares to be returned with PZP vaccine, in 2019 and result in an estimated population of 226 horses by 2025. It is assumed that this number of horses would result in reduced congregation area sizes and, therefore, the potential for additional impacts to cultural resources near man-made or natural water sources would be reduced. Archaeological sites within “generalized” grazing areas would remain unaffected.

Alternative B – Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment)

Under alternative B, the population on the range would be returned to approximately 230 horses in the HMA in 2019 and result in an estimated population of 432 horses by 2025. While it is assumed that this number of horses would also result in reduced congregation area sizes within the HMA as compared to the population prior to the October 2018 gather, it would be to a lesser extent than under the no action alternative or alternative C. Archaeological sites within “generalized” grazing areas would remain unaffected.

Alternative C (Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment)

Under alternative C, the wild horse population would be returned to low AML (96), including spaying up to 33 mares to be returned, in 2019 and result in an estimated population of 132 horses by 2025. It is assumed that this number of horses would result in reduced congregation area sizes and, therefore, the potential for additional impacts to cultural resources near man-made or natural water sources would be reduced. Archaeological sites within “generalized” grazing areas would remain unaffected.

Cumulative Effects

It is assumed that potential direct and cumulative effects to cultural resources from any future actions would be mitigated through project-specific cultural resource inventory and mitigation measures prior to any project implementation. Therefore, there are no anticipated cumulative effects to cultural resources under any of the alternatives.

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

For the purposes of this analysis, the geographic extent of the analysis area for riparian zones, wetlands, and water quality is the thirteen watersheds that overlap the HMA boundary, and the temporal scale of the analysis is five years. 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 are expected to the Little Tank Creek-Big Tank Creek and Juniper Creek-Dry Valley watersheds because so little of these watersheds fall within the HMA.

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.

In October 2018, the BLM, through a gather, reduced the amount of wild horses and burros in the HMA by 845 and 41, respectively. It is expected that this reduction in animals will result in reduced use and impact to the unfenced Thorn Springs wetland area, result in improved riparian function in that area, and reduce the concern for potential impacts to additional riparian areas due to the removal of excess animals.

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

Alternative A - No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA)

The no action alternative would minimize the potential effect of horses on riparian zones and wetlands. A reduced horse population in the HMA aids in limiting the pressure placed on riparian exclosure fences and riparian zones. Currently Thorns Springs remains unfenced and may maintain or improve in condition.

Alternative B – Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment)

Alternative B would minimize the potential effect of horses on riparian zones and wetlands but to a lesser extent than the no action alternative or alternative C. A reduced horse population in the HMA aids in limiting the pressure placed on riparian exclosure fences and riparian zones. Currently Thorns Springs remains unfenced and may maintain or improve in condition.

Alternative C (Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment)

Alternative C would minimize the potential effect of horses on riparian zones and wetlands but to a greater extent than either the no action or alternative B. A reduced horse population in the HMA aids in limiting the pressure placed on riparian exclosure fences and riparian zones. Currently Thorns Springs remains unfenced and may maintain or improve in condition.

Cumulative Effects

There are no reasonably foreseeable actions in the analysis area that would impact riparian zones, wetlands, or water quality. All other ongoing actions associated with these resources, including the actions proposed under each alternative, are anticipated to contribute to improved riparian and wetland health and water quality. Therefore, there are no anticipated cumulative effects to these resources under any of the alternatives.

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

For the purposes of this analysis, the geographic extent of the analysis area for livestock grazing management is the East Warms Spring and West Warm Springs Allotments. The HMA falls entirely within these two allotments. The temporal scale of the analysis is five years.

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-7, 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-8 and table III-9.

Table III-7: 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-8: 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-9: 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.

[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%).

Prior to October of 2018, the wild horse population in the HMA was almost 700 animals above high AML. Upland forage utilization monitoring documented moderate to high utilization levels in portions of the HMA that had experienced 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. However, in October 2018, the BLM, through a gather, reduced the amount of wild horses and burros in the HMA by 845 and 41, respectively. It is assumed that this reduction in animals will result in reduced sizes of congregation areas near man-made or natural water sources and, thereby, reduce the potential for heavy utilization levels.

Some horses make a substantial part of their use in areas not used by cattle. However, in this HMA many of the areas of major horse 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 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 areas in this HMA.

b. Environmental Consequences - Livestock Grazing Management

Analysis Assumptions

As wild horse populations increase above AML, there is a corresponding increase in the potential for conflict with permitted grazing use. Managing wild horse populations on the range above AML would increase the level of utilization and decrease the amount of available forage and available water for all uses, including livestock.

Alternative A - No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA)

Under the no action alternative, the wild horse population would be returned to low AML (96), including treating mares to be returned with PZP vaccine, in 2019 and would result in an estimated population of 226 horses by 2025. It is assumed that this number of horses would eliminate conflicts with livestock grazing management because it would maintain the wild horse population within AML for approximately 4 years.

Alternative B – Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment)

Under alternative B, the population on the range would be returned to approximately 230 horses in the HMA in 2019 and result in an estimated population of 432 horses by 2025. While it is expected that this number of horses would also result in reduced opportunities of conflict for available forage and water, as existed prior to the October 2018 gather, it would be to a lesser extent than under the no action alternative or alternative C. Conflict with other uses over available forage and water may continue to occur due to the wild horse population being over AML through 2025.

Alternative C (Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment)

Alternative C results in the least amount of wild horses on the range over the next 5 years, while maintaining the population within AML during this time period. This alternative would minimize the potential for conflict with livestock grazing management over available forage and water for the longest amount of time as compared to alternatives A and B.

Cumulative Effects

It is assumed that potential direct and cumulative effects to livestock grazing management from any future actions would be mitigated through project-specific livestock grazing management monitoring and mitigation measures prior to any project implementation. Therefore, the effects of past and present actions, combined with controlling wild horse populations would cumulatively benefit livestock grazing management under any of the alternatives.

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?***

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

For the purposes of this analysis, the geographic extent of the analysis area for wildlife includes the Jack Mountain/Dry Valley Priority Area of Conservation (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 is approximately 775,453 acres, with the HMA making up 64 percent of the area. The temporal scale of the analysis is five years.

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, year-round 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 contains 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 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 habitats 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 ≥ 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 shows that 66 percent GRSG habitat is in state A, 4 percent state B, 15 percent state C, and 12 percent state D (table III-10 and Appendix K, 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.

Primary threats to GRSG habitat are improper grazing management of 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 geographic analysis area. 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.

In October 2018, the BLM, through a gather, reduced the amount of wild horses in the HMA by 845. It is assumed that this reduction in animals will result in reduced competition for water resources and herbaceous cover by wild horses within the 4-mile lek buffer. In addition, both completed (e.g. Miller Homestead Fire rehabilitation) and ongoing treatments (e.g. noxious weed treatments, Coyote Fire stabilization and rehabilitation efforts) in the area are expected to improve sagebrush habitat for species such as GRSG, migratory birds, and other sagebrush obligates.

Table III-10: STMs Sage-grouse Habitat States Invasive Annual Grass Threat Model				
Habitat State	Acres	Percent	Causal Factor Disturbance(D) or Succession(S)	State Trending Towards
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
Juniper	6,322	< 1		
Sparse Vegetation = Large Playas	10,964	1		
<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*				

The USFWS 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 (USFWS 2018).

b. Environmental Consequences - Wildlife and Wildlife Habitat

Effects Common to All Alternatives

<u>Improper Grazing - Wild Horse Overpopulation Threat</u>

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 are serious concerns. 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 can decrease, and that native wildlife can be 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 efforts are not made to manage wild horse numbers 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 cumulative effects analysis area (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. 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 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 et al. 2019). 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) in 2018. The three RAWS sites are Foster Flat (5,000 ft.), which is in the analysis area; Rock Creek (5,640 ft.), which is located near the Hart Mountain Refuge headquarters about 18.5 miles southwest of the analysis area; and P Hill (4,860 ft.), which is located just outside the analysis area 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 gauge 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 numbers increase and outcompete native species.

Alternative A - No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA)

Under the no action alternative, the wild horse population would be returned to low AML (96), including treating mares to be returned with PZP vaccine, in 2019 and would result in an estimated population of 226 horses by 2025.

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 for approximately four years would help reduce threats to habitat degradation. Wild horse 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 than was occurring prior to the October 2018 gather. When the HMA is at AML, observations show horse numbers at water sources to be less than 20, as compared to 50 to 100 that was estimated during 2018. 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. 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 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 – No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA)

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

Alternative B – Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment)

Alternative B would reduce the potential effect of horses on wildlife, but to a lesser extent than the no action alternative or alternative C.

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, moving the wild horse population toward AML and studying ways to slow population growth in the future would be one less threat to habitat. Wild horse population levels that are moving towards AML, with efforts to slow annual population growth rates, 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 use, but to a much lesser scale than was occurring prior to the October 2018 gather. 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). Moving wild horse numbers toward 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 – Alternative B – Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment)

Moving the wild horse population closer to AML has the potential to improve current rangeland conditions for livestock operators who may have CCAA enrolled private inholdings within the HMA in the analysis area with USFWS and are permitted for grazing in allotments within the area (USFWS 2018).

Alternative C (Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment)

Alternative C results in the least amount of wild horses on the range over the next five years, while maintaining the population within AML during this time period. The effects from wild horses on wildlife would be similar to alternative A but those effects would span 8+ years as opposed to the 4 years noted in alternative A.

Cumulative Effects - Alternative C (Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment)

Similar cumulative effects to alternative A would be expected, with the difference being that alternative C has a potential to reduce impacts from wild horses to wildlife for at least 4 additional years as compared to alternative A.

6. Noxious Weeds

The following issue is addressed in this section.

- ***What would be the effects of the alternatives on the spread and introduction of noxious weeds?***

a. Affected Environment - Noxious Weeds

For the purpose of this analysis, the geographic extent of the analysis area for noxious weeds encompasses the Warm Springs HMA. The temporal scale of the analysis is five years. Past actions affecting noxious weeds in the Warm Springs HMA include large fires that 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. Ongoing 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 emergency stabilization and rehabilitation (ESR).

Noxious weeds have been documented within the Warm Springs HMA (table III-11). Noxious weeds are transported and spread by a multitude of sources including, but not limited to, vehicles, humans, wildlife, livestock, and wild horses. A recent publication by King and others (2019) found that wild horses could be contributing to, specifically, cheatgrass propagation through distribution of the viable seed via their feces.

In October 2018, the BLM, through a gather, reduced the amount of wild horses in the HMA by 845. It is assumed that this reduction in animals will result in reduced disturbance areas cause by hoof traffic, therefore reducing the potential for noxious weed establishment and spread in the HMA.

