BLM

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Bureau of Land Management

Environmental Assessment

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December 2018

Onaqui Mountain Herd Management Area
Population Control

Location: Townships 6-11 South, Ranges 5-9 West, multiple sections, Salt Lake Meridian, Tooele County, Utah.

Applicant/Address: Not Applicable.

Salt Lake Field Office
2370 South Decker Lake Boulevard
West Valley City, Utah 84119
Phone: (801) 977-4300
Fax: (801) 977-4397

Salt Lake Field Office

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1.0 PURPOSE & NEED

1.1 Executive Summary

This Environmental Assessment (EA) has been prepared to analyze the Bureau of Land Management's (BLM) Salt Lake Field Office (SLFO) proposed action to achieve and maintain the appropriate management level (AML) for wild horses in the Onaqui Mountain Herd Management Area (HMA). To achieve and maintain AML, the BLM proposes to use bait/water traps and/or helicopters to gather and remove excess wild horses from inside and adjacent to the HMA, including an initial gather and maintenance gathers to achieve and maintain AML in the HMA. The BLM is also considering treating mares with fertility control (immuno-contraceptive) vaccine(s) and conducting sterilization activities (spaying and neutering) on mares and stallions to assist in maintaining the AML. The BLM recognizes gelding as a horse-specific term that sterilizes a stallion horse through castration. Throughout the EA the term neutering will be used to describe the act of sterilizing a stallion. The term gelding is used to describe a stallion that has been neutered.

This EA is a site-specific analysis of potential impacts that could result from the implementation of the alternatives. The EA assists the BLM in project planning and ensuring compliance with the National Environmental Policy Act (NEPA), and in making a determination as to whether any "significant" impacts could result from the analyzed actions. "Significance" is defined by NEPA and is found in regulation 40 CFR 1508.27. An EA provides evidence for determining whether to prepare an Environmental Impact Statement (EIS) or a statement of "Finding of No Significant Impact" (FONSI). If the decision maker determines that this project has "significant" impacts following the analysis in the EA, then an EIS would be prepared for the project. If not, a Decision Record may be signed for the EA approving the selected alternative, whether the proposed action or another alternative. A Decision Record (DR), including a FONSI statement, documents the reasons why implementation of the selected alternative would not result in "significant" environmental impacts (effects) beyond those already addressed in Pony Express Resource Management Plan (as amended) (BLM 1990).

The State of Utah's Public Land Policy Coordinating Office (PLPCO), the State of Utah's School and Institutional Trust Lands Administration (SITLA), and Dugway Proving Ground, West Desert Test Center (DPG) were cooperating agencies in the preparation of this EA. Additional information is presented in Section 5.4.

1.2 Background

Since the passage of the Wild Free-Roaming Horses and Burros Act (WFRHBA) of 1971, BLM has implemented and refined its understanding of how to manage wild horse population levels. By law, BLM is required to control any overpopulation, by removing excess animals, once a determination has been made that excess animals are present and removal is necessary. Program goals have always been to establish and maintain a "thriving natural ecological balance" (TNEB), which requires identifying and achieving the AML for individual herds.

Decreasing the numbers of excess wild horses on the range is consistent with findings and recommendations from the National Academy of Sciences (NAS), American Horse Protection Association (AHPA), the American Association of Equine Practitioners (AAEP), Humane Society of the United States (HSUS), Government Accountability Office (GAO), Office of Inspector General (OIG) and current BLM policy.

The legal land description for the Onaqui Mountain HMA is Townships 6-11 South, Ranges 5-9 West, multiple sections, Salt Lake Meridian, Tooele County, Utah (Appendix A, Figure 1).

1.3 Purpose and Need

The BLM's purpose for agency action is to manage wild horses within the HMA in a manner that achieves and maintains the herd within the established AML and comply with applicable land use plans. Wild horse numbers must also be managed in a manner that maintains/restores a TNEB and multiple use relationships on the public lands consistent with the provisions of Section 1333(a) of the WFRHBA. The BLM must properly manage rangeland resources and prevent unnecessary or undue degradation of the public lands associated with excess populations of wild horses within the HMA.

The BLM's need for agency action is to address resource impacts caused by the current overpopulation of wild horses, identify long-term management requirements of the HMA including identification of strategies and techniques that maintain herd health, control wild horse numbers inside and adjacent to the HMA to stay within the established AML, and properly manage wild horse numbers in a manner that minimizes their use of rangeland resources adjacent to the HMA.

In addition, the BLM's need for agency action is to comply with the required adaptive management triggers (hard triggers) included in the Approved Resource Management Plan Amendment for greater sage-grouse for the Great Basin Region, including the greater sage-grouse Sub-Regions of Idaho and Southwestern Montana, Nevada and Northeastern California, Oregon, and Utah (ARMPA; BLM 2015a, BLM 2015b). The Sheeprocks Greater Sage-grouse Population Area, which overlaps with a portion of the HMA, has hit a hard trigger due to declining population numbers, which necessitates immediate management action to stop a severe deviation from sage-grouse conservation objectives (BLM 2017). This trigger includes gathering wild horse populations with the affected area to the low end of AML (BLM 2015b, Appendix I).

1.3.1 Decision to be Made

The decision to be made is if the removal of excess wild horses in the HMA via gathers (helicopter/trapping) and the use of fertility control methods (vaccinations: *Porcine zona pellucida* (PZP), GonaCon-Equine; sterilizations: spaying and neutering) should be part of the management of the herd (including actions that achieve and maintain AML), and under what conditions (protective measures and/or standard operating procedures).

The BLM is not considering whether to re-evaluate the AML or adjust livestock numbers at this time.

1.4 Conformance with BLM Land Use Plan(s)

The alternatives are in conformance with the Pony Express Resource Management Plan (RMP) (January 1990) (BLM 1990), as amended, and is consistent with the following objectives, goals, and decisions of the approved plan:

- Wild Horse Decision 1 (page 34) – manage herd size.
- Soil, Water, and Air Decision 1 (page 30) – evaluate on a case-by-case basis.
- Cultural Resource Decision 1 (page 49) – inventory and evaluate.

The alternatives are consistent with the applicable regulations at 43 CFR 4700 and with the WFRHBA.

The alternatives are also consistent with the objectives, goals, and decisions related to the BLM's programs (including but not limited to): Range, Recreation, Lands, Fire, and Wildlife/Fisheries. It has been determined that the action alternatives would not conflict with other decisions throughout the RMP, as amended.

The Onaqui Mountain Herd Management Area AML and boundary were amended by the Decision Record issued for Wild Horse Appropriate Management Level and Herd Management Area/Herd Boundary Environmental Assessment (UT-020-2002-100) (February 2003) (BLM 2003).

The BLM's goals and objectives for managing the greater sage-grouse were implemented in the ARMPA (BLM 2015a; BLM 2015b).[1] The Sheeprocks Greater Sage-grouse Population Area, which overlaps with a portion of the HMA, has hit a hard trigger due to declining population numbers, which necessitates immediate management action to stop a severe deviation from sage-grouse conservation objectives (BLM 2017). In 2017, the BLM determined that this population had declined and adaptive management was implemented, per ARMPA (MA-SSS-7 and Appendix I), as described in BLM Utah Information Bulletin (IB) 2017-101 (BLM 2017). As part of the adaptive management strategy, ARMPA's Appendix I requires the BLM to "initiate emergency gathers to reduce wild horse and burro populations within affected area to low end of AML, subject to funding and holding space availability."

1.5 Relationship to Statutes, Regulations, or Other Plans

Implementation of the action alternatives is consistent with the applicable federal and state statues[2], regulations, policies, county ordinances and other plans to the maximum extent possible. Federal policies include BLM Manuals, Handbooks (H), Instruction Memorandum (IM) [Washington Office (WO) and Utah State Office (UTSO)], and Information Bulletins (IB); which are summarized in Appendix B. Compliance with applicable statue, regulation, and policy includes the completion of procedural requirements, including consultation, coordination, and cooperation with stakeholders, interested publics, and Native American Tribes and completion of the applicable level of NEPA review.

The following documents are incorporated by reference:

- Wild Horse Appropriate Management Level and Herd Management Area/Herd Boundary EA, FONSI, and DR – UT-020-2002-100. Addressed establishing an AML and HA/HMA boundaries through a plan amendment process. The AML was set at 159 wild horses with a range of 121-210. Wild horses would be gathered when their numbers exceeded 210 and would be reduced to the low of 121 individuals. In the event of forage shortages, emergency gathers would be necessary to maintain a thriving ecological balance. Issued in February 2003.

[1] The BLM published a Notice of Intent (NOI) in 2017 that announced the Bureau's efforts to amend its land use plans for the management of the greater sage-grouse. The BLM published the corresponding Final EIS in Decemeber 2018. As this plan amendment is still in progress, this EA includes analysis of greater sage-grouse management as currently directed under the 2015 ARMPA.

[2] BLM considered the officially approved and adopted State Resource Management Plan, the officially approved and adopted Tooele County Resource Plan. Refer to Appendix B for more information. The plans can be found at: https://bit.ly/2TRHKdr

- Cedar Mountain and Onaqui Mountain Wild Horse Herd Management Areas Capture, Treat and Release Plan Fertility Control with Limited Removal EA, FONSI, and DR – UT-W010-2011-0031-EA. Addressed gathering excess animals to slow population growth, maintaining numbers at AML, applying the fertility control vaccine PZP-22, and extending the time between gathers. Issued in January 2012.
- Onaqui Mountain Herd Management Area Fertility Control EA, FONSI, and DR – UT-W010-2014-0021-EA. Addressed the use of ZonaStat-H to treat mares through darting to reduce the population growth of the Onaqui HMA. Issued in May 2015.
- The Utah GRSG Final EIS, Record of Decision, and ARMPA (BLM 2015a, BLM 2015b). Addressed management actions for land uses including wild horses, livestock grazing, and wildfire in greater sage-grouse habitat. Issued in September 2015.
- Greater Sheeprocks Sage-Grouse Habitat Restoration and Hazardous Fuels Treatment EA, FONSI, and DR – UT-W020-2016-0008-EA. Addresses the use of various fuels reduction treatments to improve the habitat for sage-grouse within the Greater Sheeprocks area. Issued in August 2017.
- Onaqui Complex Emergency Stabilization and Burned Area Rehabilitation Plan. Describes in detail what treatments will be done to improve the habitat that was burned during the summer of 2017. Issued in August 2017.

1.6 Identification of Issues

Identification of issues requiring analysis was accomplished through internal review/discussion, coordination with cooperating agencies, and through addressing scoping comments submitted from the public.

The BLM's interdisciplinary team (IDT) identified which resources within the HMA might be affected by the proposed alternatives, and considered potential impacts using current office records, geographic information system (GIS) data, site visits, and information received from the public. The results of this review are summarized in the IDT Checklist (Appendix B) and in the Scoping Report (BLM 2018a).[3]

Resources determined to be present and potentially affected by the alternatives are carried forward for analysis (Section 1.6.2). Where resources are present but not determined to be impacted or resources are determined not to be present, a rationale for not considering them further is provided in the IDT Checklist (Appendix B) and in the Scoping Report (BLM 2018a).

1.6.1 Scoping Summary

The SLFO conducted a 30-day public scoping period[4] from 10/2/2017 to 10/31/2017. Notice of the proposed project was sent to individuals and groups on the project mailing list on 9/27/2017. The project was posted on the NEPA Register[5] on 10/2/2017. A news release was also issued to local media and known wild horse advocacy groups on 10/2/2017.

[3] The scoping report is currently on ePlanning, found here: https://bit.ly/2DpuBlW

[4] A summary of the EA comment period is contained in Section 5.2.2.

[5] The NEPA Register is an online public notification website located at: https://eplanning.blm.gov/epl-front-office/eplanning/lup/lup_register.do. Sort by NEPA>Utah>Salt Lake Field Office>EA>

The BLM received approximately 6,003 comment letters (letters (12), faxes (4) or emails (5,986)) and one petition (with 7,798 names), from the public during the scoping period.[6] In addition to these comments, approximately 355 emails were received after the scoping period closed. These untimely submissions were the same as the form letters previously submitted via email.

In general, the scoping comments addressed the use of the *Porcine zona pellucida* (PZP) vaccine, reducing the number of wild horses removed if gathered, re-allocating animal unit months (AUMs) to wild horses instead of livestock, creating a wild horse range, concern about recreation opportunities if fewer wild horses are on the range, and overlap of the wild horses and greater sage-grouse habitat. Additional information is contained in the Scoping Report (BLM 2018a).

The BLM holds a single annual statewide public hearing regarding the use of helicopters and motorized vehicles to capture and transport wild horses (or burros) within the state of Utah. During the hearing, the public is given the opportunity to present new information and to voice any concerns or opinions regarding the use of these methods to capture wild horses (or burros). The public hearing for fiscal year 2019 was held on December 11, 2018 in Vernal, UT. There were four members of the public that attended.

1.6.2 Issues Analyzed in Detail

Based on scoping comments (BLM 2018a), internal review, and Cooperating Agency input, the following issue statements were prepared:

1.6.2.1 Wild Horses

What is the current wild horse population/excess wild horse determination within the HMA?

What procedures (standards, inventory, monitoring, and helicopter use) would be used for gather/trapping (water/bait)?

1.6.2.2 Recreation/Social

Would public visitation and awareness of the wild horse herd change because of the proposal?

How approachable is the wild horse herd and would the popularity of this herd change with wild horse enthusiasts?

1.6.2.3 Soil/Vegetation

What type of monitoring has been conducted and what are the results of current monitoring?

What stabilization methods would be used at the trap or staging areas?

1.6.2.4 Wetlands/Riparian Zones/Floodplains

Would trap or staging areas be located on or within these areas?

Would gather or maintenance activities reduce BLM’s ability to achieve or maintain riparian area function?

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[6] Some telephone calls/voicemails were received during the scoping period. While these messages were not transcribed, these individuals expressed disagreement with the proposed gathering and removal of horses from the HMA.

1.6.2.5 Migratory Birds

What seasonal or spatial limitations would be necessary to reduce impacts on migratory birds during the gather/maintenance activities?

1.6.2.6 Greater Sage-Grouse Habitat

What habitat overlap exists between the wild horses and greater sage-grouse?

What impact would there be to greater sage-grouse in the HMA from the gather/maintenance activities?

1.6.2.7 Special Status Animal Species

What seasonal or spatial limitations would be necessary to reduce impacts on special status species during the gather/maintenance activities?

1.6.2.8 Wildlife Excluding Special Status Species

What seasonal or spatial limitations would be necessary to reduce impacts on wildlife in the during gather/maintenance activities?

1.6.3 Issues Not Analyzed in Detail

As detailed in the Scoping Report (BLM 2018a) and revised by the Comment Report (BLM 2018d), the following issues were considered but eliminated from detailed analysis: policy/funding/education, land tenure adjustments, livestock grazing, wildfire emergency stabilization/rehabilitation plans, and pleas/frustrations/quotes. Analyzing these issues are not necessary to make a reasoned choice between the alternatives (Sections 2.2 through 2.5) and they would not provide information necessary to respond to the purpose and need for the BLM's action (Section 1.3).

2.0 DESCRIPTION OF ALTERNATIVES

2.1 Introduction

This chapter of the EA describes the Alternatives, including any that were considered but eliminated from detailed analysis.

Alternatives analyzed in detail include the following: Alternative A (proposed action), Alternative B (GonaCon-Equine Vaccine/Sterilization), and Alternative C (No Action). The potential environmental impacts or consequences resulting from the implementation of each alternative considered in detail are analyzed in Chapter 4 for each of the identified issues.

The proposed action and the GonaCon-Equine Vaccine/Sterilization alternatives were developed to achieve and maintain the established AML, so as to ensure a TNEB, remove excess wild horses from the range, prevent further deterioration to the range, and ensure the long-term health of wild horses within the HMA.

The No Action Alternative would not achieve the identified Purpose and Need; however, it is analyzed in this EA to provide a basis for comparison with the action alternatives.

The BLM did not consider other action alternatives in detail. The BLM did consider but eliminated from detailed analysis 15 alternatives that were identified by the IDT or brought forward by the public during the scoping period (BLM 2018a) or the comment period (BLM 2018d). The alternatives carried forward for detailed analysis represent those necessary for a reasoned choice (40 CFR 1502.14) and are based on the issues that were identified by the IDT and public input during the scoping period.

2.2 Alternative A – Proposed Action

Under the proposed action, the BLM would attempt to gather and remove excess wild horses inside and adjacent[7] to the HMA via trapping (bait/water) and/or helicopter methods in order to achieve low AML of 121 wild horses. With the 2018 foals, the population is now estimated to be 510. It is anticipated that by the time a gather could occur in 2019 the population would be approximately 586 wild horse. Therefore, approximately 465 wild horses would be gathered and placed in the adoption and/or sale program (the number may be adjusted based on the most current population estimate). The BLM would aim to ensure that the remaining herd has a scientifically-informed sex ratio and age structure.

If gather efficiencies during the initial gather do not allow for the attainment of the proposed action (i.e., not enough horses are successfully captured to reach low AML), the BLM would return to the HMA to remove excess horses above AML (via trapping (bait/water) and/or helicopter methods). If gather efficiencies are higher than expected, and more horses are gathered than required to achieve low AML, the BLM would return the appropriate number of horses to the HMA. The selection of horses returned to the HMA would be done by BLM personnel based upon age, sex, body type, and other appropriate characteristics. All mares returned to the HMA, who meet the fertility control vaccine criteria (refer below), would be treated with a one year dose of PZP. Hair samples from the wild horses returned to the HMA would be collected for genetic analysis.

[7] Adjacent areas included, generally, those areas where horses were seen during the 2017 population inventory flight, as shown in Appendix A, Figure 3.

Additionally, follow-up gathers, as frequently as needed, would be conducted over a 10-year period to remove any additional wild horses necessary to maintain the wild horse population at AML.

After the initial gather, the target removal number would be adjusted accordingly based off updated population inventories for the HMA and the resulting projection of excess animals over AML. All gathers proposed in this alternative would adhere to the Standard Operating Procedures (SOPs) in Appendix L, be informed by ongoing monitoring, and be dependent on funding and available space for the horses in adoption and/or sale programs or holding facilities.

The BLM would capture wild horses in trap locations at strategic sites located inside and adjacent to the HMA. Figure 1 in Appendix A provides approximate locations for trap locations. Trap locations may be moved from the locations shown in Figure 1. Additionally, a temporary holding facility(s) will be located at a strategic location in proximity to the HMA. Both trap locations and the temporary holding facility(s) would be placed in accordance with the protective measures in Section 2.2.1 and the SOPs in Appendix L.

Maintenance of the HMA and AML would also occur via fertility control methods. PZP darting would be continued (as approved in the 2015 Onaqui Mountain Herd Management Area Fertility Control EA, FONSI, and Decision Record – UT-W010-2014-0021-EA; Fertility Control EA and DR). This alternative modifies the PZP methods from the 2015 Fertility Control EA and DR, in that the bait/water trapping of unapproachable wild horses would be permitted for the purpose of PZP dart administration. In this situation, a PZP dart could be administered while the wild horses are in the trap during daylight hours. Once the dart is administered, the wild horses would be released. However, the BLM may also choose to remove the wild horses in these traps in order to maintain the herd at AML.

Additionally, under the 2015 Fertility Control EA and DR, 2-, 3-, and 4-year-old mares are being treated with PZP, and then treatments are stopped to allow the mare to foal. Since the HMA darting program started, monitoring of the wild horses has shown that it is ineffective to give the primer dose to 2-year-old mares, as they tend to already be pregnant. Under this alternative, BLM would change the PZP darting protocol for this HMA to give a primer and booster dose to yearlings to allow the mares to mature before having a foal. With this change, BLM would treat 1-, 2-, and 3-year old mares and then allow them to have a foal. After they have foaled, mares would again be subject to fertility control vaccination. All application of fertility control vaccines will follow the SOPs in Appendix G.

Genetic analyses would be periodically conducted on the herd to continue to monitor its genetic diversity. Hair samples would be taken on any horses returned to the HMA following gathers. Additionally, if necessary for appropriate sample sizes, hair samples may also be taken from horses removed from the HMA.

The BLM will continue to monitor the HMA, including for individual/herd health, inventory/census (via flight and ground surveys), water/forage availability, vegetation and habitat assessments, etc.

Additional details about the proposed action are included in Appendix E, including details about gather operations, helicopter use, bait/water trapping, gather related temporary holding facilities (corrals), transport, off-range corrals, and adoption and/or sale preparation, public viewing opportunities and notifications, and monitoring.

2.2.1 Protective Measures Under Alternative A

In addition to the Comprehensive Animal Welfare Policy (CAWP) requirements contained in BLM 2015, the following protective measures would be applied during gather and maintenance activities:

Air Quality – Vehicle speed will be reduced if vehicular or trucking traffic is creating excessive dust or limiting clear driving/flying conditions for the operations or general public. This will be discussed at the morning safety meetings, if applicable.

Cultural Resources – Class III inventory of any new trap, staging, or processing locations will be completed prior to the use of trap/holding sites. If historic properties are identified, sites would be avoided by selecting new trap/staging/processing locations.

Fuels/Fire Management – Crews and/or contractors will notify the BLM of any fires and comply with all rules and regulations administered by the BLM concerning the use, prevention and suppression of fires on federal lands, including any fire prevention orders that may be in effect at the time of the permitted activity. The crews and/or contractors may be held liable for the cost of fire suppression, stabilization, and rehabilitation. In the event of a fire, personal safety will be the first priority of the holder or its contractors. The crews and/or contractors will: 1) operate all internal and external combustion engines on federally managed lands per 43 CFR 8343.1, which requires all such engines to be equipped with a qualified spark arrester that is maintained and not modified; 2) carry shovels, water, and fire extinguishers that are rated at a minimum as ABC - 10 pound on all equipment and vehicles. If a fire spreads beyond the suppression capability of workers with these tools, all will cease fire suppression action and leave the area immediately via pre-identified escape routes; 3) initiate fire suppression actions in the work area to prevent fire spread to or on federally administered lands; and, 4) notify the Northern Utah Interagency Fire Center (801) 495-7600 (or 911) immediately of the location and status of any escaped fire.

Invasive Species/Noxious Weeds – Vehicles and equipment used in the operations will be cleaned prior to entering and after leaving the trap/staging areas. Only certified weed free hay would be fed to trapped or confined wild horses during the operations on public lands, including temporary holding facilities that could be located on private property.

Lands/Access – Trap or holding sites will not be located on survey markers. Vehicles used in operations activities will not block access to any other users of the public land. During gather operations, there may be temporary closures to allow for the safety of the wild horses, viewing public, and personnel involved in gather operations.

Migratory Birds – If project activities occur during the migratory bird breeding season (songbirds and long-billed curlew: April 1-July 31; raptors: January 1-August 31), gather sites and temporary holding facilities will be surveyed for the presence of nesting birds. Spatial buffers will be placed around active nest sites where project activities will not be allowed until the nest sites are no longer active. The buffer for songbirds will be 100'; the buffer for long-billed curlew will be 200 meters. Raptor buffers will be consistent with Romin and Muck (2002).

Greater Sage-Grouse – Per the ARMPA, project activities, gather sites, and temporary holding facilities will be designed to avoid habitat loss, habitat degradation, and prevent disturbances to GRSG populations. The BLM will coordinate with Utah Division of Wildlife Resources to apply the appropriate seasonal restrictions to avoid disturbances to sage-grouse populations.

Soils and Vegetation Excluding Special Status Species – Seed mix will be applied at helicopter trap, bait/water trap, and staging locations using a broadcast spread method prior to wild horses entering each trap or being processed at the staging location.

Threatened, Endangered, Candidate or Sensitive Animal Species – Project activity sites (staging, trapping, gathering, and holding) will be surveyed for yellow-billed cuckoo habitat. A 0.5-mile buffer area will be placed around any cuckoo habitat and project activities will be excluded from this area. Project activity sites will be surveyed for sensitive species; project sites will be moved to avoid any sensitive species nests (refer to Migratory Birds protective measures), dens, burrows, or roosts.

Threatened, Endangered, Candidate or Special Status Plant Species – Gather sites and temporary holding facilities will be surveyed for Pohl's milkvetch (*Astragalus lentiginosus var. pohlii*) prior to establishment. A monitor will be present during gather site and temporary holding facility selection. Any located populations will be avoided.

Travel/Transportation – Traffic may be stopped temporarily near gather sites and temporary holding facilities when wild horses are in the vicinity for the safety of the public and wild horses.

Wastes (hazardous or solid) – Solid or liquid materials brought on site to support operations will be stored in original containers, used as per manufacturer's directions, and removed from the site as soon as is practicable or at the conclusion of the gather/maintenance activities. Wastes will not be disposed of on site. Should solid or hazardous materials be released during the gather/maintenance activities, they will be remediated immediately. Should solid or hazardous wastes be discovered in quantities in excess of reportable quantities (RQs), as a result of the gather/maintenance activities, they will be reported to BLM and the State.

Water Resources/Quality (drinking/surface/ground) – Water used at holding or staging areas will be trucked to the sites and not taken or transported from local natural springs/sources. Water used at livestock water troughs will be augmented with hauled water. Troughs will be refilled daily and at breakdown of the gather sites.

Wetlands/Riparian Zones & Floodplains – Gather sites and temporary holding facilities will not be located on natural riparian/wetland areas. Ponds will be temporarily fenced (using panels) to exclude wild horse use for the least amount of time required to complete the activities. The size of the exclosure/fenced area will be large enough to encompass the pond.

Wildlife Excluding Special Status Species – When water sources are being restricted to facilitate water-trapping efforts, big game guzzlers will remain available to big game. Other water sources will be restricted for no more than 2 weeks at a time without consulting with UDWR. Water traps will be monitored to ensure that big game do not become trapped.

Livestock Grazing – BLM will coordinate gather and maintenance activities with existing livestock grazing permittees to minimize any disruptions in annual grazing use.

2.3 Alternative B – GonaCon-Equine Vaccine/Sterilization

Alternative B is a variation of the proposed action that includes the use of GonaCon-Equine as a fertility control vaccination and the use of permanent sterilization techniques (spaying and neutering). All other aspects of this alternative are the same as the proposed action, including the protective measures as discussed in Section 2.2.1.

Under this alternative, GonaCon-Equine vaccine may be used instead of, or in addition to, PZP for mares that have foaled or mares that do not respond to the PZP for fertility control treatment. No mare would be treated with both PZP and GonaCon-Equine in the same year. The only time a mare would be changed from one treatment to the other is if she does not respond to an initial dose of a treatment. GonaCon-Equine can and would be safely reapplied as necessary to continue to control the population growth rate; booster dose effects may lead to increased effectiveness of contraception, which is generally the intent. As the average duration of effect after booster doses has not yet been quantified for GonaCon-Equine, the BLM would make a determination in the future, based on additional research, experience, and the herd's population growth, as to the required frequency of new mare treatments and mare re-treatments. Treatments would occur through remote darting or in a bait/water trap for mares that are unapproachable. Treatments would be given to selected mares before being released back to the HMA in association with a helicopter gather event. GonaCon-Equine use would be administered consistent with the product label instructions (EPA 2009a).

As with PZP, the long-term goal of GonaCon-Equine use is to reduce or eliminate the need for gathers and removals by reducing herd's growth rate (NRC 2013). GonaCon-Equine vaccine is an EPA-approved pesticide (EPA 2009a), which is relatively inexpensive, meets BLM requirements for safety to mares and the environment, and is produced in a USDA-APHIS laboratory. Its categorization as a pesticide is consistent with regulatory framework for controlling overpopulated vertebrate animals, and in no way is meant to convey that the vaccine is lethal; the intended effect of the vaccine is as a contraceptive.

Under this alternative, the BLM would also use permanent sterilization methods (spaying and neutering) on up to 20% of the population as a means of population control. This option will be used if, after the initial gather year and continued treatment with fertility control vaccines, the annual population growth rate does not fall below 10%. Any sterilization procedures implemented will follow the SOPs included in Appendix I and K.

2.4 Alternative C – No Action

Under this alternative, no gather operations would be conducted. The PZP darting program would continue as established under the 2015 Fertility Control EA and DR. The use of GonaCon-Equine and permanent sterilization (spaying and neutering) would not be considered under this alternative.

2.5 Alternatives Considered but Eliminated

The BLM considered but eliminated the following fifteen (15) alternatives from detailed analysis:

1. No Gathers or Maintenance Activities within the HMA
2. Adjustments to HMA or HA Boundaries
3. Relocate Bands to New Locations
4. Adjustments to AML Numbers
5. Reductions/Closures in Livestock Grazing
6. Increase PZP Treatments
7. Designate a National Wild Horse Range
8. Promote Equine Therapy Program

9. Research Program
10. Use of Bait and/or Water Trapping Only
11. Gathering at the High End AML
12. Control of Wild Horse Numbers by Natural Means
13. Make Individualized Excess Wild Horse Determinations Prior to Removal
14. Use of Alternative Capture Techniques Instead of Helicopter Capture
15. Fencing to Exclude Wild Horses from Greater Sage-grouse Habitat

Refer to the Scoping Report (BLM 2018a) and Comment Report (BLM 2018d) for a description of each alternative and the rationale for not considering them further in this EA. Based on public comments, the BLM reconsidered sterilization (spaying and neutering) and added this as a component to Alternative B, which originally only considered the use of the GonaCon-Equine vaccination.

3.0 AFFECTED ENVIRONMENT

3.1 Introduction

This chapter presents the potentially affected existing environment (i.e., the physical, biological, social, and economic values and resources) within or adjacent to the HMA as identified in the IDT Checklist (Appendix B) and presented in Chapter 1. This chapter provides the baseline for comparison of impacts/consequences described in Chapter 4.