Table III-11: 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 through aggressive monitoring and treatments. Unfortunately, the longevity of the seed lends itself to reappearing when conditions are right.

b. Environmental Consequences - Noxious Weeds

Alternative A - No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA)

By maintaining wild horse populations within AML for four years under the no action alternative, disturbance areas and the spread of noxious weeds by horses would be reduced as compared to prior to the October 2018 gather. However, this would only be maintained for the normal gather cycle of 4–5 years under this alternative.

Alternative B – Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment)

Under alternative B, the population on the range would be returned to approximately 230 horses in the HMA in 2019 and result in an estimated population of 432 horses by 2025. While it is assumed that this number of horses would also result in reduced disturbance areas and spread of noxious weeds as compared to prior to the October 2018 gather, it would be to a lesser extent than under the no action alternative or alternative C.

Alternative C (Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment)

By maintaining wild horse populations within AML for 8+ years under alternative C, disturbance areas and the spread of noxious weeds by horses would be minimized. Current disturbance areas would remain in high use areas, such as watering sites; however, the areas would not increase in disturbance size. Maintaining the wild horse population within AML for a longer period of time is expected to reduce the need for active noxious weed treatments.

Cumulative Effects

Project specific noxious weeds monitoring and mitigation measures (i.e. inventory project area prior to activity and treat noxious weeds present using appropriate methods, clean vehicles and equipment prior to and after implementation of the project to guard against spreading noxious weeds, seed areas disturbed by the project with a mix of native and desirable non-native species to minimize establishment of noxious weeds, etc.) would be in place for any future projects in Burns District. There are no reasonably foreseeable actions in the analysis area that would affect noxious weed spread, and, therefore, there are no anticipated cumulative effects to these resources under any of the alternatives.

7. 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?***

a. Affected Environment - Soils and Biological Crusts

For the purpose of this analysis, the geographic extent of the analysis area for soils and biological crusts encompasses the Warm Springs HMA. The temporal scale of the analysis is five years. The analysis of potential effects to soils is 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. 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, post-fire ESR projects, noxious weed treatments, and recreation.

In October 2018, the BLM, through a gather, reduced the amount of wild horses in the HMA by 845. It is assumed that this reduction in animals will result in reduced impacts to soils and biological crusts throughout the HMA.

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 (*Artemisia tridentata wyomingensis*), low sagebrush (*Artemisia arbuscula*), needlegrass species (*Achnatherum* ssp.), and bluebunch wheatgrass (*Pseudoroegneria spicata)*.

The Fury-Skunkfarm-Housefield soil association 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 that 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 grass (*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 that 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 (*Elymus elymoides)*.

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 -

Assumptions

A 5-acre area of compaction would double in size in 4–5 years to 10 acres based on a 15–20 percent wild horse annual population growth. In another 4-5 years, that acreage would be 20 acres. Therefore maintenance of wild horse populations within AML would limit areas of compaction.

Alternative A - No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA)

By maintaining wild horse populations within AML for four years under the no action alternative, additional impacts to soils and biological crusts would be prevented. Current soil compaction and early successional states of biological crusts 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.

Alternative B – Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment)

Under alternative B, the population on the range would be returned to approximately 230 horses in the HMA in 2019 and result in an estimated population of 432 horses by 2025. While it is assumed that this number of horses would also result in reduced impacts to soils and biological crusts within the HMA, it would be to a lesser extent than under the no action alternative or alternative C.

Alternative C (Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment)

By maintaining wild horse populations within AML for 8+ years under alternative C, additional impacts to soils and biological crusts would be prevented. Current soil compaction and early successional states of biological crusts 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.

Cumulative Effects

There are no reasonably foreseeable actions in the analysis area that would affect noxious weed spread, and, therefore, there are no anticipated cumulative effects to this resource under any of the alternatives.

8. 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

For the purposes of this analysis, the geographic extent of the analysis area for upland vegetation is the HMA boundary. The temporal scale of the analysis is five years.

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-12: 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. In October 2018, the BLM, through a gather, reduced the amount of wild horses and burros in the HMA by 845 and 41, respectively. It is assumed that this reduction in animals will result in reduced sizes of congregation areas near man-made or natural water sources and, thereby, reduce the potential for impacts to upland vegetation.

b. Environmental Consequences - Upland Vegetation

Analysis Assumptions

As wild horse populations increase above AML, there is a corresponding decrease in native plant health and vigor. Increasing the number of horses and burros on the range would increase the level of utilization and decrease the amount of available forage. Over time, this is expected to reduce the vigor and resiliency of perennial grasses in the HMA.

Alternative A - No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA)

Under the no action alternative, the wild horse population would be returned to low AML (96), including treating mares to be returned with PZP vaccine, in 2019 and would result in an estimated population of 226 horses by 2025. It is assumed that this number of horses 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, as well as 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.

Alternative B – Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment)

Alternative B would reduce the potential effect of horses on upland vegetation, but to a lesser extent than the no action alternative or alternative C due to the amount of animals estimated to be present by 2025. A reduced horse population in the HMA, resulting from the October 2018 gather, aids in limiting the grazing pressure on upland vegetation.

Alternative C (Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment)

Alternative C results in the least amount of wild horses on the range over the next five years and maintaining the population within AML for 8+ years. This alternative would minimize the potential effect of horses on upland vegetation, but to a greater extent than either the no action or alternative B. A reduced horse population in the HMA aids in limiting the grazing pressure placed on upland vegetation.

Cumulative Effects

The effects of past and present actions, combined with controlling wild horse populations, would cumulatively benefit upland vegetation under all of the alternatives. There are no reasonably foreseeable actions in the analysis area that would affect upland vegetation and, therefore, there are no anticipated cumulative effects to this resource under any of the alternatives.

9. 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

For the purposes of this analysis, the geographic extent of the analysis area for lands with wilderness characteristics is the eleven wilderness character units comprising 371,103 acres of public land that intersect the HMA. The temporal scale of the analysis is five years.

The 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.

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 (hereafter referred to as 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 Wilderness Inventory Decisions. Some wilderness boundary roads described in the Wilderness Inventory Decisions 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 were 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 dominant 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, bushcrafting, 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 and contain deer and antelope winter range, sage-grouse habitat, pygmy rabbit habitat, and rare plants; and are in a wild horse and burro HMA.

b. Environmental Consequences - Lands with Wilderness Characteristics

Analysis Assumptions

Wild horse populations managed in excess of AML would expand the size of existing congregation areas and result in the development of additional congregation areas. The size and extent of congregation areas have the potential to effect naturalness.

Alternative A - No Action (No Spay Feasibility Action, Continue with Existing Population Management Plans for Warm Springs HMA)

Under the no action alternative, the wild horse population would be returned to low AML (96), including treating mares to be returned with PZP vaccine, in 2019 and would result in an estimated population of 226 horses by 2025. It is assumed that this number of horses would result in reduced congregation area sizes and, therefore, would minimize the potential effect of horses on naturalness.

Alternative B – Proposed Action (Spay Feasibility Action and USGS On-Range Behavioral Outcomes Assessment)

Under alternative B, the population on the range would be returned to approximately 230 horses in the HMA in 2019 and result in an estimated population of 432 horses by 2025. While it is assumed that this number of horses would also result in reduced congregation area sizes and associated effects to naturalness within the HMA as compared to prior to the October 2018 gather, it would be to a lesser extent than under alternative A or alternative C.

Alternative C (Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment)

Alternative C would also minimize the potential effect of horses on naturalness but to a greater extent than either the no action or alternative B. The wild horse population under this alternative is estimated to be 132 horses by 2025. A reduced horse population in the HMA would result in reduced congregation area sizes, and therefore, impacts to naturalness would be reduced.

Cumulative Effects

There are no reasonably foreseeable actions in the analysis area that would affect lands with wilderness characteristics, and, therefore, there are no anticipated cumulative effects to this resource under any of the alternatives.

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).	A letter was mailed to the Burns Paiute Tribal Council Chairman on May 21, 2018, requesting government-to-government consultation for the proposed action of the 2018 EA. 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. A letter was mailed to the Tribal Chairman on May 13, 2019, announcing the availability of this EA for comment.
Fort McDermitt Paiute and Shoshone Tribes	Consultation as required by the American Indian Religious Freedom Act of 1978 (42 U.S.C. 1531).	A letter was mailed to the Tribal Council Chairman on May 21, 2018, requesting government-to-government consultation for the proposed action of the 2018 EA. 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. A letter was mailed to the Tribal Council Chairman on May 13, 2019, announcing the availability of this EA for comment.
Livestock Grazing Permittees	An effort to coordinate with permitted land users directly affected by the	A letter was mailed to all livestock grazing permittees within the HMA on May 13,

	management of wild horse and burro populations within Warm Springs HMA.	2019, announcing the availability of the EA for public comment.
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.	A letter was mailed to the regional filed office of the U.S. Fish and Wildlife Service announcing the availability of the EA for public comment.

B. Summary of Public Participation

On May 13, 2019, the BLM mailed a letter announcing the availability of the EA and unsigned finding of no significant impact (FONSI) for public comment to 107 interested individuals, groups, and agencies. 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 May 15, 2019.

C. List of Preparers

Interdisciplinary Team

Breanna O'Connor, Riparian Specialist (Riparian Zones, Wetlands, and Water Quality)
Brenda Lincoln-Wojtanik, Program Analyst, Oregon State Office
Carolyn Temple, District Archaeologist (Cultural Resources)
Caryn Burri, Natural Resource Specialist (Soils and Biological Crusts)
Jeffrey Rose, District Manager, Burns District BLM
Kyle Jackson, Rangeland Management Specialist (Livestock Grazing Management, Upland Vegetation)
Lindsay Davies, Planning and Environmental Coordinator (Environmental Justice)
Lisa Grant, District Wild Horse and Burro Specialist (Project Lead: Wild Horses)
Paul Griffin, Wild Horse and Burro Program Research Coordinator
Robert Hopper, State Wild Horse and Burro Specialist and Rangeland Management Specialist, Oregon State Office
Robert Sharp, Supervisory Wild Horse Management Specialist
Stacy Fenton, Geographic Information Specialist
Thomas Wilcox, Outdoor Recreation Planner (Lands with Wilderness Characteristics)
Travis Miller, Wildlife Biologist (Wildlife and Wildlife Habitat including Special Status Species).
Ty Cronin, Environmental Protection Specialist (Noxious Weeds)