3.2 General Setting

The HMA is located in southeastern Tooele County, Utah, approximately 35 air miles southwest of Tooele, Utah. This area varies in elevation from 4,800 feet at the valley floor to 8,200 feet at the highest point of the Onaqui Range. The soil and vegetation types, in general, are sagebrush steppe ecotypes. Scattered conifers are found on the upper elevations with juniper and pinion pine on the lower slopes. Cheatgrass and other non-native species are spread throughout the HMA. There are winter cattle grazing allotments in the area and year-round habitats supporting native wildlife such as mule deer and antelope. Various avian wildlife species are also found including raptors and passerine species.

3.3 Resources/Issues Brought Forward for Analysis

3.3.1 Wild Horses

Wild horses (*Equus caballus*) are introduced species within North America and have few natural predators. The lack of sufficient natural controls acting upon wild horse herds makes the wild horses very competitive with native wildlife and other living resources managed by the BLM.

<u>Appropriate Management Level</u>

The Appropriate Management Level (AML) is defined as the number of wild horses that can be sustained within a designated HMA, which achieves and maintains a TNEB in keeping with the BLM’s multiple-use management mandate.

The AML for the HMA is 159 wild horses with a range of 121-210 wild horses. This population range was established in Decision Record approving the Wild Horse Appropriate Management Level and Herd Management Area/Herd Boundary EA, FONSI, and DR – UT-020-2002-100. The HMA covers approximately 240,153 acres, including 205,394 acres managed by the BLM.

<u>Horse Health</u>

Overall, the horses on the Onaqui Mountain HMA are in good health. Horses typically are in good body condition with majority of horses having a body condition score of 5 out of 9 on the Henneke scoring system (Henneke *et al*. 1983). The exception to this is seen in old horses, young mares with foals, and any horses that might have been injured. These horses will vary in condition anywhere from a 1 to 4.

<u>Current Population/Inventory/Modeling</u>

The BLM has conducted population inventory flights in the HMA every three to five years. These inventories have provided information pertaining to population numbers, foaling rates, distribution, and herd health.

In a population inventory flight conducted on November 18-19, 2017, observers visually confirmed the presence of 399 adult and 46 foals during the flights. Data were recorded using the double-observer method (Lubow and Ransom 2016), which allowed for a statistical estimate of the 409 adults and 47 foals being the number of animals that were in the surveyed area at that time (USGS, unpublished data); those estimates including animals that were present but not seen (USGS, unpublished data). With the 2018 foals, the population is now estimated to be 510. This is a 12 percent population increase. This is below the average of 20 percent population increase across other HMAs due to the fertility control program that is in place in the Onaqui HMA. It is anticipated that by the time a gather could occur in 2019 the population would be approximately 586 wild horse.

Figure 3 in Appendix A shows where horses were seen during the November 2017 population inventory flight. The map shows the general distribution of wild horses inside and adjacent to the HMA. While some of the herd is easily accessible via the road network, other parts of the herd are in more remote areas.

There have been ten gathers on the HMA, the most recent in 2012, since the WFRHBA was passed. All excess wild horses gathered were removed and placed in the adopt-a-horse program or off-range pasture facilities.

Diet/Dietary Overlap with Other Species

Numerous studies identify dietary overlap of preferred forage species and habitat preference between horses, cattle, and wildlife species in the Great Basin ecosystems for all season (Ganskopp 1983; Gandskopp *et al.* 1986, 1987; McInnis 1984; McInnis 1987; Smith *et al.* 1982; Vavra and Sneva 1987). A strong potential exists for exploitative competition between wild horses and cattle under conditions of limited forage (water and space) availability (McInnis *et al.* 1987).

Although horses and cattle are often compared as grazers, horses can be more destructive to the range than cattle due to their differing digestive systems and grazing habits. The dietary overlap between horses and cattle is much higher than with wildlife, and averages between 60 and 80% (Hubbard and Hansen 1976, Hansen *et al.* 1977, Hanley 1982, Krysl *et al.* 1984, McInnis and Vavra 1987). Horses are cecal digesters while most other ungulates including cattle, pronghorn, and others are ruminants (Hanley and Hanley 1982, Beever 2003). Cecal digesters do not ruminate, or have to regurgitate and repeat the cycle of chewing until edible particles of plant fiber are small enough for their digestive system. Ruminants, especially cattle, must graze selectively, searching out digestible tissue (Olsen and Hansen 1977). Horses, however, are one of the least selective grazers in the West because they can consume high fiber foods and digest larger food fragments (Hanley and Hanley 1982, Beever 2003).

Horses can exploit the high cellulose of graminoids, or grasses, which have been observed to make up over 88% of their diet (McInnis and Vavra 1987, Hanley 1982). However, this lower quality diet requires that wild horses consume 20-65% more forage than a cow of equal body mass (Hanley 1982, Menard *et al.* 2002). With more flexible lips and upper front incisors, both features that cattle do not have, wild horses trim vegetation more closely to the ground (Symanski 1994, Menard *et al.* 2002, Beever 2003). As a result, areas grazed by horses may retain fewer plant species and may be subject to higher utilization levels than areas grazed by cattle or other ungulates. A potential benefit of a horse’s digestive system may come from seeds passing through system without being digested but the benefit is likely minimal when compared to the overall impact wild horse grazing has on vegetation in general.

Competition from a large dominant species may drive niche partitioning of other species (Carothers and Jaksi 1984; Ziv *et al.* 1993; Schuette *et al.* 2013). The study found that during times of greatest physiological stress (increased temperature, decreased precipitation), horses monopolized access to water sources where they were present up to 73% of the day, leaving limited time for other species. The potential for an exotic species, such as the horses, to outcompete native species for a limited communal resource during peak need raises concern for native communities in water-limited environments (Hall *et al.* 2016).

3.3.2 Recreation/Social

The HMA’s wild horses are very popular with the viewing public and wild horse advocacy community, and have been featured in social and traditionally media outlets. The popularity of the herd results from their photogenic nature, their relative habituation to humans, and the relatively close drive to the HMA from the Salt Lake Valley. One large band of approximately 100-200 wild horses is most popular, and tends to congregate in the south end of Skull Valley close to Davis Mountain and the Pony Express Trail, especially in the spring foaling season.

Accurate numbers of visitors to the HMA are not currently available; however, traffic counters along the Pony Express Trail near Lookout Pass have recorded as many as 70,000 visits per year. However, not all visitors to the Pony Express Trail, which is also a primary transportation route, come to view the wild horses. Visitation to view the wild horses is highest in the spring when the wild horses tend to congregate near roads in the south end of Skull Valley near the DPG southern boundary, north and south of Davis Mountain, at Winter Springs, near the road leading south from the main DPG entrance, near the Pony Express road, and at Simpson Springs.

In recent years, the BLM has received reports and complaints from the public regarding visitors touching, petting, and even feeding wild horses, especially young foals. Some photographers will take risks to acquire photos of unusual interactions (e.g., fighting among studs, etc.). Monitoring of the HMA and social media posts show visitors regularly approaching wild horses at unsafe distances of less than 20 feet and drive off established roads to get closer to the herd.

The BLM began receiving applications in 2015 from professional photographers to serve as commercial outfitters that bring customers out to the herd to learn about wild horse behavior and photography. BLM identified the issuance of Special Recreation Permits for this activity as an opportunity to educate the public and wild horse advocates about responsible behavior towards the wild horses and other resources on public lands. As part of the permitting process, BLM requires the wild horse photography permittees to maintain at least 100 feet separation from wild horses, does not allow petting, touching, or feeding of any wild horses, and requires all motor vehicles remain on existing routes at all times. The BLM currently has issued five wild horse photography commercial permits; however, only two permits have reported hosting workshop groups.

In addition to restrictions placed on the wild horse photography permittees, the BLM initiated a public outreach and education program within the HMA. The BLM installed three visitor kiosks and other signs asking all visitors to maintain 100-foot separation from the wild horses, and prohibiting petting or feeding and off-road vehicle travel. These efforts assist in protecting the health and welfare of both the public and the wild horse herd.

Other recreational activities occurring within the HMA include off-highway vehicle use, dispersed camping, hunting, target shooting, and visiting the Pony Express Trail. Recreational visitor use is highest during March thru June, which coincides with wild horse foaling season.

3.3.3 Soil/Vegetation

The current landcover classification for the HMA is summarized in Table 1. Landcover data were compiled using landfire (www.landfire.gov).[8]

Table 1. Landcover Classes for the HMA.

Landcover Class	**Acres**	**Percent**
Agriculture	5.3	<0.01%
Barren	41.8	0.017%
Developed (e.g., buildings, infrastructure)	1,778.9	0.74%
Water	0.44	<0.01%
Sagebrush (Total)	67,247.0	28.0%
Low Sagebrush	*22,221.2*	*9.25%*
Mountain Big Sagebrush	*1,345.9*	*0.56%*
Wyoming Big Sagebrush	*43,679.8*	*18.18%*
Other Shrublands (Total)	31,288.2	13.02%
Greasewood	*3,063.9*	*1.28%*
Salt Desert Shrub	*26,077.5*	*10.86%*
Mixed Mountain Shrub	*330.7*	*0.14%*
Mountain Mahogany Woodlands	*1,816.1*	*0.76%*
Forests and Woodlands (Total)	80,248.2	33.40%
Aspen and Maple Forest	*672.5*	*0.28%*
Mixed Conifer Forest	*345.6*	*0.14%*
Pinyon and Juniper Woodlands	*78,800.8*	*32.80%*
Riparian Forests	*429.2*	*0.18%*
Grasslands (Total)	59,625.1	24.82%
Annual Grassland	*51,032.6*	*21.24%*
Perennial Grassland	*7,202.9*	*3.00%*
Mesic Meadow	*916.9*	*0.38%*
Non-native Perennial Grassland	*472.6*	*0.20%*
TOTAL	240,235	100%

The HMA occurs within Major Land Resource Area (MLRA) 28A, the Great Salt Lake Area first described by the U.S. Department of Agriculture in the early 1960s. The Natural Resource Conservation Service (NRCS) has extensively described the topography, geology, soils, climate, and range sites of each MLRA. The NRCS periodically updates information concerning each MLRA as new data becomes available. Table 2 provides the NRCS data used in this analysis.

[8] The LANDFIRE program provides national geo-spatial layers (e.g. vegetation, fuel, disturbance, etc.), databases, and ecological models that are available to the public for the US and insular areas. Its applications include resource management in addition to wildfire management.

Soils within the HMA are typical of the Great Salt Lake Resource Area and vary with elevation. Soils range in depth from very shallow (below 20 inches to bedrock) to deep (greater than 60 inches) and are typically gravelly, sandy and/or silty loams. Soils located on low hill slopes and upland terraces are typically shallow to deep over bedrock. They are medium textured with gravel. Soils on mountain slopes typically have very gravelly loam textures and are shallow over bedrock with rock outcrops. Mountain soils typically have gravelly to very gravelly silt loam textures. Soils on floodplains and fan skirts are deep, have silty to sandy textures, are highly calcareous, and are susceptible to erosion when disturbed. Table 2 shows the principal soil types found within the HMA and the approximate acres of each soil type within the HMA.

Table 2. Principle Soils for the HMA.

Map Unit Symbol	Soil Unit Name	Approx. Acers Within HMA
2	Abela very gravelly loam, 5 to 15 percent slopes	17,634
5	Berent-Hiko Peak complex, 2 to 15 percent slopes	9,508
7	Borvant gravelly loam, 2 to 15 percent slopes	23,452
11	Checkett-Rock outcrop complex, 10 to 14 percent slopes	1,788
12	Cliffdown gravelly sandy loam, 2 to 15 percent slopes	18,714
21	Hiko Peak gravelly loam, 2 to 15 percent slopes	3,876
24	Hiko Peak Taylors Flat, 1 to 15 percent slopes	23,788
35	Kapod very cobbly loam, 5 to 30 percent slopes	12,778
38	Lodar-Lundy-rock outcrop association, 30 to 60 percent slopes	28,619
47	Podmor-Onaqui-Rock outcrop association, 20 to 60 percent slopes	11,706
48	Reywat-Broad-Rock outcrop association, 30 to 60 percent slopes	24,454
62	Spager gravelly loam, 2 to 15 percent slope	6,508
64	Taylorsflat loam, 1 to 5 percent slope	10,212
66	Timpie silt loam, 0 to 3 percent slopes	14,599
69	Tooele fine sandy loam, 0 to 5 percent slope	17,253

There are 48 Assessment, Inventory, and Monitoring (AIM) terrestrial vegetation plots within the HMA (BLM 2018e). At each of the monitoring plots, information was collected on species diversity, amount of bare ground, grass forb and shrub cover, vegetation gap, and soil stability (Herrick, *et al.* 2016). Analysis of the greater sage-grouse habitat requirements can be found in EA section 3.3.6.

Within the HMA, over 62% of the sites had some level of invasive grass cover and 35% of the sites have over 10% invasive grass cover. Cheatgrass is the primary invasive grass within the HMA. Presence of cheatgrass indicates degraded range conditions, as high amounts of cheatgrass lead to lower overall plant diversity and an increase in fire intensity and return interval. Cheatgrass is often observed near high-use areas that wild horses frequent (such as around water sources). Overall, shrub cover is also lower than what is expected for this area. These data indicate that current conditions are somewhat degraded and invasive grasses are of significant concern. These conditions indicate the potential for a reduction in the amount of available high quality forage needed to support horse and other species' habitat requirements in the future.

3.3.4 Wetlands/Riparian Zones/Floodplains

There is limited surface water present in the HMA. The majority of springs and water sources that are present have been developed to provide water in troughs and ponds for wild horses and livestock. Except for Simpson Springs and an unnamed exclosure near Government Creek, there are no other known riparian area exclosures within the HMA. The majority of streams in the HMA are intermittent or ephemeral or only flow a short distance downstream from a spring. Riparian vegetation occurs in and around natural stream channels and washes, natural springs, as well as trough overflows, and stock ponds. Riparian vegetation in the area includes multiple species of willow, cattails, sedges, and rushes.

Riparian areas in the HMA have been evaluated through Proper Functioning Condition assessments and aquatic AIM (Prichard *et al.* 2003, Dickard *et al*. 2015, BLM 2016a). Many of the riparian areas are degraded or lacking in expected riparian vegetation due to existing water developments diverting water from riparian areas, and grazing by wild horses, livestock, and wildlife (BLM 2018f) . Unlike permitted livestock grazing where timing and intensity of use is controlled by permit terms and conditions, wild horses have season-long/continuous grazing and access to riparian areas in the analysis area throughout the year.

There are no surface or groundwater municipal drinking water sources in the area.