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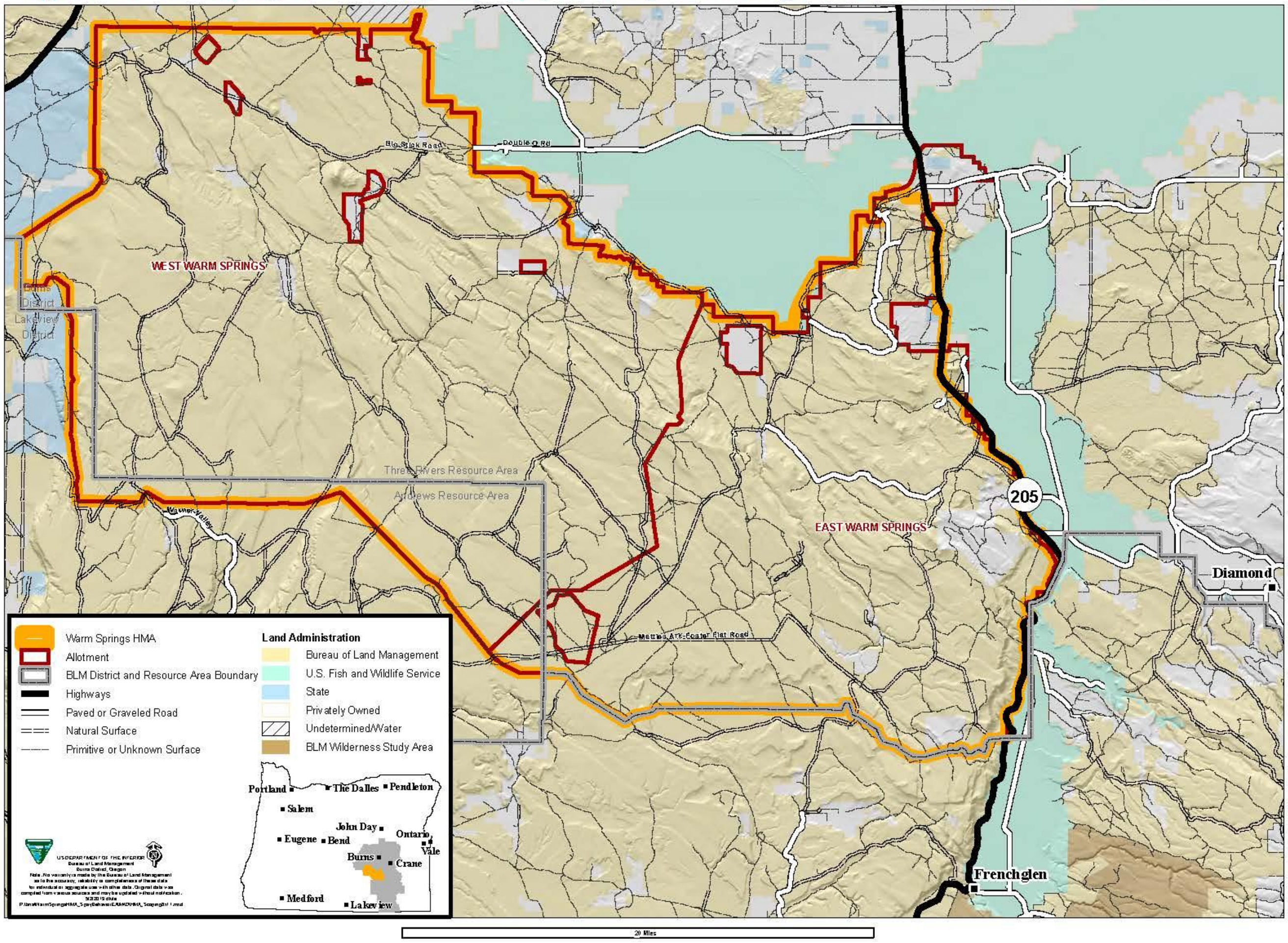
Appendix A: Warm Springs HMA Vicinity Map - Spay Feasibility and On-Range Outcomes Environmental Assessment



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-####)

A. COVER PAGE

BLM Research Proposal Format

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
	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]

[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 $\geq$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 $\geq$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).

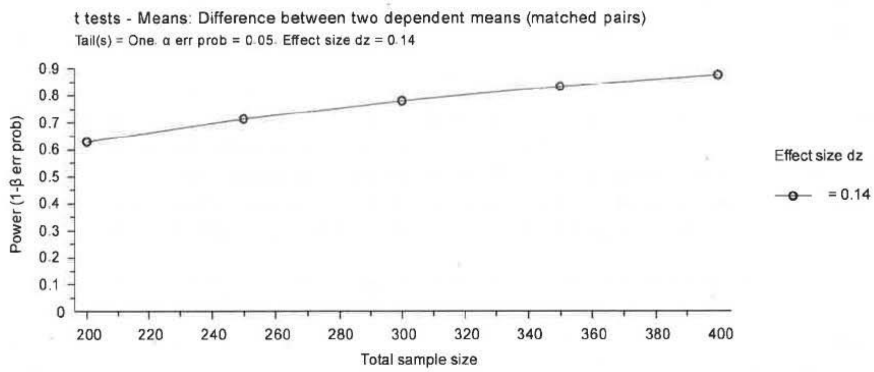
Population Growth: Annual population growth (of individuals ≥ 1 year old) will be calculated using the equation $\lambda_t = N_t / (N_{t-1})$, where λ_t is the growth multiplier from year $t - 1$ to year t, N is the population size. In this formulation, λ represents the apparent growth rate of the population (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.

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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]***/IACUC 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:

Utah:
Axtell Facility: [redacted]
Delta Facility: [redacted]
Cedar City Corrals: [redacted]
Price/San Rafael Area: [redacted]

Wyoming:
[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 ($\geq$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.

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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.

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USGS
science for a changing world

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

Other comments: ____

____

____

____

____

____

____

____

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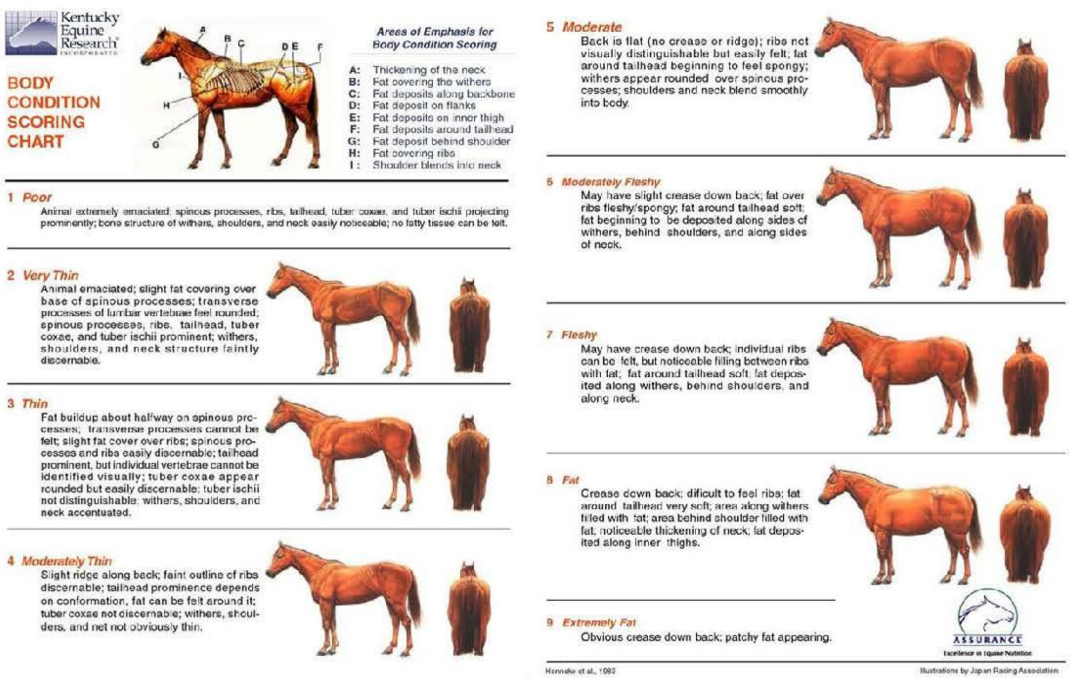

Data written on reverse? Y N

Date: ____/____/____ *Observer/s*: __________

Start time: ____:____ *UTM*: ____________________ *Distance to animals*: _____m

Focal indiv BLM ID# _______

☐ + ☐ + ☐ + ☐ = ☐

Adult males + # Adult females + # yearlings + # foals = Total in group

Temperature:	*Precipitation*:	*Cloud cover*:	*Wind*:
Below freezing	None	None	Still
Cold	Mist	Partly cloudy	Light wind
Cool	Light rain	Mostly cloudy	Gusty
Warm	Heavy rain	Overcast	Very windy
Hot	Snow/ice		

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
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.

Appendix E: Photos of the Oregon Wild Horse Corral Facility.
Below are photos of the handling facilities and holding pens

Photo A: Looking toward front of chute and working area immediately adjacent to the chute.

Photo B: Looking into the chute (from front). Blue mark on far right is a boarded up window to the planned public observation area.

Photo C: Overlooking initial recovery pen inside barn. Blue mark near center is the window to the planned public observation area.

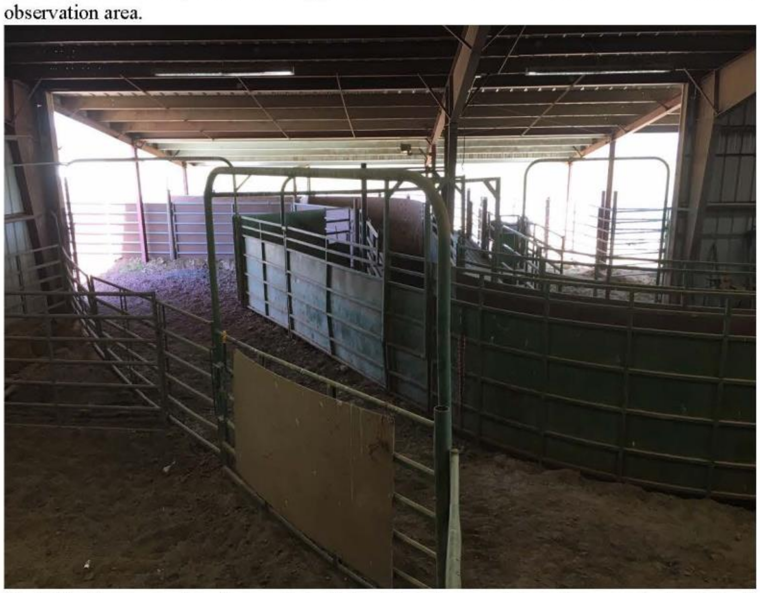

Photo D: From same location as photo C, Looking at sweep (where horses enter barn) leading up to the chute and looking at alley leaving initial recovery pen (where horses exit barn).

Photo E: Looking at holding pens where mares would remain after initial recovery pen. Blue line is the "Auto Tour" road which circles the facility.

Photo F: Additional view of holding pens. Blue line is the "Auto Tour" road on the opposite side of the facility.

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 (Simultaneous double-observer)[a]	279 (East)	36			
		218 (W)	38	19	8	9 horses on State Land
6/7/2017	Ground Count			12	2	Iron Mountain area only.
5/24/2018	Ground Count	NA	NA	21	0	Burro ground count west of Iron Mtn.
6/18-19/2018	Inventory (Simultaneous double-observer)	372 (East)	67			
		306 (West)	87	25 plus 1 mule	4	5 adult/2 foal horses on State land outside HMA.
7/13/2018	Ground Count	NA	NA	21	2	Burro ground count east of Iron Mtn.
October 2018	Gather	655	190	33	8	2 mules captured. Estimated 30 horses and 30 burros remain on range.

*** 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.

[a] These simultaneous double-observer surveys were not intended or designed to be adequate for estimating burro population size.

Appendix G

M E M O R A N D U M
DRAFT – FOR INTERNAL REVIEW

To: Rob Sharp, Paul Griffin (BLM)
CC: Lisa Grant, James Price, Bob Hopper, Justin Rodgers, Alan Shepherd, Bruce Rittenhouse (BLM)
From: L. Stefan Ekernas, USGS
Date: 5 July 2018
RE: Statistical analysis for 2018 survey of horse abundance in Liggett Table, Palomino Buttes, and Warm Springs HMAs, Oregon

I. SUMMARY TABLE

Survey areas and Dates:	**Start date**	**End date**	**Area name**	**Area ID**
	6/18/2018	6/19/2018	Warm Springs HMA	OR0007
	6/19/2018	6/19/2018	Palomino Buttes HMA	OR0006
	6/21/2018	6/21/2018	Liggett Table HMA	OR0037
Type of Survey	Simultaneous double-observer			
Aviation Company	Jairus Duncan (pilot), El Aero, Bell 206 L4 Long Ranger (N226GM) Keegan Bolton (pilot), Reeder, Bell 206 L4 Long Ranger (N356L)			
Agency Personnel	Rob Sharp, Rick Knox, Kyle Jackson, Jim Wagner, James Price, Derek Hammer, and Scott Yamasaki (BLM)			

TABLE 1. Estimated abundance (Estimate) is for the number 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 Mean Group Size	Foals per 100 Adults	Est. No. Horses Outside HMA
Liggett Table HMA	Total	91	86	113	13.1	14.4%	86	5.5%	14	6.5	21.1	36
	Foals	16	15	21	2.7	17.1%	15					
	Adults	76	71	96	10.7	14.1%	71					
Palomino Buttes HMA	Total	241	228	282	26.2	10.9%	228	5.4%	23	10.5	24.9	0
	Foals	48	45	57	5.9	12.2%	45					
	Adults	193	183	226	20.4	10.6%	183					
Warm Springs HMA	Total[b]	852	831	921	33.2	3.9%	831	2.4%	61	14	22.8	7
	Foals[c]	158	154	169	5.1	3.2%	154					
	Adults	694	677	752	28.9	4.2%	677					

[a] The lower 90% confidence limit is based on bootstrap simulation results or the number of horses seen, whichever is higher.

[b] 30 burros and 1 mule were also seen at Warm Springs HMA. I included the mule observation in the analysis of detection probability for horses. I did not have enough data to estimate detection probability for burros, with only 5 groups seen.

[c] In one large group of 82 adults, observers could not get an accurate count on foals even after reviewing video and photos of the group. Only 4 foals were seen in that group, which may be an undercount.

II. NARRATIVE

In June 2018 Bureau of Land Management (BLM) personnel conducted simultaneous double-observer aerial surveys of the wild horse populations in the Liggett Table, Palomino Buttes, and Warm Springs herd management areas (HMAs; Figure 1). Surveys were conducted using methods recommended by BLM policy (BLM 2010) and a recent National Academy of Sciences review (NRC 2013). I analyzed 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 abundance estimates.

Abundance Results

The estimated total horse abundance values (Table 1) within or associated with the surveyed HMAs were relatively large. Observers recorded 94 horse groups, of which 90 horse groups had data recorded in a way suitable to be used in computing statistical estimates of sighting probability. All 94 observations made during 2018 aerial surveys were used to inform the total estimates of abundance. Confidence intervals and coefficients of variation for the total horse abundance estimate in Warm Springs HMA was quite precise (<10% CV), but uncertainty was higher in Palomino Buttes and Liggett Table (Table 1).

I estimate the mean size of detected horse groups, after correcting for missed groups, to be 12.1 horses/group across the surveyed area, with a median of 9.0 horses/group. I estimate 23.1 foals per 100 adult horses at the time of these surveys, with only modest variation between areas. Given the June survey date, this value may not represent all foals born in 2018.

Sighting Probability Results

The combined front observers saw 84.4% of the horse groups (87.3% of the horses) seen by any observer, whereas the back seat observers saw 77.8% of all horse groups (83.9% of horses) seen (Table 2). These results demonstrate that simple raw counts do not fully reflect true abundance without statistical corrections for missed groups made possible by the double observer method and reported here. There were undoubtedly additional groups not seen by any observer; I address this issue in the analysis that follows.

The sample size of observations (90 usable horse groups) was sufficient to parameterize sighting probability functions. I therefore did not pool data from this survey with any other surveys conducted in previous years. Observers were rotated appropriately in the back seat, photographed large horse groups, and carefully noted groups that were double counted; all observers had high detection probabilities, and the survey covered multiple HMAs to increase sample size. All these practices follow guidelines in the draft SOPs and the conduct of the surveys is commendable.

Informed by preliminary analyses, past analyses for this survey area, and *a priori* reasoning, I considered 32 alternative models. Based on preliminary testing, all models used in the double-observer analysis contained:

1. An estimated parameter for an intercept common to all observations; and

2. A parameter for an effect of horse groups located on the pilot's side of the aircraft.

In addition to these 2 parameters listed above, I tested 5 possible effects on sighting probability by fitting models for all possible combinations of these effects, resulting in 32 alternative models. The 5 effects were for (1) horse group size, (2) presence of trees around the horse group, (3) high contrast light, (4) group movement, (5) an average back seat effect. Preliminary testing showed more AICc support for a threshold rather than linear effect of concealing vegetation (trees). I did not include an effect for horse group distance to the transect line, because preliminary testing found implausible results that groups further from the transect line were more likely to be detected. Preliminary testing showed little support for differences between any of the back seat observers.

Groups that were recorded on the centerline, directly under the aircraft, were not available to backseat observers and I therefore set their sighting probability to 0. Sighting probability for groups visible on both sides of the aircraft was computed based on the assumption that both backseat observers could independently have seen them, thereby increasing total detection probability for these groups.

Support (measured as % of AICc model weight) was strong for an average back seat effect (79%), moderate for presence of trees within 10m of the group (47%) and the group moving (46%), and weak for high contrast light (35%) and group size (32%). As expected, estimated sighting probability was higher for groups that were larger, moving, and in flat light, and lower for groups in tree cover, on the pilot's side, and in high contrast light. Sighting probability was lower, on average, for back-seat observers, and did not differ measurably among the individual observers (Table 3)

Estimated overall sighting probabilities, $\hat{p}$, for the combined observers ranged across horse groups from 0.77-1.00. Comparing actual horses seen to the estimated abundance computed from the overall $\hat{p}$ from all HMAs combined, I estimate that 3.2% of the horses in these surveys were never seen by any of the observers, with some differences between HMAs (Table 1). A combination of large group sizes, few trees, and experienced observers with high acuity contributed to high overall detection probabilities. One observer became airsick and was replaced by a different observer the next day, but the airsick observer maintained high detection probability.

<u>Assumptions and Caveats</u>

Results from this double observer analysis are a conservative estimate of abundance. True abundance values are likely to be higher, not lower, than abundance estimates in Table 1 because of several potential sources of bias that I list below. 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. Nonetheless, results of the analysis should always be interpreted with a clear understanding of the assumptions and implications.

1. 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. Abundance values reported here may vary from the annual March 1 population estimates for each HMA; aerial survey data are just one component of all the available information that BLM uses to make March 1 population estimates. Aerial surveys only provide information about the area surveyed at the time of the survey, and do not account for births, deaths, movements, or any management removals that may have taken place afterwards.

2. Double-observer analyses cannot account for undocumented animal movement between, within, or outside of HMAs. The surveyed HMAs are largely enclosed by fencing, roads, or natural barriers. 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 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 that normally live in the target HMAs having not being present at the time of survey. In principle, if the level of such movement were high, then the numbers of animals found within the survey areas at another time could differ substantially. If there were any wild horses that are part of a local herd but were outside the surveyed areas, then the estimates in Table 1 underestimates true abundance.

3. 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. Animal movements during a survey can potentially bias results if those movements result in unintentional over- or under-counting of horses. 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. Groups that were never available to be seen (for example due to temporary emigration out of the study area or undetected movement from an unsurveyed area to an already-surveyed area) can lead to estimates that are negatively biased compared to the true abundance.

   Each HMA required multiple flights with intervening fuel stops that thereby created some opportunity for horses to move between surveyed and unsurveyed areas. The identification of 'marker' horses (with unusual coloration) in observed groups was recorded on paper, and variation in group sizes helped the observers to reduce the risk of double counting during aerial surveys. Observers also took photographs of many observed groups, and used those photos after landing to identify any groups that might have been inadvertently recorded twice. Unfortunately, there is no effective way after the survey to correct for the converse problem of horses fleeing and thus never having the opportunity for being detected. Because observers can account for horse movements leading to double counting, but cannot account for movement causing horses to never be observed, animal movements can contribute to the estimated abundance (Table 1) potentially being lower than true abundance

4. The double observer 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 abundance. In other words, even under ideal conditions the double-observer method tends, if anything, to provide underestimates of abundance.

5. I must assume 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 could lead to biased estimates of abundance. Observers in this survey followed draft SOPs for WHB aerial surveys, circling over many groups to get as accurate a count as possible and using photography for groups of >20 horses. Nonetheless, foals could not be accurately counted even from video in one large group in Warm Springs HMA. Foal numbers I report here may consequently be too low in this HMA.

Suggestions for Future Surveys

Observations about the data may offer opportunities to improve future surveys.

1. This survey had a high number of observers (5 back seat observers and 2 pilots in total). Reducing the number of observers would minimize potential error and improve uncertainty estimates.

TABLE 2. Tally of raw counts of horses and horse groups by observer (front, back, and both) for combined data from Liggett Table, Palomino Buttes, and Warm Springs HMAs surveyed in June 2018.

Observer	Groups Seen[a] (Raw Count)	Horses Seen[a] (Raw Count)	Actual Sighting Rate[b] (groups)	Actual Sighting Rate (Horses)
Front	76	853	84.4%	87.3%
Back	70	820	77.8%	83.9%
Both	56	696	62.2%	71.2%
Combined	90	977		

[a] Includes only groups and horses where protocol was followed.

[b] 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 during the June 2018 survey of Liggett Table, Palomino Buttes, and Warm Springs HMAs. Baseline case (bold) for horses presents the predicted sighting probability for a group of 9 horses (the median group size observed) that are not moving, with no trees, in flat light, not on the pilot's side, with the average back-seat observer. Other example cases vary a covariate or observer, one effect at 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 shows in bold wherever they occur. Sighting probabilities are weighted averages across all 32 models considered (Burnham and Anderson 2002).