3.3.5 Migratory Birds

For the purpose of analyzing project impacts to terrestrial wildlife species, an area encompassing all of the potential project sites, including those sites adjacent to the HMA, was delineated (Wildlife Project Area; Appendix A, Figure 2). A variety of migratory songbird species use habitats within the Wildlife Project Area for breeding, nesting, foraging, and migratory habitats. Migratory birds are protected under the Migratory Bird Treaty Act of 1918 (MBTA). The MBTA makes it unlawful to pursue, hunt, kill, capture, possess, buy, sell, purchase, or barter any migratory bird, including the feathers or other parts, nests, eggs, or migratory bird products unless it is a permitted action. The Executive Order 13186 sets forth the responsibilities of Federal agencies to further implement provisions of the MBTA by integrating bird conservation principles and practices into agency activities and by ensuring that Federal actions evaluate the effects of proposed actions and agency plans on migratory birds. BLM's role under the MBTA is to adequately manage migratory birds and their habitats, and to reduce the likelihood of a sensitive bird species from being listed under the Endangered Species Act.

In addition, a Memorandum of Understanding (MOU) between the BLM and United States Fish and Wildlife Service (USFWS) (BLM MOU WO-230-2010-04) provides BLM further direction for project-level NEPA guidance for meeting MBTA conservation and compliance. The emphasis is on the identifying sensitive bird species and habitats through the USFWS 2008 Birds of Conservation Concern (BCC) Species List (USFWS 2008), the Utah Partners in Flight (UPIF) Species List (IM 2008-050), and BLM Sensitive Species List. The MOU direction includes evaluating the effects of BLM's actions on these species during the NEPA process; including effects on bird populations and habitat. The BLM is to implement approaches to lessen the likelihood of impacts by having project alternatives that avoid, minimize and mitigate adverse impacts for migratory birds the habitats they depend upon that are most likely to be present in the Wildlife Project Area.

The Wildlife Project Area is within the Great Basin Bird Conservation Region (BCR) (USFWS 2008a). The UPIF Priority Species List (Parrish *et al.* 2002), the Birds of Conservation Concern (BCC) list for Region 9 (Great Basin) (USFWS 2008a), the Raptor Inventory Nest Survey database (RINS 2017), the Utah Natural Heritage Database (Utah Division of Wildlife Resources 2013), Breeding Bird Survey records (Pardieck *et al.* 2017), and eBird records (eBird 2017) were used to identify potential habitat for priority species that could utilize habitats within the Wildlife Project Area. Table 3 lists the UPIF Priority Species list and the USFWS BCC species potentially occurring within the Wildlife Project Area (excluding sensitive species).

Bird habitats within this BCR are dominated by grasslands, sagebrush, and other xeric shrubs on the flats and lowlands, with pinyon-juniper woodlands and open ponderosa pine forests on higher slopes. Lodgepole pine/sub-alpine fir forests occur at higher elevations on north-facing slopes (NABCI 2000).

In addition, the Wildlife Project Area includes portions of two Bird Habitat Conservation Areas (BHCA) totaling 169,039 acres: 135,039 acres within the Skull Valley BHCA and 34,000 acres within the Fish Springs NWR BHCA. BHCAs are areas where priority birds and their habitats are located and opportunities for effective conservation activities exist (Evans and Martinson 2008). The Skull Valley BHCA was designated because of its large expanses of shrub-steppe habitat and the high densities of nesting long-billed curlews, ferruginous hawks, and burrowing owls. The Fish Springs NWR BHCA was identified because of its large expanses of shrub-steppe bird nesting habitat, and shorebird and waterfowl nesting areas (which are primarily located outside of the Wildlife Project Area) (Evans and Martinson 2008).

Table 3. Migratory Birds (Excluding BLM Sensitive).

Common Name	Scientific Name	Status	1st Breeding	2nd Breeding	Winter
American Avocet	*Recurvirostra americana*	UPIF	Wetland	Playa	Migrant
Black-necked Stilt	*Himantopus mexicanus*	UPIF	Wetland	Playa	Migrant
Black Rosy-Finch	*Leucosticte atrata*	BCC, UPIF	Alpine	Alpine	Grassland
Black-throated Gray Warbler	*Setophaga nigrescens*	UPIF	Pinyon-Juniper	Mountain Shrub	Migrant
Brewer's Sparrow	*Spizella breweri*	BCC, UPIF	Shrub-steppe	High Desert Scrub	Migrant
Broad-tailed Hummingbird	*Selasphorus platycercus*	UPIF	Lowland Riparian	Mountain Riparian	Migrant
Calliope Hummingbird	*Selasphorus calliope*	BCC	Mountain Riparian	Mountain Shrub	Migrant
Eared Grebe	*Podiceps nigricollis*	BCC	Wetland	Water	Water
Flammulated Owl	*Psiloscops flammeolus*	BCC	Ponderosa Pine	Sub-Alpine Conifer	Lowland Riparian
Gray Vireo	*Vireo vicinior*	UPIF	Pinyon-Juniper	Northern Oak	Migrant
Green-tailed Towhee	*Pipilo chlorurus*	BCC	Mountain Riparian	High Desert Scrub	Migrant
Loggerhead Shrike	*Lanius ludovicianus*	BCC	High Desert Scrub	Pinyon-Juniper	High Desert Scrub
Peregrine Falcon	*Falco peregrinus*	BCC	Cliff	Lowland	Wetland

Common Name	Scientific Name	Status	1st Breeding	2nd Breeding	Winter
				Riparian	
Pinyon Jay	*Gymnorhinus cyanocephalus*	BCC	Pinyon-Juniper	Ponderosa Pine	Pinyon-Juniper
Sagebrush Sparrow	*Artemisiospiza nevadensis*	BCC, UPIF	Shrub-steppe	High Desert Scrub	Low Desert Scrub
Sage Thrasher	*Oreoscoptes montanus*	BCC	Shrub-steppe	High Desert Scrub	Migrant
Virginia's Warbler	*Oreothlypis virginae*	BCC, UPIF	Northern Oak	Pinyon-Juniper	Migrant
Williamson's Sapsucker	*Sphyrapicus thyroideus*	BCC	Sub-Alpine Conifer	Aspen	Migrant
Willow Flycatcher	*Empidonax traillii*	BCC	Lowland Riparian	Mountain Riparian	Migrant
BCC=Bird of Conservation Concern in Bird Conservation Region 9 (Great Basin); UPIF=Utah Partners in Flight priority species for conservation action.					

Table 1 shows the habitat types available for migratory birds in the HMA, which is predominated by pinyon and juniper woodland, sagebrush, annual grassland, and salt desert shrub, which together account for 92.9 percent of the vegetative cover. Although large areas of habitat are available for migratory bird species, much of it has been degraded. The amount of annual grassland (21.2 percent) is indicative of the spread of cheatgrass into the HMA, resulting in lower plant diversity and lower biomass of native plants. The amount of juniper woodland (32.8 percent) is indicative of the encroachment of juniper into sagebrush and mountain shrub habitats, reducing desirable shrub species and native herbaceous cover. Riparian forest habitats provide breeding habitat for four of the priority species, but only represent 0.18 percent of the vegetative cover in the HMA. Much of the riparian habitat, especially at the lower elevations, has been degraded by season-long grazing access by wild horses, livestock, wildlife, and the construction/maintenance and long-term use of livestock water developments, which have dewatered some systems and result in riparian habitats lacking riparian obligate and woody vegetation. In the mid- to higher elevation drainages where some wooded riparian habitat does exist, it is mostly limited to narrow, single-canopy stringers of willow.

3.3.6 Greater Sage-Grouse Habitat

The greater sage-grouse is currently a BLM sensitive species – it had been a candidate for listing under provisions of the ESA; in March 2010 the USFWS determined that listing was warranted but precluded by higher priorities (75 FR 13910). Subsequently a planning effort was completed by the BLM and the US Forest Service, which resulted in the amendment of BLM land use plans, as, is documented in the ARMPA (BLM 2015b). On October 2, 2015, the USFWS determined the greater sage-grouse was not warranted for protection under ESA (80 FR 59857). Management of the species is guided by the ARMPA.

The ARMPA delineated sage-grouse habitat into Priority Habitat and General Habitat Management Areas (PHMA and GHMA). PHMA are lands identified as having the highest value for maintaining sustainable greater sage-grouse populations. GHMA are areas of occupied greater sage-grouse habitat (seasonal or year-round) outside of PHMA where some special management will apply to sustain greater sage-grouse populations. About 29 percent (149,735 acres) of the entire Wildlife Project Area is within PHMA; there is no GHMA within the project boundaries. Within the PHMA, 124,918 acres are on BLM lands. There are 123,904 acres of PHMA within the HMA, of which 107,092 are on BLM lands.

Approximately 195,427 acres of greater sage-grouse seasonal habitats occur (on all ownerships) within the Wildlife Project Area. Of these, 169,325 acres are also within the HMA. Seasonal habitats within the Wildlife Project Area include nesting/brood-rearing (23,294 acres), winter (44,068), other habitat (85,806), as well as opportunity areas (45,038 acres). There is one lek (Government Creek) located within the Wildlife Project Area and the HMA.

The greater sage-grouse in the Wildlife Project Area are part of the Sheeprocks Greater Sage-grouse Population Area, as defined in the ARMPA, which is a small, isolated area with natural and anthropogenic fragmentation. Upper elevation habitats are small but currently intact, and lower-elevation wintering habitats are small and degraded areas that are susceptible to fire. Modeling of the existing habitat trends projects a downward trend over the next 10 to 50 years due to increasing acreage affected by annual grass and conifer encroachment. This population's primary threats are cheatgrass invasion and associated changes in fire intervals that threaten wintering habitat, pinyon-juniper encroachment, localized recreational impacts, corvid predation, and localized wild horse impacts (BLM/Forest Service 2015; USFWS 2013).

Greater sage-grouse hunting was discontinued in the early 1990s due to decreasing lek counts. Wild horses use some of the northwest portion of the Sheeprocks Greater Sage-grouse Population Area. Increasing human populations in Utah Valley and adjacent areas contribute to increasing recreational use of the roads that go through greater sage-grouse habitats (including the Pony Express Trail). Due to the prevalence of cheatgrass at lower elevations, fire has impacted the area and is a future concern. Other disturbances include various right-of-ways with train tracks, power lines, roads, and pipelines.

Within greater sage-grouse habitats, vegetation ranges from high-elevation diverse mountain big sagebrush communities to low-elevation, converted agricultural areas, or Wyoming big sagebrush stands dominated with an understory of cheatgrass. Breeding and brood-rearing areas are found in mid to high elevations. In the winter, most birds concentrate in a small, low-elevation area on the southern portion of the population area. Biologists have observed unusually high raven populations and increasing nonnative red fox in the area (BLM/Forest Service 2015).

From lek counts conducted from 2004 to 2013, the estimated population for the Sheeprocks Greater Sage-grouse Population Area ranges between 200 and 760 birds (50 to 190 males). Until recently, the Sheeprocks population numbers were believed to be increasing. Based on calculations of the annual change in lek counts between 1996 and 2013, for years when the same leks were consistently counted, the Sheeprocks population showed an increase (BLM/Forest Service 2015). However, lek data collected up to 2015 suggested that the population was decreasing. In response to the decline, population augmentation efforts began in 2016. From 2016 to 2018, 120 birds were translocated from the West Box Elder and Parker Mountain sage-grouse areas into the Sheeprocks Greater Sage-grouse Population Area. The augmentations have brought the population in the Sheeprocks Greater Sage-grouse Population Area up to the low end of the population fluctuations between 2004 and 2013.

A key component of the ARMPA (BLM 2015a; BLM 2015b) is the adaptive management plan, which requires more restrictive land use allocations and management actions to be implemented if habitat or population triggers are met. Recent monitoring has indicated that the population in the Sheeprocks Greater Sage-grouse Population Area has declined, and the trigger for immediate management action to stop a severe deviation from sage-grouse conservation objectives has been met (BLM 2017).

Due to the decrease in population numbers, the ARMPA's adaptive management responses require BLM to complete the following (BLM 2015. ARMPA, Appendix I, Table I.1): "Initiate emergency gathers to reduce wild horse and burro populations within affected area to low end of AML, subject to funding and holding space availability. If the population is within AML and the area does not meet greater sage-grouse habitat objectives, reduce AML for the HMA within the affected area up to 25 percent to facilitate meeting habitat objectives."

AIM data previously described in Section 3.3.3 (BLM 2018e) was evaluated within greater sage-grouse habitat. Twelve data points were within nesting habitat within the HMA; nine of those points had less than 6 percent sagebrush cover, which is below the ARMPA's habitat objectives for sagebrush cover (Table 2-2, BLM 2015b). Similarly, looking across all greater sage-grouse seasonal habitat sites, shrub cover was generally below the ARMPA's habitat objectives with 12 percent average shrub cover and 8 percent average sagebrush cover. In addition, the prevalence of invasive annual grasses in most monitoring plots was an indicator of degraded rangeland condition. The cover and diversity of forbs and desirable grasses meet the ARMPA's habitat objectives, which may help the area's native vegetation compete with non-native annual grasses.

3.3.7 Special Status Animal Species

Section 7 of the Endangered Species Act (ESA) requires BLM land managers to ensure that any action authorized, funded or carried out by the BLM is not likely to jeopardize the continued existence of any threatened or endangered species. Consultation with USFWS is required on any action under consideration by the BLM or another Federal agency that affects a listed species or that jeopardizes or modifies critical habitat.

The management of special status species is guided by the BLM 6840 Manual, Special Status Species Management (2008). The objective of the 6840 Manual is to: 1) To conserve and/or recover ESA-listed species and the ecosystems on which they depend so that ESA protections are no longer needed for these species and 2) To initiate proactive conservation measures that reduce or eliminate threats to Bureau sensitive species to minimize the likelihood of and need for listing of these species under the ESA.

The western yellow-billed cuckoo (*Coccyzus americanus*) is the only federally listed species potentially occurring in the Wildlife Project Area. The western distinct population segment (DPS) of the yellow-billed cuckoo was federally listed as a threatened species in 2014 (79 FR 59991 60038). The western DPS includes the entire range of the species in the western United States, including the entire state of Utah. Critical habitat for the cuckoo was proposed in 2014, but the designation has not been finalized.

The loss of riparian habitats is the primary reason for the decline of this species (Parrish *et al.* 2002). Breeding western yellow-billed cuckoos are riparian obligates and nest almost exclusively in low to moderate elevation riparian woodlands with multilayered broadleaf trees and shrubs that are 5 hectares (12 acres) or more in extent within arid to semiarid landscapes. They are most commonly associated with cottonwood–willow–dominated vegetation cover, but the composition of dominant riparian vegetation can vary across its range. At the landscape level, the amount of cottonwood–willow-dominated vegetation cover and the width of riparian habitat influence western yellow-billed cuckoo breeding distribution. Riparian patches used by breeding cuckoos vary in size and shape, ranging from a relatively contiguous stand of mixed native/exotic vegetation to an irregularly shaped mosaic of dense vegetation with open areas (Halterman *et al.* 2015). Historically cuckoos were probably common to uncommon summer residents in Utah. The current distribution of yellow-billed cuckoos in Utah is poorly understood, though they appear to be an extremely rare breeder in lowland riparian habitats statewide.