	Sighting Probability, Front Observer[a]	Sighting Probability, Back Observer	Combined Sighting Probability
Baseline	**92.4%**	**80.8%**	**98.5%**
Effect of group size (N=1)	92.1%	80.0%	98.4%
Effect of group size (N=20)	92.7%	81.7%	98.7%
Effect of moving	94.8%	86.4%	99.3%
Effect of trees	88.5%	72.5%	96.8%
Effect of high contrast light	90.4%	76.6%	97.8%
Effect of PilotSide	52.7%	**80.8%**	90.9%
Effect of back=front detection	**92.4%**	92.4%	99.4%

[a] Sighting probability for the front observers acting as a team, regardless of which of the front observers saw the horses first.

Literature Cited

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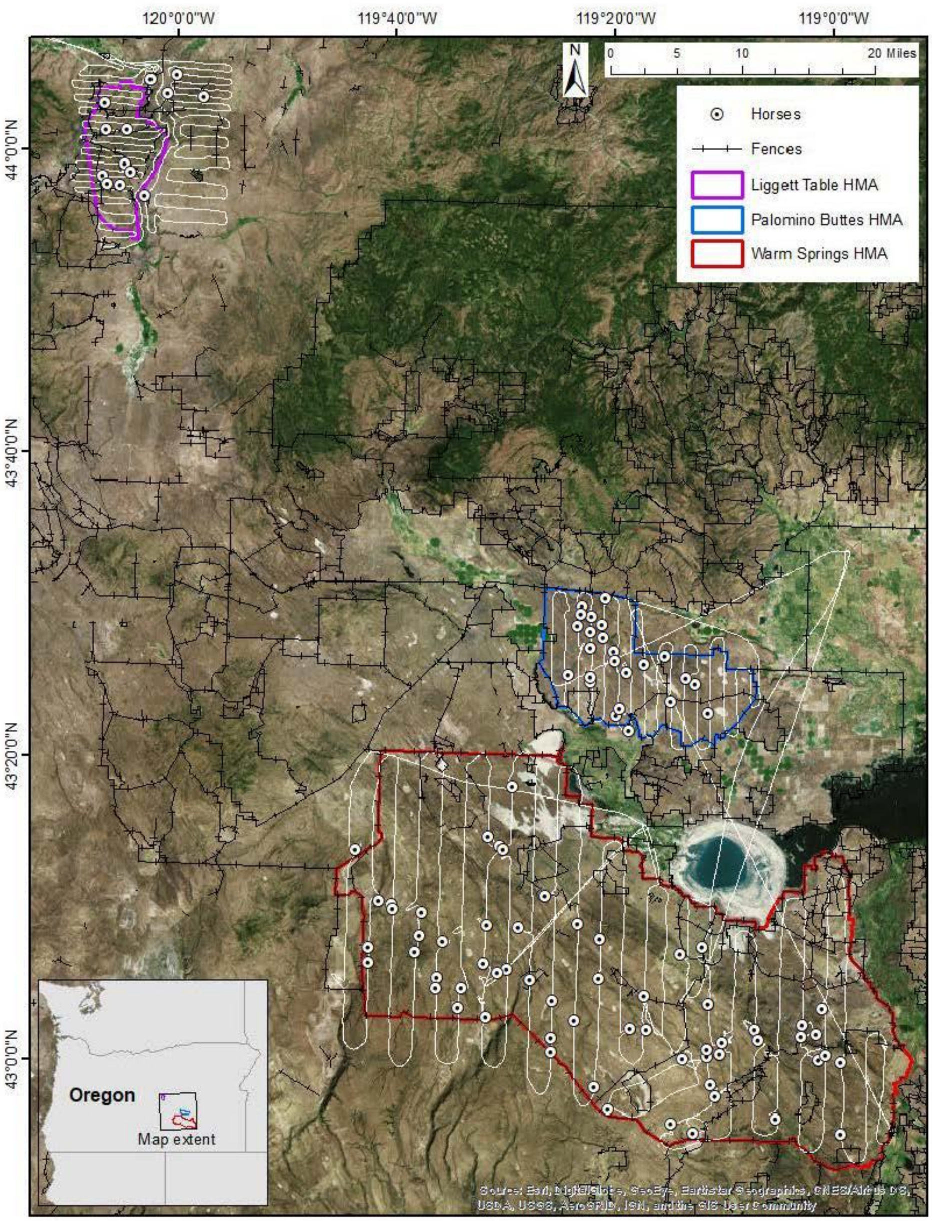
Burnham, K., and D. R. Anderson. 2002. Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach. Springer-Verlag, New York, New York.

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 page). Maps of survey tracks flown (white lines), fences (black lines), locations of observed horse groups (black and white circles), and surveyed HMA boundaries.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119°40'0"W
119°20'0"W
119°0'0"W
44°0'0"N
43°40'0"N
43°20'0"N
43°0'0"N
N
0
5
10
20 Miles
Horses
Fences
Liggett Table HMA
Palomino Buttes HMA
Warm Springs HMA
Oregon
Map extent

M E M O R A N D U M

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.

<u>Sighting Probability Results</u>

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%

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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.

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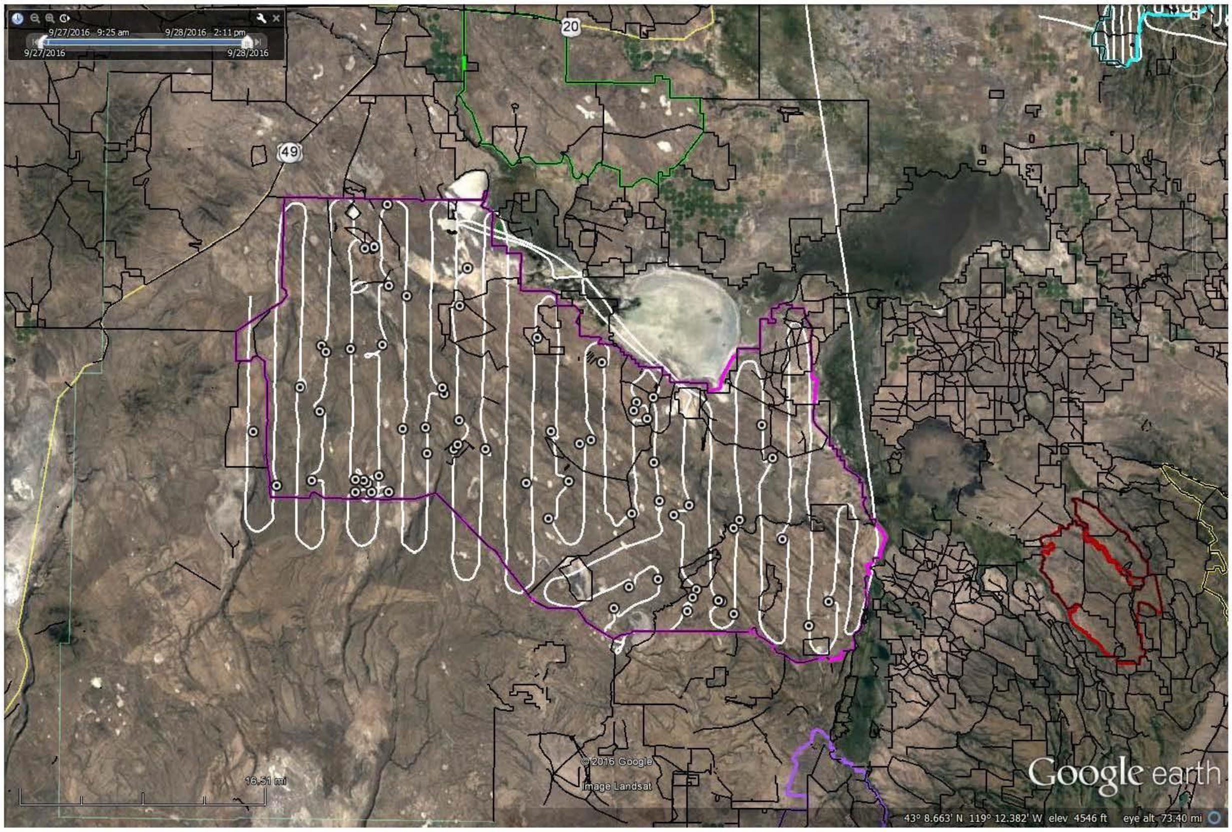
National Research Council. 2013. Using Science to Improve the BLM Wild Horse and Burro Program. The National Academies Press. Washington, D.C.

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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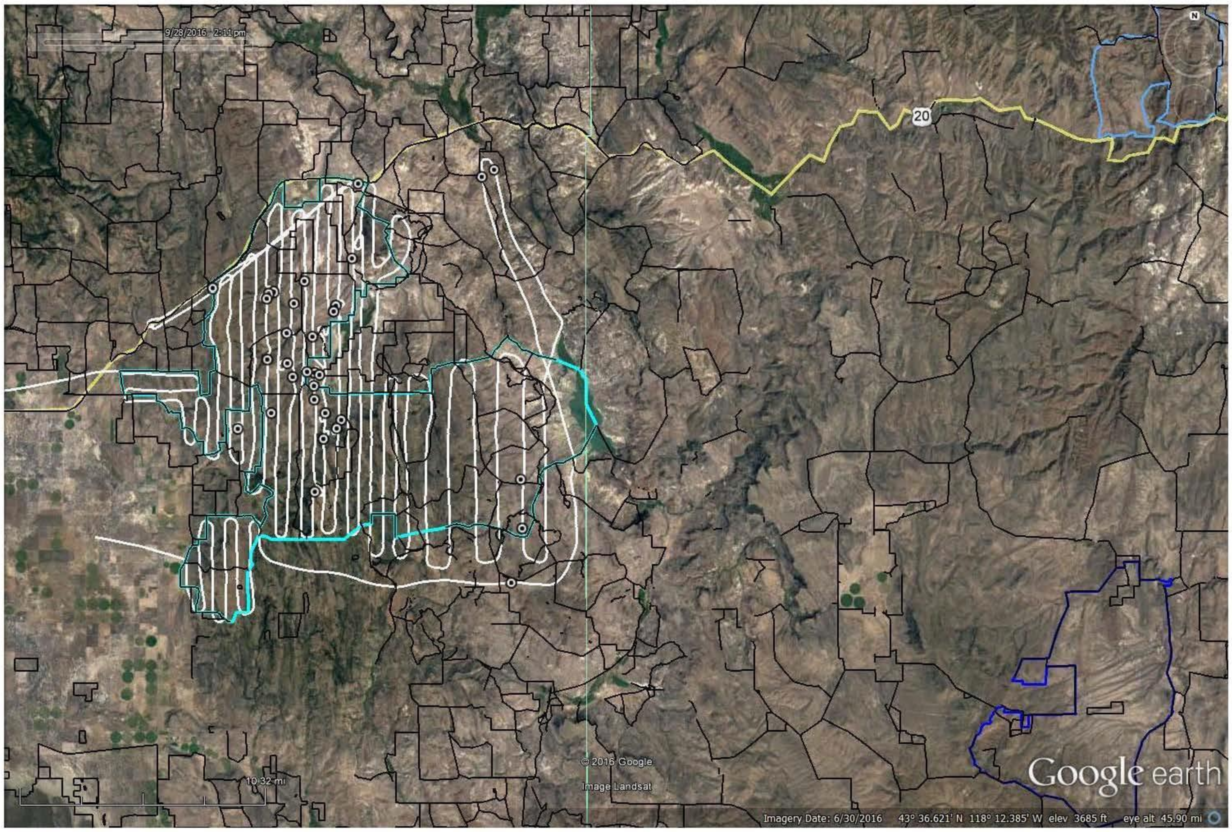
B.