There is potential yellow-billed cuckoo riparian forest habitat in the HMA, although it represents only 0.18 percent of the landcover in the HMA (Table 1). Much of riparian habitat, especially at the lower elevations, has been degraded by livestock and wild horse grazing and development for livestock water, resulting in riparian habitats lacking woody vegetation. In the mid- to higher-elevation drainages, where some wooded riparian forest habitat does exist, it is mostly limited to narrow, single-canopy stringers of willow, which do not provide adequate habitat for this species. There are no UNHP records in the Wildlife Project Area. The nearest eBird record is approximately 7 miles away at the Fish Springs National Wildlife Refuge, and dates back to 1990 (eBird 2017). The nearest proposed critical habitat is 112 miles away in eastern Duchesne County.

Sensitive Species

There are 22 wildlife species that are designated sensitive by the BLM (Table 4). Sensitive species are those species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the Endangered Species Act.

Table 4. BLM sensitive species potentially occurring in the Wildlife Project Area.

Common Name	Scientific name	Status	Habitat
Birds			
American Three-toed Woodpecker	*Picoides dorsalis*	SS	Sub-alpine coniferous forests
American White Pelican	*Pelecanus erythrorhynchos*	SS	Shallow lakes, marshlands, rivers
Bald Eagle	*Haliaeetus leucocephalus*	SS, BGEPA	Lowland riparian
Black Swift	*Cypseloides niger*	SS	Cliffs, lowland riparian
Bobolink	*Dolichonyx oryzivorus*	SS	Wet meadow, agricultural fields
Burrowing Owl	*Athene cunicularia*	SS	High desert scrub, grasslands
Ferruginous Hawk	*Buteo regalis*	SS	Pinyon-juniper, cliffs, grassland, shrub-steppe
Golden Eagle	*Aquila chrysaetos*	BGEPA	Cliffs, open country
Grasshopper Sparrow	*Ammodramus savannarum*	SS	Grassland
Greater Sage-grouse	*Centrocercus urophasianus*	SS	Sagebrush
Lewis's Woodpecker	*Melanerpes lewis*	SS	Ponderosa pine, lowland riparian
Long-billed Curlew	*Numenius americanus*	SS	Grassland
Northern Goshawk	*Accipiter gentilis*	CA	Mature mountain forests, riparian
Short-eared Owl	*Asio flammeus*	SS	Wetland, grassland, shrubland
Snowy Plover	*Charadrius nivosus*	SS	Playa, sparsely vegetated areas near water
Mammals			
Dark Kangaroo Mouse	*Microdipodops megacephalus*	SS	Sagebrush areas with sandy soils
Fringed Myotis	*Myotis thysanodes*	SS	Many habitats with roost sites (caves, cliffs, mines, building, cavities in decadent trees and snags)
Kit Fox	*Vulpes macrotis*	SS	Sparsely vegetated arid habitat
Preble's Shrew	*Sorex preblei*	SS	Many habitats, espcially wetland areas.
Pygmy Rabbit	*Brachylagus idahoensis*	SS	Areas of tall dense sagebrush with loose soils
Spotted Bat	*Euderma maculatum*	SS	Many habitats with tall cliffs
Townsend's big-eared Bat	*Corynorhinus townsendii*	SS	Many habitats with roost sites (caves, cliffs, mines, building)
BGEPA=Bald and Golden Eagle Protection Act; SS=BLM sensitive; CA=Conservation Agreement			

Table 1 shows the habitat types available for sensitive species in the HMA, which is predominated by pinyon and juniper woodland, sagebrush, annual grassland, and salt desert shrub, which together account for 92.9 percent of the vegetative cover. Although large areas of habitat are available for sensitive species, much of it has been degraded. The amount of annual grassland (21.2 percent) is indicative of the spread of cheatgrass into HMA, resulting in lower plant diversity and lower biomass of native plants. The amount of juniper woodland (32.8 percent) is indicative of the encroachment of juniper into sagebrush and mountain shrub habitats, reducing desirable shrub species and native herbaceous cover. Riparian forest habitats represent 0.18 percent of the vegetative cover in the HMA. Much of that riparian habitat, especially at the lower elevations, has been degraded by livestock and wild horse grazing and development for livestock water, resulting in riparian habitats lacking woody vegetation. In the mid- to higher elevation drainages where some wooded riparian habitat does exist, it is mostly limited to narrow, single-canopy stringers of willow.

3.3.8 Wildlife Excluding Special Status Species

Mule deer (*Odocoileus hemionus*) and pronghorn (*Antilocapra americana)* are the primary big game species found within the Wildlife Project Area, in portions of Wildlife Management Units (WMU) 18 and 19. UDWR has identified areas of crucial habitats that are considered essential to the life history requirements of big game species, such that continued degradation and loss of crucial habitats will lead to declines in carrying capacity and/or numbers of big game species.

Approximately 102,721 acres of crucial mule deer habitat is within Wildlife Project Area, including 84,526 acres of spring habitat, 1,564 acres of summer habitat, 23,526 acres of fall habitat, and 79,195 acres of winter habitat. Some areas provide crucial habitat for multiple seasons, so there is overlap in the habitat designations (UDWR 2017a). Even though vegetative communities vary throughout the range of mule deer, habitat is nearly always characterized by areas of thick brush or trees interspersed with small openings. The thick brush and trees are used for escape cover, whereas the small openings provide forage and feeding areas. Mule deer do best in habitats that are in the early stages of plant succession (UDWR 2014c).

The primary concerns in for mule deer in WMU 18 and 19 are the invasion of annual grasses, particularly cheatgrass, resulting in an increase in fire risk, and the encroachment of pinyon/juniper into sagebrush and mountain shrub and sagebrush habitats, resulting in the loss of forage production, diversity, and quality. The distribution of available water is also a concern in Unit 19 (UDWR 2014a, 2014b).

Approximately 320,444 acres of crucial year-long pronghorn habitat is within the Wildlife Project Area (UDWR 2017a). In Utah, nearly all pronghorn populations occur in shrub-steppe habitat. Large expanses of open, low rolling or flat terrain characterize the topography of most of those habitats. Of particular importance in sustaining pronghorn populations is a strong forb component in the vegetative mix. The presence of succulent forbs is essential to lactating does and thus fawn survival during the spring and early summer. High quality browse, protruding above snow level, is especially critical to winter survival of pronghorn (UDWR 2009).

A critical limiting factor in much of Utah's pronghorn habitat is the lack of succulent forbs and grasses on spring/summer ranges. The availability of water during dry years also limits pronghorn populations in Utah (UDWR 2009).

4.0 ENVIRONMENTAL IMPACTS

4.1 Introduction

This chapter of the EA analyzes the impacts of the alternatives to those resources described in the affected environment Chapter 3.

4.2 Direct, Indirect, and Cumulative Impacts

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.

A cumulative effect is defined under the NEPA as "the change in the environment which results from the incremental impact of the action, decision, or project when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other action." "Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." 40 CFR 1508.7. The Past, Present, and Reasonably Foreseeable Future Actions applicable to the assessment area are identified in Table 5. Unless otherwise stated below, the Cumulative Impact Area (CIA) for each resource is inside and adjacent to the HMA. The timeframe for effects analysis is a 10-year period that coincides with population cycles and trends over AML.

Table 5. Past, Present, and Reasonably Foreseeable Actions.

Actions	Past	Present	Future
Livestock grazing authorizations and permit issuance.	✓	✓	✓
Recreation use (dispersed and SRPs).	✓	✓	✓
Invasive/noxious weed inventory and treatments.	✓	✓	✓
Hazardous fuels and habitat restoration treatments.	✓	✓	✓
Wildfire stabilization and rehabilitation plans.	✓	✓	✓
Land tenure adjustments.		✓	✓
Rights-of-ways (facilities, roads, pipelines, power lines, etc.)	✓	✓	✓
Travel and Transportation Management – Sheeprock Mountains (BLM 2018c)	✓		✓
Research proposals			✓
Oil and gas leasing/development	✓	✓	✓
Maintenance or reconstruction of existing infrastructure (rangeland developments, rights-of-ways, vegetation treatments, etc.)	✓	✓	✓
Land use planning amendments or revisions or resource specific activity-level plans (Federal, State, or County)	✓		✓

Any future proposed project within the HMA would be analyzed in an appropriate environmental document following site specific planning. Future project planning would also include public involvement. Proposals could include any activity from a right-of-way, a special recreation permit, and oil/gas leasing and/or development, to a land use plan revision.

4.2.1 Alternative A – Proposed Action

4.2.1.1 Wild Horses

Under the proposed action, decreased competition for forage following removal of excess animals, coupled with reduced reproduction as a result of fertility control, should result in the maintenance of good health and condition of mares and foals and improved range conditions over the longer-term. Additionally, reduced reproduction rates would be expected to extend the time interval between gathers and reduce disturbance to individual animals as well as herd social structure over the foreseeable future.

Population modeling was completed for the HMA using Version 1.40 of the WinEquus population (Jenkins 2002) to analyze how the alternatives would affect the wild horse population. This modeling analyzed removal of excess wild horses with no fertility control, as compared to removal of excess wild horses with fertility control for released wild horses and fertility control only. The No Action Alternative was also modeled. One objective of the modeling was to identify whether any of the alternatives "crash" the population or cause extremely low population numbers or growth rates. Minimum population levels and growth rates were found to be within reasonable levels and adverse impacts to the population not likely. Graphic and tabular results are also displayed in detail in Appendix D.

<u>Helicopter Gather/Bait and Water Traps</u>

The BLM has been gathering excess wild horses from public lands since 1975, and has been using helicopters for such gathers since the late 1970's. Refer to BLM 2015c for information on the methods that are utilized to reduce injury or stress to wild horses and burros during gathers. In 2017 and 2018, BLM Utah has gathered over 2,600 excess animals. Of these, gather related mortality has averaged only 0.4%, which is very low when handling wild animals. This data affirms that the use of helicopters and motorized vehicles are a safe, humane, effective and practical means for gathering and removing excess wild horses and burros from the range.

Direct impacts are known to occur intermittently during wild horse gather operations. Traumatic injuries could occur and typically involve biting and /or kicking bruises. Horses may potentially strike or kick gates, panels or the working chute while in corrals or trap which may cause injuries. Some wild horses may experience stress from being herded to the trap by a helicopter, or being closed into a bait/water trap. This stress may cause the horses to sweat and have elevated heart rates and respiration rates. It is expected that those will return to normal within a few minutes after the animals are in the trap. For helicopter gathers, these impacts will be mitigated by placing the traps close to the locations that the horses are found and limiting the distance that horses need to travel to the trap. The applicable stipulations in the CAWP will be followed and BLM will monitor horses after they have been capture (in close coordination with the project veterinarian for helicopter gathers).

Indirect individual impacts are those impacts that occur to individual wild horses after the initial stress event, and may include increased social displacement, increased conflict between studs, and spontaneous abortions in mares. These impacts, like direct individual impacts, are known to occur intermittently during wild horse gather operations. An example of an indirect individual impact would be the brief skirmish that occurs among studs following sorting and release into the stud pen, which lasts less than a few minutes and ends when one stud retreats. Traumatic injuries usually do not result from these conflicts. Instead, these injuries typically involve a bite and/or kicking with bruises that do not break the skin. Like direct individual impacts, the frequency of occurrence of these impacts among a population varies with the individual animal.

Spontaneous abortion is not considered to be an issue for either of the two proposed capture methods, since per BLM policy, helicopter/drive trap method would not be utilized during peak foaling season (March 1 thru June 30), unless an emergency exists, and the bait/water trapping method is anticipated to be low stress. Furthermore, given that most of the horses are in good body condition and as poor body condition can increase the incidence of such spontaneous abortions, spontaneous abortion is not considered an issue for the proposed gather.

A few foals may be orphaned during gathers. This may occur due to:

- The mare rejecting the foal. This occurs most often with young mothers or very young foals;
- The foal and mother become separated during sorting, and cannot be matched;
- The mare dies or must be humanely euthanized during the gather;
- The foal is ill, weak, or needs immediate special care that requires removal from the mother; or,
- The mother does not produce enough milk to support the foal.

Foals are often gathered that were orphaned on the range (prior to the gather) because the mother rejected it or died. These foals are usually in poor, unthrifty condition. Orphans encountered during gathers are cared for promptly and rarely die or have to be euthanized. It is unlikely that orphan foals would be encountered since majority of the foals would be old enough to travel with the group of wild horses. Also depending on the time of year, the age of the current foal crop could vary. Any decision on whether a foal is weaned or not would be made on an individual basis.

Gathering wild horses during the summer months can potentially cause heat stress. Gathering wild horses during the fall/winter months reduces risk of heat stress, although this can occur during any gather, especially in older or weaker animals. Adherence to the CAWP would help minimize the risks of heat stress. Heat stress does not occur often, but if it does, death can result. Most temperature related issues during a gather can be mitigated by adjusting daily gather times to avoid the extreme hot or cold periods of the day. The helicopter pilot would allow wild horses to travel slowly at their own pace during hot weather. If there are extreme heat conditions, gather activities are suspended during that time.

During summer gathers, roads and corrals may become dusty, depending upon the soils and specific conditions at the gather area. Dust impacts are mitigated by slowing speeds on dusty roads and watering down corrals and alleyways. Despite precautions, it is possible for some animals to develop complications from dust inhalation and contract dust pneumonia. This is rare, and usually affects animals that are already weak or otherwise debilitated due to older age or poor body condition.

Water consumption is monitored, and wild horses are often lightly sprayed with water as the corrals are being sprayed to reduce dust. The wild horses appear to enjoy the cool spray during summer gathers. Individual animals are also monitored and veterinary or supportive care administered as needed. Electrolytes can be administered to the drinking water during gathers that involve animals in weakened conditions or during summer gathers. Additionally, supplies of electrolyte paste can be directly administered to an affected animal. As a result of adherence to the CAWP, and care taken during summer gathers, potential risks to wild horses associated with summer gathers can be minimized or eliminated.

During winter gathers, wild horses are often located in lower elevations, in less steep terrain due to snow cover in the higher elevations. Subsequently, the animals are closer to the potential gather corrals, and need to maneuver less difficult terrain in many cases. However, snow cover can increase fatigue and stress during winter gathers, therefore the helicopter pilot allows wild horses to travel slowly at their own pace. In some cases, trails are plowed in the snow leading to the gather corrals to make it easier for animals to travel to the gather site and to ensure the wild horses can be safely gathered.

Through the capture and sorting process, wild horses are examined for health, injury and other defects. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy. BLM Euthanasia Policy IM 2015-070 is used as a guide to determine if animals meet the criteria and should be euthanized. Animals that are euthanized for non-gather related reasons include those with old injuries (broken hip, leg) that have caused the animal to suffer from pain or which prevent them from being able to travel or maintain body condition: old animals that have lived a successful life on the range, but now have few teeth remaining, are in poor body condition, or are weak from old age; and wild horses that have congenital (genetic) or serious physical defects such as club foot, or sway back and should not be returned to the range.

Transport, Short Term Holding, and Adoption and/or Sale Preparation

During transport, potential impacts to individual wild horses can include stress, as well as slipping, falling, kicking, biting, or being stepped on by another animal. Unless wild horses are in extremely poor condition, it is rare for an animal to die during transport.

Most wild horses begin to eat and drink immediately and adjust rapidly to their new situation. Recently captured wild horses, generally mares, in very thin condition may have difficulty transitioning to feed. A small percentage of animals can die during this transition; however, some of these animals are in such poor condition that it is unlikely they would have survived if left on the range.

During the preparation process for adoption and/or sale (freeze-marking, vaccination, castration and de-worming), potential impacts to wild horses are similar to those that can occur during transport. Injury or mortality during the preparation process is low, but can occur.

At short-term corral facilities, a minimum of 700 square feet is provided per animal. Mortality at short-term holding facilities averages approximately 5% (GAO-09-77, Page 51), and includes animals euthanized due to a pre-existing condition, animals in extremely poor condition, animals that are injured and would not recover, animals which are unable to transition to feed; and animals which die accidentally during sorting, handling, or preparation.

Wild Horses Remaining or Released into the HMA following Gather/Trapping

Under the proposed action, the post-gather population of wild horses would be about 121 wild horses, which is the low end of the AML range for the HMA. Reducing population size would ensure that the remaining wild horses are healthy and vigorous.

The wild horses that are not captured may be temporarily disturbed and move into another area during the gather operations. With the exception of changes to herd demographics, direct population wide impacts have proven, over the last 20 years, to be temporary in nature with most if not all impacts disappearing within hours to several days of when wild horses are released back into the HMA. No observable effects associated with these impacts would be expected within one month of release, except for a heightened awareness of human presence.

As a result of lower density of wild horses across the HMA following the removal of excess wild horses, competition for resources would be reduced, allowing wild horses to utilize preferred, quality habitat. Confrontations between stallions would also become less frequent, as would fighting among wild horse bands at water sources. Injuries and death to all age classes of animals would also be expected to be reduced as competition for limited forage and water resources is decreased.

The primary effects to the wild horse population that would be directly related to the gather(s) would be to herd population dynamics (age structure, sex ratio, growth rates, population size) and social structure. The BLM would aim to ensure that the remaining herd has a scientifically-informed sex ratio and age structure, so impacts would be negligible. Growth rates and population size would slow/reduce to more appropriate levels. Wild horses not captured, or captured and released back to the HMA, would form new bands or would group back up with horses that they had associated with prior to the gather. As the majority of horses in the HMA tend to live in large bands, with multiple family groups making up the band, it is expected that any effects to the social structure would be minimal due to the familiarity of the horses to each other. No other observable effects to the remaining population associated with the gather impacts would be expected, except potentially a heightened shyness toward human contact.

Porcine Zona Pellucida (PZP) Vaccine

The use of PZP was analyzed in detail in the 2015 Fertility Control EA (BLM 2015). New information and any additional information that was not included in the Fertility Control EA is discussed in this section.

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).

Reversibility and Effects on Ovaries

In most cases, PZP contraception appears to be temporary and reversible (Kirkpatrick and Turner 2002, Joonè *et al.* 2017a). Although the rate of long-term or permanent sterility following repeated vaccinations with PZP has not been quantified, it must be acknowledged that this could be a result for some number of wild horses receiving multiple repeat PZP vaccinations.

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

In some mares, PZP vaccination may cause direct effects on ovaries (Gray and Cameron 2010, Joonè *et al.* 2017b). Joonè *et al.* (2017a) noted reversible effects on ovaries in mares treated with one primer dose and booster dose. In studies with native ZP proteins and recombinant ZP proteins, Joonè *et al.* (2017a) found transient effects on ovaries after PZP vaccination in some treated mares; normal estrus cycling had resumed 10 months after the last treatment. Kirkpatrick *et al.* (1992) noted effects on ovaries after three years of treatment with PZP. Observations at Assateague Island National Seashore indicate that the more times a mare is consecutively treated, the longer the time lag before fertility returns, but that even mares treated 7 consecutive years did eventually return to ovulation (Kirkpatrick and Turner 2002). Other studies have reported that continued applications of PZP may result in decreased estrogen levels (Kirkpatrick *et al.* 1992) but that decrease was not biologically important, as ovulation remained similar between treated and untreated mares (Powell and Monfort 2001). Permanent sterility for mares treated consecutively 5-7 years was observed by Nuñez *et al.* (2010, 2017). 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. Skinner *et al.* (1984) speculated about PZP effects on ovaries, based on their study in laboratory rabbits, as did Kaur and Prabha (2014), though neither paper was a study of PZP effects in equids.

Effects on Existing Pregnancies, Foals, and Birth Phenology

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

Effects of Marking and Injection

Use of remotely delivered, 1-year PZP is generally limited to populations where individual animals can be accurately identified and repeatedly approached. The dart-delivered formulation produced injection-site reactions of varying intensity, though none of the observed reactions appeared debilitating to the animals (Roelle and Ransom 2009). Joonè *et al.* (2017a) found that injection site reactions had healed in most mares within 3 months after the booster dose, and that they did not affect movement or cause fever. The longer-term nodules observed did not appear to change any animal's range of movement or locomotor patterns and in most cases did not appear to differ in magnitude from naturally occurring injuries or scars.

Indirect Effects

Because successful fertility control would reduce foaling rates and population growth rates, another indirect effect would be to reduce the number of wild horses that have to be removed over time to achieve and maintain the established AML. So long as the level of contraceptive treatment is adequate, the lower expected birth rates can compensate for any expected increase in the survival rate of treated mares. In addition, 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 wild horses from this area to ORPs or for other statutorily mandated disposition. A high level of physical health and future reproductive success of fertile mares within the herd would be sustained, as reduced population sizes would be expected to lead to more availability of water and forage resources per capita.

Reduced population growth rates and smaller population sizes could also allow continued and increased environmental improvements to range conditions within the HMA, 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 TNEB, 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 TNEB, and with a less concentrated distribution of wild horses across the HMA, there should also be less trailing and concentrated use of water sources, which would have many benefits to the wild horses still on the range. Lower population density would be expected to lead to reduced competition among wild horses using the water sources, and less fighting among wild 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.

Behavioral Effects

The National Research Council (NRC) report (2013) noted that all fertility suppression has effects on mare behavior, mostly because 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, when compared to mares that are fertile. Such behavioral differences should be considered as potential consequences of successful contraception.

In two studies involving a total of four wild horse populations, both Nuñez *et al.* (2009) and Ransom *et al.* (2010) found that PZP-treated mares were involved in reproductive interactions with stallions more often than control mares, which is not surprising given the evidence that PZP-treated females of other mammal species can regularly demonstrate estrus behavior while contracepted (Shumake and Wilhelm 1995, Heilmann *et al.* 1998, Curtis *et al.* 2001). There was no evidence, though, that mare welfare was affected by the increased level of herding by stallions noted in Ransom *et al.* (2010). Nuñez's later analysis (2017) noted no difference in mare reproductive behavior as a function of contraception history.

Ransom *et al.* (2010) found that control mares were herded by stallions more frequently than PZP- treated mares, and Nuñez *et al.* (2009, 2014, and 2017) found that PZP-treated mares exhibited higher infidelity to their band stallion during the non-breeding season than control mares. Madosky *et al.* (2010) and Knight (2014) found this infidelity was also evident during the breeding season in the same population that Nuñez *et al.* (2009, 2010, 2014, 2017) studied; they concluded that PZP-treated mares changing bands more frequently than control mares could lead to band instability. Nuñez *et al.* (2009), though, cautioned against generalizing from that island population to other herds. Nuñez *et al.* (2014) found elevated levels of fecal cortisol, a marker of physiological stress, in mares that changed bands. The research is inconclusive as to whether all the mares' movements between bands were related to the PZP treatments themselves or the fact that the mares were not nursing a foal, and did not demonstrate any long-term negative consequence of the transiently elevated cortisol levels. The authors (Nuñez *et al.* 2014) concede that these effects "…may be of limited concern when population reduction is an urgent priority." In contrast to transient stresses, Creel *et al.* (2013) highlight that variation in population density is one of the most well-established causal factors of chronic activation of the hypothalamic-pituitary-adrenal axis, which mediates stress hormones; high population densities and competition for resources can cause chronic stress. Creel also states "…there is little consistent evidence for a negative association between elevated baseline glucocorticoids and fitness." Band fidelity is not an aspect of wild horse biology that is specifically protected by the WFRHBA of 1971. It is also notable that Ransom *et al.* (2014b) found higher group fidelity after a herd had been gathered and treated with a contraceptive vaccine; in that case, the researchers postulated that higher fidelity might have been facilitated by the decreased competition for forage after excess wild 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 welfare or well-being have been noted 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 would respond similarly to PZP treatment. Differences in habitat, resource availability, and demography among conspecific populations would undoubtedly affect their physiological and behavioral responses to PZP contraception, and need to be considered. Kirkpatrick *et al.* (2010) concluded that: "the larger question is, even if subtle alterations in behavior may occur, this is still far better than the alternative," and that the "…other victory for horses is that every mare prevented from being removed, by virtue of contraception, is a mare that would only be delaying her reproduction rather than being eliminated permanently from the range. This preserves herd genetics, while gathers and adoption do not."

Genetic Effects of PZP Vaccination

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

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 wild horses in a small number of well-known HMAs that contain a relatively high fraction of alleles associated with old Spanish horse breeds (NRC 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with admixtures from multiple 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 treating young animals with a contraceptive led to more genetic diversity being retained than either a strategy that preferentially treats older animals, or periodic gathers and removals.

Except for herds that are designated to be entirely non-breeding, BLM policy is that 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. The most recent genetic diversity sampling in the Onaqui Mountain HMA herd was conducted in 2005 (Cothran 2008). Results from that sampling then indicated that the Onaqui herd had higher than average numbers of genetic variants in the markers used, but a low heterozygosity at the time. The geneticist who analyzed the samples recommended that BLM introduce 2 or 3 mares from any other herd to bolster heterozygosity (Cothran 2008). Since 2005, BLM has introduced a total of 18 mares and 6 stallions to the herd – numbers far greater than what had been recommended. In 2005, 2007, and 2011, BLM introduced five males and 12 females; 3 females; and 1 male and 3 females, respectively. Those animals came from a wide variety of source herds, including from Saylor Creek HMA (Idaho), Cedar Mountain HMA (Utah), Round Mountain HMA and Fox Hog HMA (California), Moriah HA and Goshute HA (Nevada), and from other HMAs managed by the Cedar City FO. Therefore, allowing for foals born to and sired by those introduced animals, the expectation is that by now the Onaqui herd has a much higher level of heterozygosity, and still has high levels of allelic diversity. The gather(s) associated with this action will provide BLM with an opportunity to confirm that those animal introductions have increased the genetic diversity of the Onaqui HMA herd since 2005. Maintaining the herd at population levels between 121 and 210 is expected to allow for maintenance of adequate genetic diversity, even if some members of the herd are temporarily or permanently infertile. For example even if the herd were only to include 40 effectively breeding females and 60 effectively breeding males, the genetic effective population size would be 96 (based on the equation, $N_e = 4N_mN_f/(N_m + N_f)$), so the rate of heterozygosity loss per horse generation would be expected to be only 0.5%...one half of one percent (based on the equation, $H_1 = (1\text{-}1/2N_e)H_0$). Continued genetic diversity monitoring would allow the BLM to be alerted if, at any point in the future, genetic diversity levels become low. The BLM could then take action to supplement the genetics of the herd by adding new individuals.

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. In addition, there is no Bureau-wide policy that requires BLM to allow each female in a herd to reproduce before she is treated with contraceptives.

Correlations between physical factors and immune response would not preclude the possibility 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.

Treatment History and Effectiveness

BLM continues to administer PZP within the HMA (Table 6). Field observations and information documented on data sheets have shown a decrease in the number of foals. All treatments continue to be recorded on data sheets for each individual mare. For example, wild horse #4045 (mare id) has not had a foal since 2016 and that was the first year she received the liquid PZP. From the inventory flight, the reported number of foals per 100 adults was 11.5.

Table 6. PZP Treatment History HMA.

Fiscal Year	2015	2016	2017
Number of Mares Treated	15	37	53

Cumulatively over the next 10-15 year period, continuing to manage wild horses within the established AML range would result in improved vegetation condition (i.e. forage availability and quantity), which in turn would result in improved vegetation density, cover, vigor, seed production, seedling establishment and forage production over current conditions. Managing wild horse populations within the established AML would allow the primary forage plant species to return more rapidly and allow for improvements to riparian habitat, even though some vegetation conditions may never be able to return to their potential. Maintaining AML over a sustained period of time throughout the CIA would allow for the collection of scientific data to evaluate current AML levels and to identify whether any changes to AML are warranted.

The cumulative effects associated with the capture and removal of excess wild horses across all HMAs in the West, include gather-related mortality of less than 1% of the captured animals, about 5% per year associated with transportation, short term holding, adoption or sale with limitations and about 8% per year associated with long-term holding. These rates are comparable to natural mortality on the range ranging from about 5-8% per year for foals (animals under age 1), about 5% per year for horses ages 1-15, and 5-100% for animals age 16 and older (Stephen Jenkins, 1996, Garrott and Taylor, 1990). In situations where forage and/or water are limited, mortality rates in the wild increase, with the greatest impact to young foals, nursing mares and older horses.

As part of its efforts to manage the population growth of wild horses on public rangelands, the BLM has also supported the development of an effective contraceptive agent for wild horses since 1978. Over the years, attempts at different approaches – such as hormone implants, chemical vasectomies, and intrauterine devices – were tried, but abandoned as ineffective or impractical at that time. BLM will also continue its partnering efforts to conduct research projects that leads to new information on ecological interactions or wild horse physiology.

After the conclusion of the patenting process of the Skull Valley Land Exchange, the BLM would begin monitoring to determine if any adjustments to AML or AUMs are justified.

Finally, in Utah, the BLM manages 19 HMAs and the combined AML for all HMAs in the state is 1,956 animals. The Onaqui Mountain HMA is one of these 19 HMAs. Each HMA is unique in its terrain features, local climate and natural resources, just as each herd is unique in its history, genetic heritage, coloring, and size distribution. The Onaqui Mountain HMA would continue as an integral part of the BLM's wild horse and burro program under this (and all) alternatives.

The actions shown in Table 5 could continue over the next 10-15 years and would contribute to minor changes in areas available for foraging wild horses. Vegetation treatments, future land tenure adjustments or fencing could cause the most changes in available water or forage for wild horses. Protective measures would continue to be reviewed and to be applied to actions under BLM jurisdiction.

4.2.1.2 Recreation/Social

Fewer wild horses could result in a reduced opportunity for viewing them by the general public, depending on where the horses returned to the HMA elect to congregate. Reduced viewing opportunities may also impact the demand of the commercial wild horse photography permit holders. While these impacts would not be significant, some of these potential impacts would be mitigated by careful selections in the horses to remove from or retain within the HMA.