10

<u>WinEquus – Warm Springs HMA</u>
<u>DOI-BLM-ORWA-B050-2019-0013-EA – April 17, 2019</u>

<u>WinEquus parameters for all models</u>
S. King's age ratio from Scenario 3, scaled appropriately
garsurv, garfoal
Tools | Advanced Options| Is initial population size exact? YES
Start in 2020
Survival and foaling rates are from Garfield flats (garsurv and garfoal), which is the highest combo in WinEquus and project about 18% annual growth rate.

Females won't give birth in 2020 because held at Oregon Coral Facility separate from stallions since October 2018 – like they were treated in 2019.
In this model, infertility runs out in five years. These scenarios were only run through 2025 for comparison of alternatives.

<u>No Action</u>
Start low AML (96), PZP
Sex ratio 50:50
Age: return 1 year olds and up, even age distribution
Treat 33 mares: 100%
30 animals out there uncaught
Returning 66 total: 33 mares and 33 stallions
Just one year treatment and then leaving them
2020-2025

<u>WinEquus parameters</u>
PZP effectiveness: 51%, 30%, 0,0,0
Sarah King's age ratio from Scenario 3, scaled to 96 animals
% Pop that can be gathered: 69% (to capture 33 out of 48 mares)
Treat in specific years: 2019
Gather for fertility treatment regardless of pop size: YES

<u>Spaying scenario 2: USGS</u>
<u>Control population: 2020-2022 (but really 2020 to get no foaling or foals)</u>
Start with exactly 115 animals; starting ages shown in screenshot
Percent of population that can be gathered: 100%
Plus 15 animals 50/50 still out there, call them all adults

<u>WinEquus parameters</u>
Management | No management

<u>Treatment population: 2020-2022</u>
Start with exactly 115 animals; starting ages shown in screenshot
Spay 0% of foals, yearlings, and 2 year olds, 75% of all age classes 3+
31 mares getting spayed. 8 mares are untreated. 6 1yo and 5 female foals untreated.

<u>WinEquus parameters</u>
Management| Fertility control only | 2020-2022
Gather in specific years: 2019

Gather for fertility treatment regardless of population size? YES
Contraceptive at 100% for 5 years
Percent of population that can be gathered: 100%
Treat 90% of horses 3+ to get 31 mares spayed. Model only captures 106 horses, I don't know why.

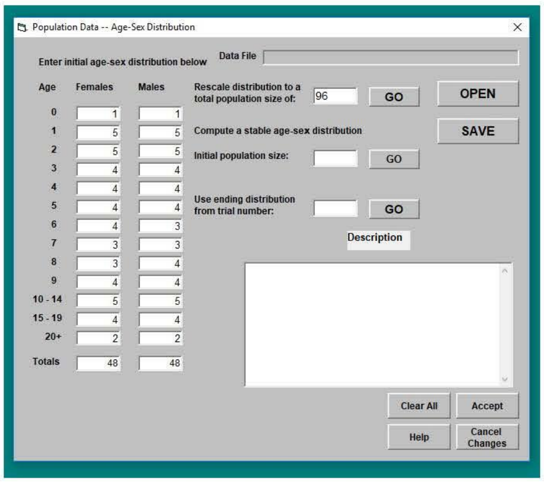
Then unite the clans in 2023 and run the populations together through 2025
Model spaying having already happened in 2019.
Starting population is 176+153=329, median trials from control & treatment in 2022

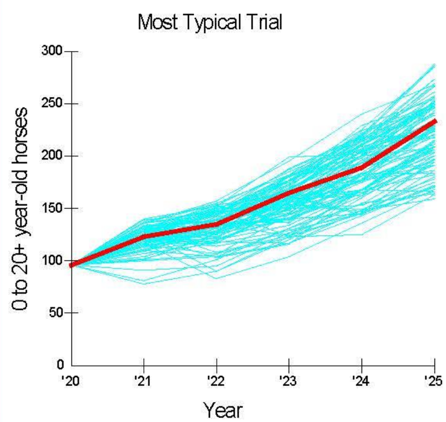
WinEquus parameters
Start with median + median animals =329
Use age-sex from earlier, but add 100 new animals into ages 0,1,2
Management| Fertility control only | 100% effectiveness
Specific years, 2023
Treat only 3+ year olds, treating 90% again (this ignores aging, but so does our age structure above 3 year olds)
-Note that fertility wears off by 2027, and doesn't kick in the first year.

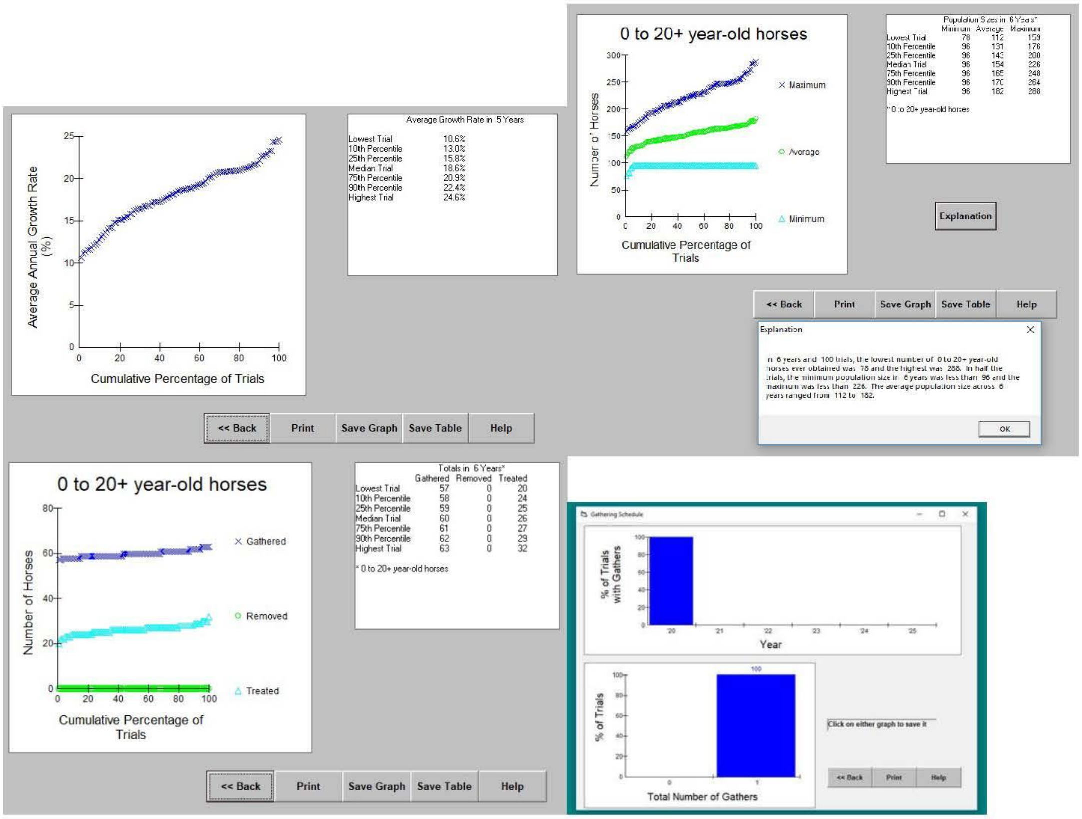
Scenario 3:
30 animals out there
33 males untreated
33 mares spayed. No foals released.
2020-2025 to avoid having spaying run out, or needing to re-treat which really screws up the results.

WinEquus parameters
New starting age-sex population as pictured, with 96 animals
Capture 100%
Spay 100% animals >=2 years old to get 33 mares treated, modeling 15 unspayed mares
-Even at 100% capture it only gathers 87 of the 96 animals.
Management| Fertility control only| gather specific years: 2020
100% effectiveness
Gather for fertility treatment regardless of pop size: YES

No Action

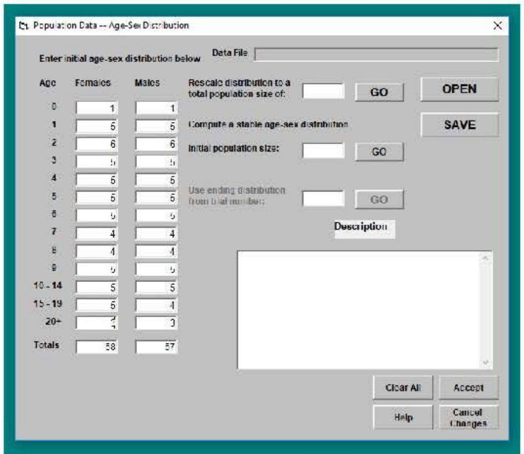

Population Data -- Age-Sex Distribution
Enter initial age-sex distribution below
Data File
Age Females Males
0 1 1
1 5 5
2 5 5
3 4 4
4 4 4
5 4 4
6 4 3
7 3 3
8 3 4
9 4 4
10 - 14 5 5
15 - 19 4 4
20+ 2 2
Totals 48 48
Rescale distribution to a total population size of: 96
GO
OPEN
SAVE
Compute a stable age-sex distribution
Initial population size:
GO
Use ending distribution from trial number:
GO
Description
Clear All
Accept
Help
Cancel Changes

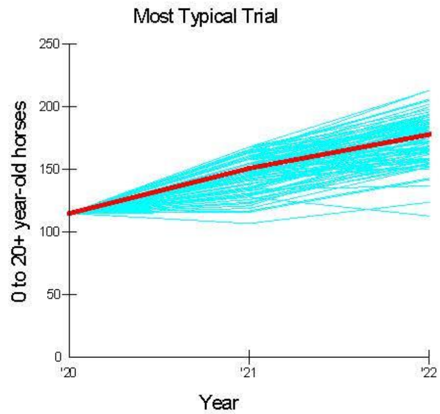

Most Typical Trial
0 to 20+ year-old horses
300
250
200
150
100
50
0
'20
'21
'22
'23
'24
'25
Year

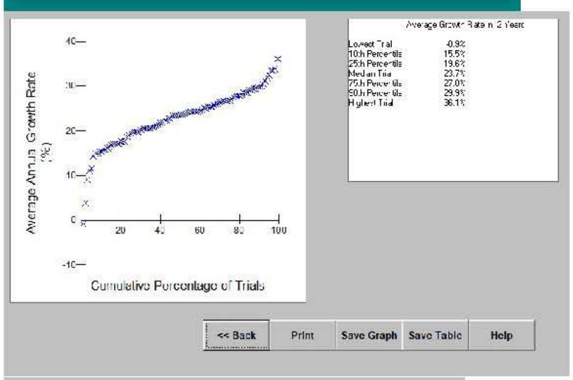


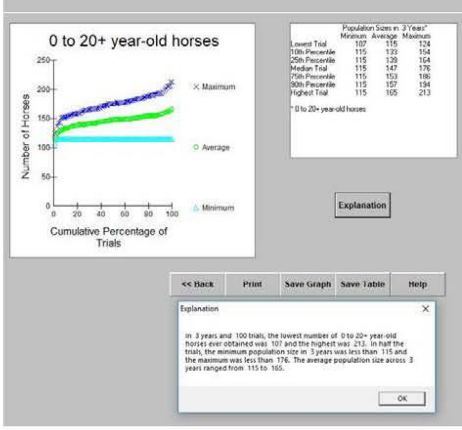
Alternative B – Proposed Action: Spay Feasibility Study and USGS Behavioral Outcomes Assessment.