Removal of wild horses to the low AML may also help modify behaviors of both horses and the public to minimize close contact incidents, which are detrimental to both public safety and herd health, by decreasing opportunities for close encounters.

Over the long-term, the recreating public would still use areas inside and adjacent to the HMA. SRPs would continue to be administered by the BLM. The public would remain highly interested in BLM's administration of the wild horse program.

The actions shown in Table 5 could continue over the next 10-15 years and would contribute to important changes in available areas for recreational activities. Travel and transportation management may change recreational opportunities and patterns. Visitors to the area are accustomed to human and wild horse activities. Public viewing opportunities and locations could change over time as wild horse use area preferences change. SRPs would continue to be processed for wildlife and wild horse viewing. Protective measures would continue to be reviewed and to be applied to actions under BLM jurisdiction.

4.2.1.3 Soil/Vegetation

Soils

The proposed action would have limited impacts to soil from trampling and disturbance occurring at gather sites and temporary holding facilities. Any direct, indirect, and cumulative effects to soil resources resulting from the proposed action would be minor and short-term. Vehicles would use existing roads and only relatively small areas would be used for gathering and holding operations.

Removing excess wild horses would make progress towards achieving a natural ecological balance. Implementation of the proposed action would bring the wild horse population within the HMA to AML. It would reduce current impacts to soil resources resulting from an overpopulation of wild horses in the HMA. Rangeland health and soil resources would improve in the long-term with management of wild horses at AML.

Overall, soil conditions are expected to improve after wild horse numbers are reduced. Fewer numbers of wild horses using riparian systems would result in a lessening of soil compaction in riparian areas, where the soils are most susceptible due to their higher moisture content. Compression-related impacts to biological soil crusts from wild horses would be lessened over the area with wild horse removal, and crust cover on the highly calcareous soils would increase. Following wild horse removal, increased vegetative and biological soil crust cover should reduce wind and water erosion.

Indirectly, wild horses cause an increase in soil compaction as measured through soil penetration resistance (Beever and Herrick 2006, Davies *et al.* 2014) and lower soil aggregate stability (Davies *et al.* 2014). Soil characteristics, such as soil compaction, can fundamentally change plant communities through processes such as water movement and seedling germination and recruitment (Beever and Herrick 2006).

Impacts to soils with implementation of the proposed action would include disturbance around gather sites and at temporary holding facilities. Impacts would be caused by vehicle traffic and the hoof action of penned wild horses, and would be locally severe in the immediate vicinity of the corrals or temporary holding facilities. Generally, these activity sites would be small in size, at less than one half acre for each site. Soil compaction, localized wind erosion, and destruction of biological soil crusts where present, would occur at the gather sites. Since most gather sites and temporary holding facilities are re-used during subsequent wild horse gather operations, impacts from the gather activities would remain site-specific and isolated in nature. In addition, most gather sites or temporary holding facilities are selected to enable easy access by transportation vehicles and logistical support equipment and would generally be adjacent to or on roads, pullouts, water haul sites, or other flat spots that were previously disturbed, thereby minimizing new disturbance. Vehicles used in the horse gather would also cause soil compaction and increased erosion in a small area. By adhering to the SOPs, adverse impacts to soils would be minimized.

Vegetation

Wild horses impact vegetation through removal of biomass by grazing and through trampling of vegetation and soils by movement. The simplest direct impact of horse removal is the relief to the vegetation from grazing. Wild horses require more forage than cattle because they have less efficient digestion. The BLM calculates AUMs for wild horses to be 1.25 times that of a cow. In parts of the HMA (i.e., South Skull Valley Allotment), it takes almost 15 acres of land to supply a single horse AUM. If 465 wild horses are removed, that would provide relief for up to 6,975 AUMs per year. Using an average of 760 pounds per AUM, 5,301,000 pounds of vegetation would be left on the land to support wildlife, livestock and provide cover and habitat.

Studies examining the impacts of feral wild horses on arid ecosystems in the Great Basin reveal some consistent and inconsistent impacts. Horse grazing consistently leads to lower shrub cover and lower plant diversity (Beever and Brussard 2000, Beever *et al.* 2008, Davies *et al.* 2014). In contrast, horse grazing impacts on plant cover, density and frequency were less consistent with some studies showing reductions in these parameters and some showing no impacts (i.e., statistically important, e.g., Beever *et al.* 2008 versus Davies *et al.* 2014). In some cases horse grazing impacts were only important at heavily grazed sites or at lower elevations (e.g., Davies *et al.* 2014). At higher elevations or in areas with lower evapotranspiration, the variation in precipitation was demonstrated to have a much larger impacts on vegetation than horse grazing (Fahnstock and Detling 1999). It is possible that the higher elevation portions of the HMA may also be more resilient to grazing and show little impact with removal.

Additional indirect impacts of grazing, which removes vegetation and creates more bare ground, is the greater potential for establishment and spread of invasive species which was demonstrated in at least one study (Beever *et al.* 2008). The HMA is located in the squarrose knapweed cooperative weed management area where knapweed *(Centaurea virgata*) infestations are already an issue. In addition, cheatgrass is quite common in the HMA (Table 1). This grass proliferates with disturbances such as fire and overgrazing. Higher levels of cheatgrass make the landscape more susceptible to wildfires and increase the loss of shrubland and woodland habitat in a positive-feedback cycle that favors annual grasslands (Baker 2008). Decreased disturbance due to wild horse overuse is expected to occur under this alternative. This would decrease spread of cheatgrass into new areas.

Cumulatively over the next 10-year period, soil and vegetation resources inside and adjacent to the HMA would remain dependent on proper rangeland management. It is expected that rangeland conditions would improve with removal of wild horses down to low AML. An increase in perennial cover would be expected as well as a decrease in new areas invaded by cheatgrass. In addition, future climate predictions show widespread changes in the current vegetation cover with increase in aridity (Balzotti *et al.* 2016).

The actions shown in Table 5 could continue over the next 10-15 years and would contribute minor or small changes in soil structure and vegetation communities. Protective measures would continue to be reviewed and to be applied to actions under BLM jurisdiction.

4.2.1.4 Water Resources/Wetlands/Riparian Zones/Floodplains

The proposed action would not directly impact water resources, wetlands, riparian zones or floodplains as gather sites and temporary holding facilities would not be located on top of any natural aquatic systems. While developed water would be available in gather sites and temporary holding facilities, these would be either from permanent developments, which have already been analyzed, or through temporary watering facilities. Natural aquatic resources would not be impacted from additional trampling and disturbance as long as gather sites and temporary holding facilities are not co-located with these resources. Vehicles would use existing roads and only relatively small areas that would not have a larger impact than already analyzed would be used for gathering and holding operations.

Removing excess wild horses would make progress towards achieving a natural ecological balance. Implementation of the proposed action would bring the wild horse population within the HMA to AML. It would reduce current impacts to aquatic resources resulting from an overpopulation of wild horses in the HMA. Rangeland health and aquatic ecosystem health would improve in the long-term with management of wild horses at AML.

Overall, aquatic resources are expected to improve after wild horse numbers are reduced. Fewer numbers of wild horses using riparian systems would result in a lessening of soil compaction in riparian areas, where the soils are most susceptible due to their higher moisture content. Wild horses greatly impact riparian and wetland systems by disturbing soil and vegetation especially at spring sources through digging action. Following wild horse removal, riparian vegetation should recover resulting in improved riparian condition and increasing BLM's ability to achieve and maintain rangeland health.

Cumulatively over the next 10-year period, water associated resources inside and adjacent to the HMA would remain dependent on proper rangeland management and adjustments due to drought and other changing conditions in the local environment.

The actions shown in Table 5 could continue over the next 10-15 years and would contribute to minor changes available water, designated water uses and the overall function of wetlands/riparian zones/floodplains. Under proper rangeland management, wetland/riparian area function would continue to improve. Protective measures would continue to be reviewed and to be applied to actions under BLM jurisdiction.

4.2.1.5 Migratory Birds

Very few direct negative impacts to migratory bird species are expected from the proposed action. The area affected by trapping activities would be very small, approximately 15 acres. Sites used for water or helicopter traps or for holding areas are typically low value habitat because of proximity to high use areas, such as roads, stock ponds, and troughs and the resulting degradation of habitat due to compaction, trampling, and vegetation removal. If project activities occur during the migratory bird breeding season (songbirds: April 1 – 31 July; raptors 1 January – August 31), these sites would be surveyed for the presence of nesting birds. Spatial buffers would be placed around active nest sites where project activities would not be allowed until the nest sites were no longer active. The buffer for songbirds would be 100'; raptor buffers would be consistent with Romin and Muck (2002). There is the possibility of active bird nests being disturbed or destroyed by wild horses during helicopter trapping activities.

The indirect, and overall, impact of the project would be positive for migratory birds. Wild horses remove more of the plant than cattle or sheep, which limits and/or delays vegetative recovery, which can result in reduced vegetative cover for ground-nesting birds (BLM/Forest Service 2015). Areas grazed by wild horses have been found to have reduced plant diversity and grass density, and greater abundance of invasive species (BLM/Forest Service 2015). Wild horses can range farther than cattle from water sources, and can therefore impact migratory bird habitats beyond the reach of cattle, including steep slopes and higher elevations. Lowering the wild horse population would diminish the negative impacts resulting from wild horses and result in improved migratory bird habitat. Soil compaction, erosion would be lessened and vegetative and biological crust cover would increase. Nesting and foraging substrates and insect prey populations (Beever and Herrick 2006) would increase.

Cumulatively, the proposed action would add to the beneficial effects of habitat restoration and rehabilitation projects, while countervailing the negative effects of rights-of-way, recreational use, and historic overgrazing. The proposed action would countervail the reduction in water availability due to drought, although the cumulative effects of drought and wildfire on vegetation could overwhelm any contribution from the proposed action in portions of the project area.

The actions shown in Table 5 could continue over the next 10-15 years and would contribute to minor changes in available habitat for migratory birds. Birds expected in the region would continue to return to the HMA. Protective measures would continue to be reviewed and to be applied to actions under BLM jurisdiction.

4.2.1.6 Greater Sage-Grouse Habitat

Very few direct negative impacts to greater sage-grouse are expected from the proposed action. The area affected by gather sites and temporary holding facilities would be small, approximately 15 acres (Appendix A, Figure 1). Sites used for water or helicopter traps or for holding areas are typically low value sage-grouse habitat because of proximity to human high use areas, such as roads, stock ponds, and troughs and the resulting degradation of habitat due to compaction, trampling, and vegetation removal. The BLM will coordinate with Utah Division of Wildlife Resources to apply the appropriate seasonal restrictions to avoid disturbances to sage-grouse populations. There is the possibility of sage-grouse broods being disturbed by wild horses during helicopter trapping activities. However, helicopter gather operations are limited to the period of July 1 through 28 February (to avoid the foaling season), and broods would be capable of moving away from the disturbance caused by the operation.

The indirect, and overall, impact of the project would be positive for greater sage-grouse. Wild horses remove more of the plant cover than cattle or sheep, which limits and/or delays vegetative recovery, which can result in reduced vegetative cover for nesting and brooding sage-grouse (BLM/Forest Service 2015). Areas grazed by wild horses have been found to have reduced plant diversity and grass density, and greater abundance of invasive species (BLM/Forest Service 2015). Wild horses can range farther than cattle from water sources, and can therefore impact sage-grouse habitats beyond the reach of cattle, including steep slopes and higher elevations. Lowering the wild horse population would diminish the negative impacts resulting from wild horses and result in improved sage-grouse habitat. Fewer wild horses on the landscape would result in less vegetation removal by horses. Less wild horse pressure on herbaceous vegetation will result in better vegetation vigor to benefit sage-grouse. Improved vegetation condition can provide sage-grouse with important thermal or escape cover, more direct forage, and more habitat for arthropods (important for sage-grouse, especially for chicks) (Beever and Aldridge 2011). Soil compaction, erosion would be lessened and vegetative and biological crust cover would increase. Nesting, brood-rearing, and foraging habitats and insect prey populations would increase (Beever and Herrick 2006).

Furthermore, wild horse removal aids in recovery goals in this area by decreasing grazing pressure on desirable grasses and allow desirable vegetation to better compete against undesirable annual grasses. Decreasing the abundance and presence of undesirable annual grasses will decrease the risk of wildfire, a primary threat to greater sage-grouse in this area. This decrease in fire would also be beneficial to shrub cover, which would be expected to increase.

This alternative would implement required adaptive management responses that initiate gathers to reduce wild horse and burro populations within the affected area to the low end of AML, subject to funding and holding space availability (BLM 2015. ARMPA, Appendix I, Table I.1).

The CIA for sage-grouse is the Sheeprocks Greater Sage-grouse Population Area. The proposed action would add to the beneficial effects of habitat restoration and rehabilitation projects, while countervailing the negative effects of rights-of-way, recreational use, and historic overgrazing (Knick *et al*. 2011). The proposed action would countervail the reduction in water availability due to drought, although the cumulative effects of drought and wildfire on vegetation could overwhelm any contribution from the proposed action in portions of the project area.

The reasonably foreseeable development scenario for oil and gas described in Appendix R of BLM/Forest Service (2015) indicates that only one new well and 186 acres of disturbance are projected within the Sheeprocks Greater Sage-grouse Population Area through 2030. In 2017, two oil and gas lease sale parcels located in the southeast corner of the Sheeprocks Greater Sage-grouse Population Area were sold. These parcels included 924 acres of PHMA within low quality habitat on the periphery of the population area. The “no surface occupation” stipulation attached to these parcels would prevent direct disturbance and degradation of habitat on the BLM parcels. If the parcels were developed using directional drilling from adjacent private lands, there could be direct impacts (disturbance, habitat loss/degradation/fragmentation) to the private lands and indirect disturbance impacts and habitat degradation/fragmentation on the adjacent BLM lands. The proposed action would countervail the habitat degradation/fragmentation resulting from development of the lease sale parcels by improving habitat conditions over a much larger area.

The actions shown in Table 5 could continue over the next 10-15 years and would contribute to changes in available habitat for the greater sage-grouse. Protective measures defined in the ARMPA would continue to be applied as warranted to actions under BLM jurisdiction.

4.2.1.7 Special Status Animal Species

No effects to the yellow-billed cuckoo are expected from the proposed action. The BLM received technical assistance and informally consulted with the Fish and Wildlife Service Utah Field Office regarding the effects of this proposed action. The total area affected by gather sites and temporary holding facilities would be small, approximately 15 acres, and typically would not be located in cuckoo habitat. Sites used for water or helicopter traps or for holding areas typically lack cuckoo habitat because of proximity to high use areas, such as roads, stock ponds, and troughs, and the resulting degradation of habitat due to compaction, trampling, and vegetation removal. If project activities occur during the cuckoo breeding season (June 1-August 31), gather sites and temporary holding facilities would be surveyed for cuckoo habitat, and if present, surveys for nesting cuckoos would be performed. A 0.5-mile buffer would be placed around active nest sites where project activities would not be allowed until the nest sites were no longer active. The possibility of active cuckoo nests being disturbed or destroyed by wild horses during helicopter trapping activities is negligible, given that their nesting habitat is typically dense, multi-canopied wooded riparian areas, and not the more open habitat that wild horses would be expected to move through while being herded. Disturbance due to helicopter flyovers while searching or herding horses would be brief and is not expected to negatively affect nesting cuckoos. The proposed action would not contribute to any cumulative effects for yellow-billed cuckoo because there is little to no habitat in the Wildlife Project Area.