Control Population (2020 – 2022)

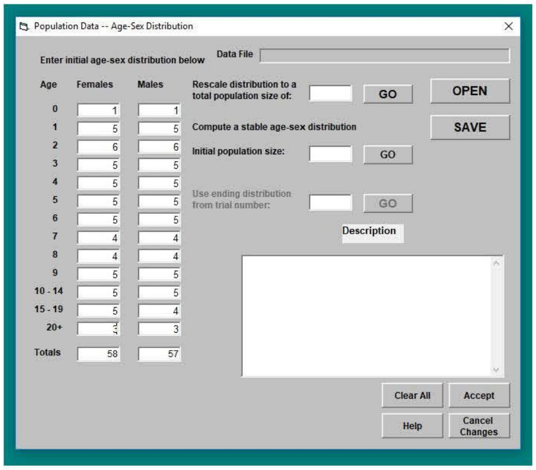


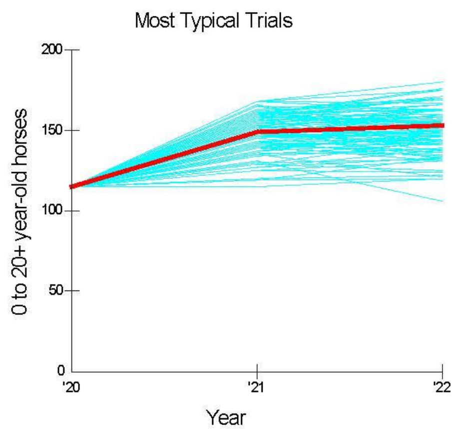


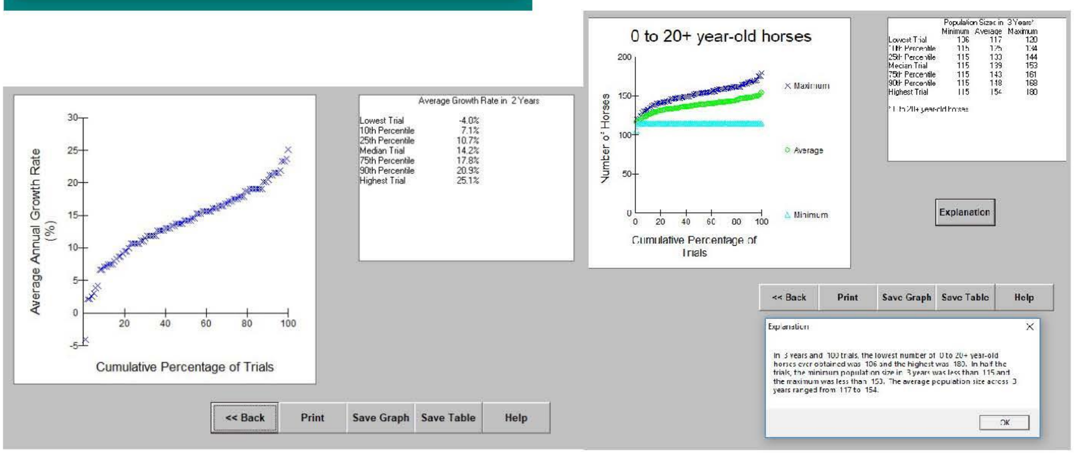


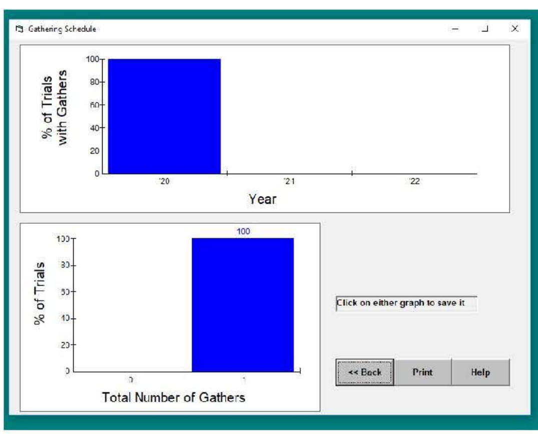


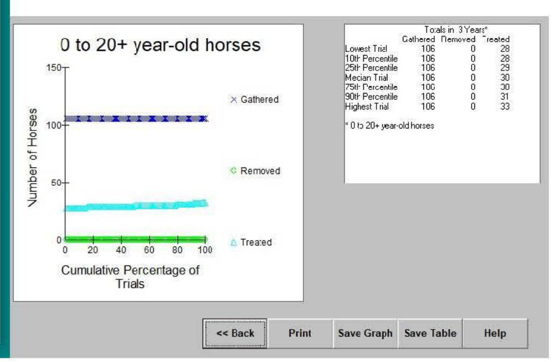
Treatment Population (2020-2022)


Population Data -- Age-Sex Distribution
Enter initial age-sex distribution below
Data File
Age
Females
Males
Rescale distribution to a total population size of:
GO
OPEN
SAVE
Compute a stable age-sex distribution
Initial population size:
Use ending distribution from trial number:
Description
Totals
58
57
Clear All
Accept
Help
Cancel Changes

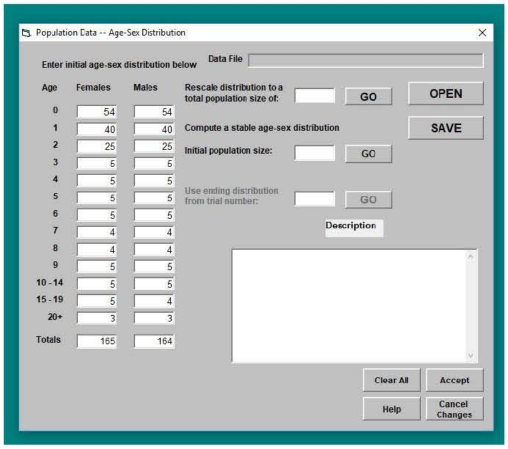

Most Typical Trials
0 to 20+ year-old horses
Year

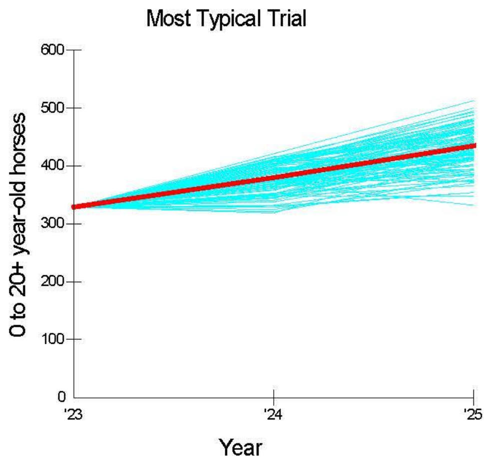

Average Annual Growth Rate (%)
Cumulative Percentage of Trials
Average Growth Rate in 2 Years
Lowest Trial -4.0%
10th Percentile 7.1%
25th Percentile 10.7%
Median Trial 14.2%
75th Percentile 17.8%
90th Percentile 20.9%
Highest Trial 25.1%
0 to 20+ year-old horses
Number of Horses
Maximum
Average
Minimum
Population Sizes in 3 Years*
Explanation
<< Back
Print
Save Graph
Save Table
Help

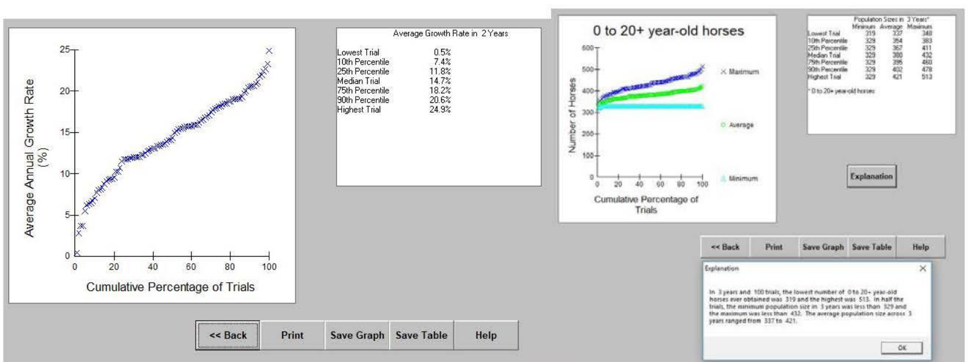

Gathering Schedule
% of Trials with Gathers
Year
% of Trials
Total Number of Gathers
Click on either graph to save it
<< Back
Print
Help

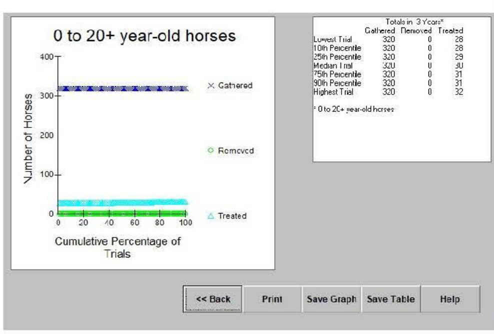

0 to 20+ year-old horses
Number of Horses
Gathered
Removed
Treated
Cumulative Percentage of Trials
Totals in 3 Years*
* 0 to 20+ year-old horses
<< Back
Print
Save Graph
Save Table
Help

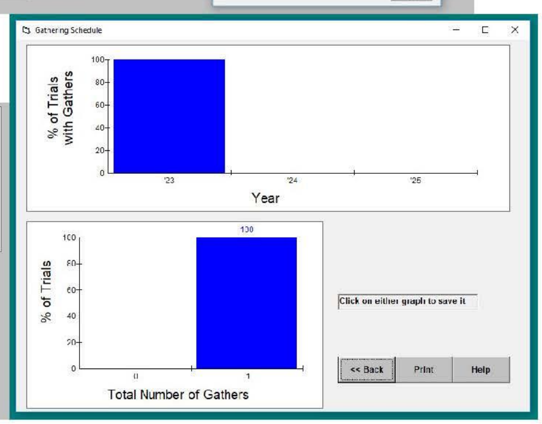
Alternative B – Proposed Action <u>continued</u> – (2023-2025) Post On-Range Observations, Control & Treatment Populations United.



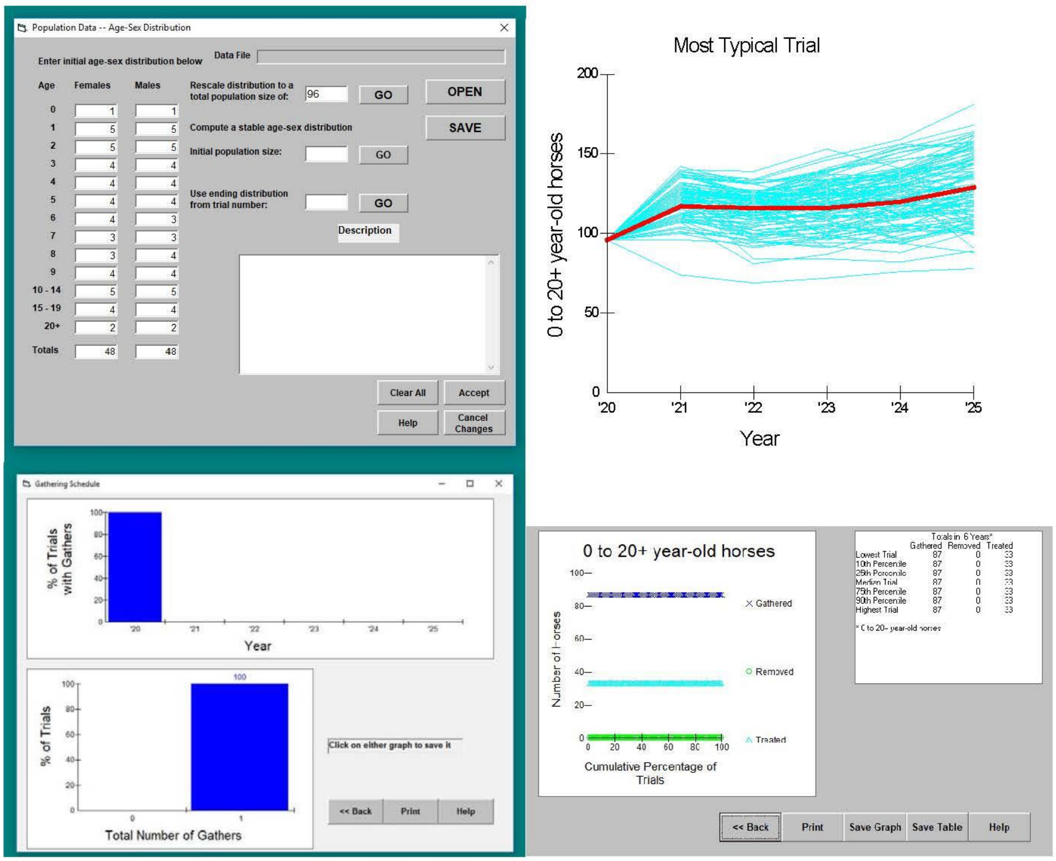


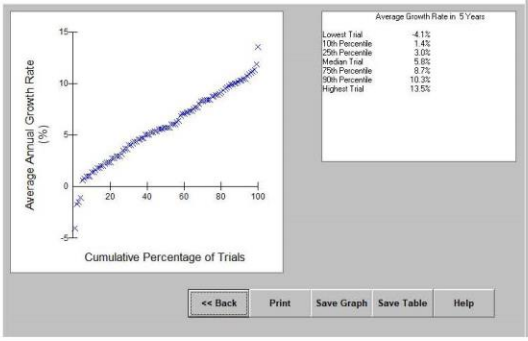


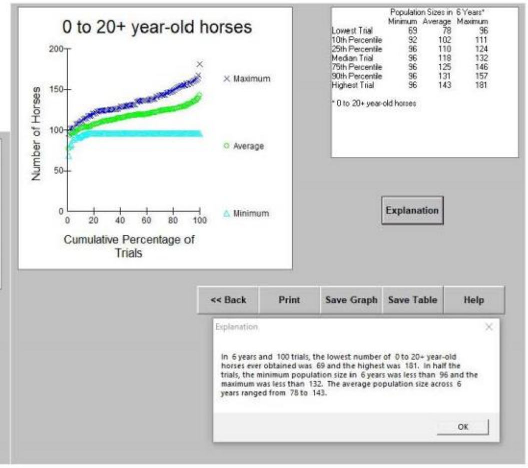




Alternative C – Spay Feasibility Action with Limited On-Range Behavioral Outcomes Assessment (2020 – 2025).




Average Annual Growth Rate (%)
Cumulative Percentage of Trials
Average Growth Rate in 5 Years
Lowest Trial -4.1%
10th Percentile 1.4%
25th Percentile 3.0%
Median Trial 5.8%
75th Percentile 8.7%
90th Percentile 10.3%
Highest Trial 13.5%
<< Back
Print
Save Graph
Save Table
Help


0 to 20+ year-old horses
Number of Horses
Cumulative Percentage of Trials
Maximum
Average
Minimum
Population Sizes in 6 Years*
Minimum Average Maximum
Lowest Trial 69 78 96
10th Percentile 92 102 111
25th Percentile 96 110 124
Median Trial 96 118 132
75th Percentile 96 125 146
90th Percentile 96 131 157
Highest Trial 96 143 181
* 0 to 20+ year-old horses
Explanation
<< Back
Print
Save Graph
Save Table
Help
Explanation
In 6 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 69 and the highest was 181. In half the trials, the minimum population size in 6 years was less than 96 and the maximum was less than 132. The average population size across 6 years ranged from 78 to 143.
OK

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240

Appendix J

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.

<u>HMA Selection</u>

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.

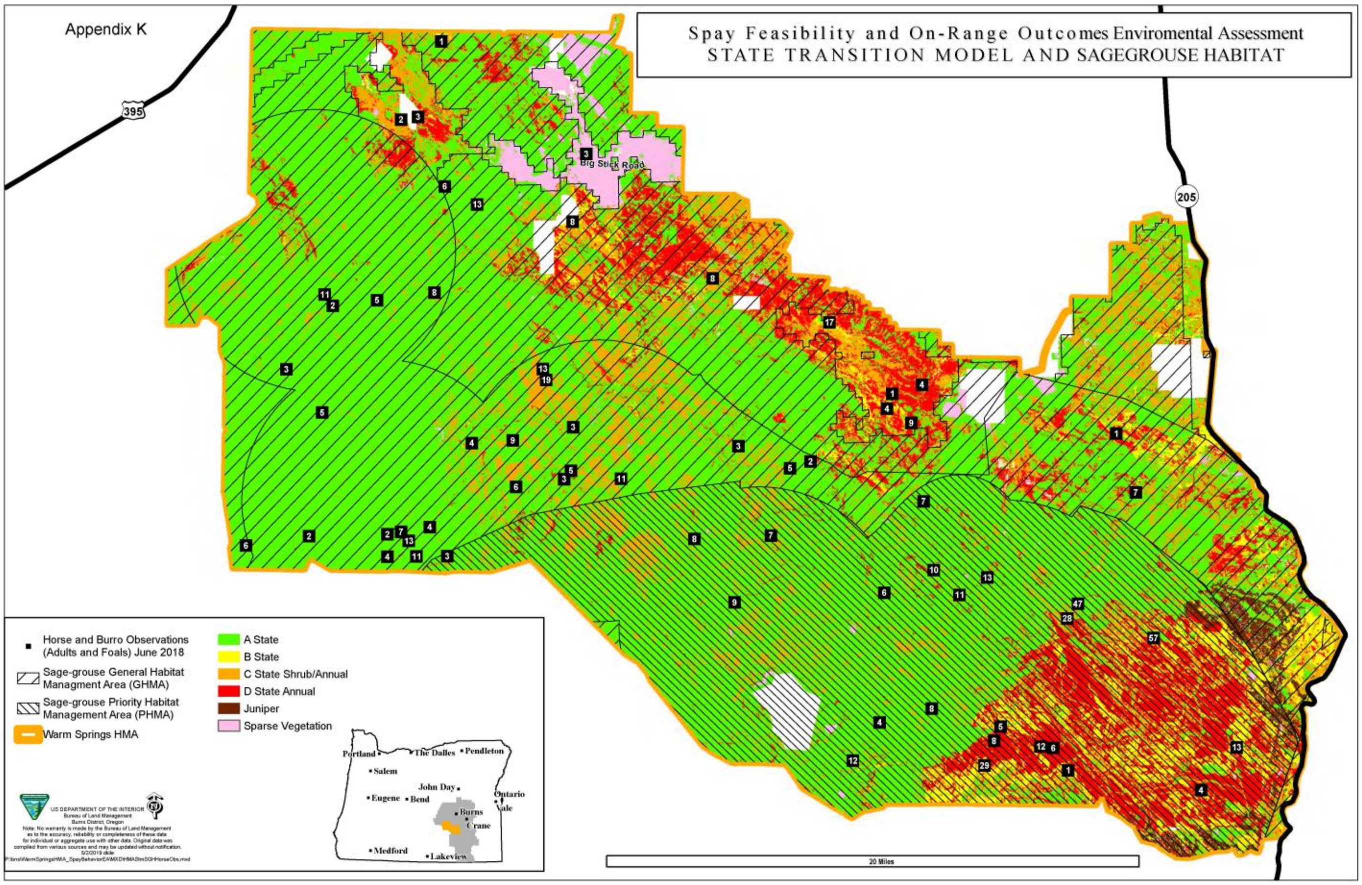
22-month time-release pelleted vaccine:

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.



Appendix K
Spay Feasibility and On-Range Outcomes Enviromental Assessment
STATE TRANSITION MODEL AND SAGEGROUSE HABITAT
395
205
Big Stick Road
Horse and Burro Observations (Adults and Foals) June 2018
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
US DEPARTMENT OF THE INTERIOR
Bureau of Land Management
Burns District, Oregon
Note: No warranty is made by the Bureau of Land Management as to the accuracy, reliability or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources and may be updated without notification.
Portland
The Dalles
Pendleton
Salem
John Day
Eugene
Bend
Ontario
Vale
Burns
Crane
Medford
Lakeview
20 Miles