Very few direct negative impacts to sensitive species are expected. The area affected by trapping activities would be very small, approximately 15 acres. Sites used for water or helicopter traps or for holding areas are typically low value habitat because of proximity to high use areas, such as roads, stock ponds, and troughs, and the resulting degradation of habitat due to compaction, trampling, and vegetation removal. Project sites would be surveyed for sensitive species and their habitats prior to project implementation. Project activities would be relocated to avoid sensitive species occurrences or spatial buffers would be placed around active nest/den/burrow/roost sites where project activities would not be allowed until the sites were no longer active. There is the possibility of active nests/dens/burrows being disturbed or destroyed by wild horses during helicopter trapping activities.

The indirect, and overall, impact of the project would be positive for sensitive species. Wild horses remove more of the plant than cattle or sheep, which limits and/or delays vegetative recovery, which can result in reduced vegetative cover for ground-nesting birds (BLM/Forest Service 2015). Areas grazed by wild horses have been found to have reduced plant diversity and grass density, and greater abundance of invasive species (BLM/Forest Service 2015). Horses can range farther than cattle from water sources, and can therefore impact sensitive species habitats beyond the reach of cattle, including steep slopes and higher elevations. Lowering the wild horse population would diminish the negative impacts resulting from wild horses and result in improved sensitive species habitat. Soil compaction, erosion would be lessened and vegetative and biological crust cover would increase. Nesting and foraging substrates and insect prey populations (Beever and Herrick 2006) would increase, as would hiding and thermal cover.

Cumulatively, for sensitive species, the proposed action would add to the beneficial effects of habitat restoration and rehabilitation projects, while countervailing the negative effects of rights-of-way, recreational use, and historic overgrazing. The proposed action would countervail the reduction in water availability due to drought, although the cumulative effects of drought and wildfire on vegetation could overwhelm any contribution from the proposed action in portions of the project area.

The actions shown in Table 5 could continue over the next 10-15 years and would contribute to minor changes in available habitat for currently identified and future special status animal species. Protective measures would continue to be reviewed and to be applied to actions under BLM jurisdiction.

4.2.1.8 Wildlife Excluding Special Status Species

Very few direct negative impacts to big game species are expected from the proposed action. The area affected by trapping activities would be very small, approximately 15 acres. Sites used for water or helicopter traps or for holding areas are typically low value habitat because of proximity to high use areas, such as roads, stock ponds, and troughs, and the resulting degradation of habitat due to compaction, trampling, and vegetation removal. The reduction of available water for water trapping could affect big game use of the Wildlife Project Area. At these times big game guzzlers would remain available to big game. Other water sources would be restricted for no more than 2 weeks at a time without consulting with UDWR. Water traps would be monitored to ensure that big game do not become trapped. Helicopters searching for and herding wild horses could disturb big game. These disturbances would be brief and big game would be able to move away from the disturbance.

The indirect, and overall, impact of the project would be positive for big game species. Wild horses remove more of the plant than cattle or sheep, which limits and/or delays vegetative recovery, which can result in reduced forage availability for big game. Areas grazed by wild horses have been found to have reduced plant diversity and grass density, and greater abundance of invasive species (BLM/Forest Service 2015). Wild horses can range farther than cattle from water sources, and can therefore impact big game habitats beyond the reach of cattle, including steep slopes and higher elevations. In addition, wild horses have been shown to spatially displace pronghorn and mule deer from water sources (Hall *et al.* 2018). Lowering the wild horse population would diminish the negative impacts resulting from wild horses and result in improved big game habitats and reductions in competition for forage limited water resources. Soil compaction, erosion would be lessened and vegetative and biological crust cover would increase.

Cumulatively, the proposed action would add to the beneficial effects of habitat restoration and rehabilitation projects, while countervailing the negative effects of rights-of-way, recreational use, and historic overgrazing. The proposed action would countervail the reduction in water availability due to drought, although the cumulative effects of drought and wildfire on vegetation could overwhelm any contribution from the proposed action in portions of the project area. Helicopter trapping during the hunting season could add to the cumulative disturbance effects of hunting.

The actions shown in Table 5 could continue over the next 10-15 years and would contribute to minor changes in available habitat for wildlife. Protective measures would continue to be reviewed and to be applied to actions under BLM jurisdiction.

4.2.2 Alternative B – GonaCon-Equine Vaccine/Sterilization

4.2.2.1 Wild Horses

<u>GonaCon-Equine Vaccinations</u>

Under this alternative, the BLM would incorporate GonaCon-Equine into the current fertility control vaccine plan as another tool to help control population growth in the herd (Section 2.3).

<u>*Vaccine Formulations: Gonadotropin Releasing Hormone (GnRH)*</u>

GonaCon (which is produced under the trade name GonaCon-Equine for use in feral horses and burros) is approved for use by authorized federal, state, tribal, public and private personnel, for application to free-ranging wild horse and burro herds in the United States (EPA 2013, 2015). GonaCon has been used on feral horses in Theodore Roosevelt National Park and on wild horses administered by BLM (BLM 2015). GonaCon has been produced by USDA-APHIS (Fort Collins, Colorado) in several different formulations, the history of which is reviewed by Miller *et al*. (2013). GonaCon vaccines present the recipient with hundreds of copies of GnRH as peptides on the surface of a linked protein that is naturally antigenic because it comes from invertebrate hemocyanin (Miller *et al* 2013). Early GonaCon formulations linked many copies of GnRH to a protein from the keyhole limpet (GonaCon-KHL), but more recently produced formulations where the GnRH antigen is linked to a protein from the blue mussel (GonaCon-B) proved less expensive and more effective (Miller *et al*. 2008). GonaCon-Equine is in the category of GonaCon-B vaccines. GonaCon is a pharmaceutical-grade vaccine, including aseptic manufacturing technique to deliver a sterile vaccine product (Miller *et al*. 2013). If stored at 4° C, the shelf life is 6 months (Miller *et al* 2013).

Miller *et al.* (2013) reviewed the vaccine environmental safety and toxicity. When advisories on the product label (EPA 2015) are followed, the product is safe for users and the environment (EPA 2009b). EPA waived a number of tests prior to registering the vaccine, because GonaCon was deemed to pose low risks to the environment, so long as the product label is followed (Wang-Chaill *et al.* 2017, in press).

Direct Effects GnRH Vaccine

GonaCon-Equine is one of several vaccines that have been engineered to create an immune response to the gonadotropin releasing hormone peptide (GnRH). GnRH is a small peptide that plays an important role in signaling the production of other hormones involved in reproduction in both sexes. When combined with an adjuvant, a 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.

GnRH is highly conserved across mammalian taxa, so some inferences about the mechanism and effects of GonaCon-Equine in horses can be made from studies that used different anti-GnRH vaccines, in horses and other taxa. Other commercially available anti-GnRH vaccines include: Improvac (Imboden *et al.* 2006, Botha *et al*. 2008, Janett *et al*. 2009a, Janett *et al*. 2009b, Schulman *et al*. 2013, Dalmau *et al*. 2015), made in South Africa; Equity (Elhay *et al*. 2007), made in Australia; Improvest, for use in swine (Bohrer *et al*. 2014); Repro-BLOC (Boedeker *et al*. 2011); and Bopriva, for use in cows (Balet *et al*. 2014). Of these, GonaCon-Equine, Improvac, and Equity are specifically intended for horses. Other anti-GnRH vaccine formulations have also been tested, but did not become trademarked products (e.g., Goodloe 1991, Dalin *et al* 2002, Stout *et al*. 2003, Donovan *et al*. 2013, Schaut *et al*. 2018, Yao *et al*. 2018). The effectiveness and side effects of these various anti-GnRH vaccines may not be the same as would be expected from GonaCon-Equine use in horses. Results could differ because of differences in the preparation of the GnRH antigen, and the choice of adjuvant used to stimulate the immune response. For some formulations of anti-GnRH vaccines, a booster dose is required to elicit a contraceptive response, though GonaCon can cause short-term contraception in a fraction of treated animals from one dose (Powers *et al*. 2011, Gionfriddo *et al*. 2011a, Baker *et al*. 2013, Miller *et al* 2013).

GonaCon can provide multiple years of infertility in several wild ungulate species, including horses (Killian *et al*., 2008; Gray *et al*., 2010). 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).

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

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

Reversibility and Effects on Ovaries: GnRH Vaccines

The NAS (2013) review pointed out that single doses of GonaCon-Equine do not lead to high rates of initial effectiveness, or long duration. Initial effectiveness of one dose of GonaCon-Equine vaccine appears to be lower than for a combined primer plus booster dose of the PZP vaccine ZonaStat-H (Kirkpatrick *et al.* 2011), and the initial effect of a single GonaCon dose can be limited to as little as one breeding season. However, preliminary results on the effects of booster dose of GonaCon-Equine indicate that it can have high efficacy and longer-lasting effects in free-roaming horses (Baker *et al.* 2017) than the one-year effect that is generally expected from a single booster of ZonaStat-H.

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

Not all mares should be expected to respond to the GonaCon-equine vaccine; some number should be expected to continue to become pregnant and give birth to foals. In studies where mares were exposed to stallions, the fraction of treated mares that are effectively contracepted in the year after anti-GnRH vaccination varied from study to study, ranging from ~50% (Baker *et al*. 2017), to 61% (Gray *et al*. 2010), to ~90% (Killian *et al*. 2006, 2008, 2009). Miller *et al*. (2013) noted lower effectiveness in free-ranging mares (Gray *et al*. 2010) than captive mares (Killian *et al*. 2009). Some of these rates are lower than the high rate of effectiveness typically reported for the first year after PZP vaccine treatment (Kirkpatrick *et al*. 2011). In the one study that tested for a difference, darts and hand-injected GonaCon doses were equally effective in terms of fertility outcome (McCann *et al*. 2017).

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

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

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

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

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

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

Effects on Existing Pregnancies, Foals, and Birth Phenology: GnRH Vaccines

Although fetuses are not explicitly protected under the WFRHBA of 1971, as amended, it is prudent to analyze the potential effects of fertility control vaccines on developing fetuses and foals. Any impacts identified in the literature have been found to be transient, and do not influence the future reproductive capacity of offspring born to treated females.

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

GonaCon had no apparent effect on pregnancies in progress, foaling success, or the health of offspring, in horses that were immunized in October (Baker *et al*. 2013), elk immunized 80-100 days into gestation (Powers *et al*. 2011, 2013), or deer immunized in February (Miller *et al*. 2000). Kirkpatrick *et al*. (2011) noted that anti-GnRH immunization is not expected to cause hormonal changes that would lead to abortion in the horse, but this may not be true for the first 6 weeks of pregnancy (NAS 2013). Curtis *et al*. (2011) noted that GonaCon-KHL treated white tailed deer had lower twinning rates than controls, but speculated that the difference could be due to poorer sperm quality late in the breeding season, when the treated does did become pregnant. Goodloe (1991) found no difference in foal production between treated and control animals.

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

Indirect Effects: GnRH Vaccination

An expected long-term, indirect effect on wild horses treated with fertility control would be an improvement in their overall health. Body condition of anti-GnRH-treated females was equal to or better than that of control females in published studies. Ransom *et al*. (2014b) observed no difference in mean body condition between GonaCon-B treated mares and controls. Goodloe (1991) found that GnRH-KHL treated mares had higher survival rates than untreated controls. In other species, treated deer had better body condition than controls (Gionfriddo *et al*. 2011b), treated cats gained more weight than controls (Levy *et al*. 2011), as did treated young female pigs (Bohrer *et al*. 2014).

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

Reduced population growth rates and smaller population sizes could also allow continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse habitat quality. As the local horse abundance nears or is maintained at the level necessary to achieve a TNEB, vegetation resources would be expected to recover, improving the forage available to wild horses and wildlife throughout the HMA or HMAs. With rangeland conditions more closely approaching a TNEB, and with a less concentrated distribution of wild horses across the HMA, there should also be less trailing and concentrated use of water sources. Lower population density would be expected to lead to reduced competition among wild horses using the water sources, and less fighting among horses accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild horses. Wild horses would also have to travel less distance back and forth between water and desirable foraging areas. Should GonaCon-Equine treatment, including booster doses, continue into the future, with treatments given on a schedule to maintain a lowered level of fertility in the herd, the chronic cycle of overpopulation and large gathers and removals might no longer occur, but instead a consistent abundance of wild horses could be maintained, resulting in continued improvement of overall habitat conditions and animal health. While it is conceivable that widespread and continued treatment with GonaCon-Equine could reduce the birth rates of the population to such a point that birth is consistently below mortality, that outcome is not likely unless a very high fraction of the mares present are all treated with primer and booster doses, and perhaps repeated booster doses.

Behavioral Effects: GnRH Vaccines

The result that GonaCon treated mares may have suppressed estrous cycles throughout the breeding season can lead treated mares to behave in ways that are functionally similar to pregnant mares. Where it is successful in mares, GonaCon and other anti-GnRH vaccines are expected to induce fewer estrous cycles when compared to non-pregnant control mares. This has been observed in many studies (Garza *et al*. 1986, Curtis *et al*. 2001, Dalin *et al*. 2002, Killian *et al*. 2006, Dalmau *et al*. 2015). Females treated with GonaCon had fewer estrous cycles than control or PZP-treated mares (Killian *et al*. 2006) or deer (Curtis *et al*. 2001). Thus, any concerns about PZP treated mares receiving more courting and breeding behaviors from stallions (Nuñez *et al*. 2009, Ransom *et al*. 2010) are not generally expected to be a concern for mares treated with anti-GnRH vaccines (Botha *et al*. 2008).

Stallion herding of mares, and harem switching by mares are two behaviors related to reproduction that might change because of contraception. Ransom *et al*. (2014b) observed a 50% decrease in herding behavior by stallions after the free-roaming horse population at Theodore

Roosevelt National Park was reduced via a gather, and mares there were treated with GonaCon-B. The increased harem tending behaviors by stallions were directed to both treated and control mores. It is difficult to separate any effect of GonaCon in this study from changes in horse density and forage following horse removals.

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

Genetic Effects of Fertility Control Vaccines

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 (NAS 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with admixtures from domestic breeds. As a result, in most HMAs, applying fertility control to a subset of mares is not expected to cause irreparable loss of genetic diversity. Improved longevity and an aging population are expected results of contraceptive treatment that can provide for lengthening generation time; this result would be expected to slow the rate of genetic diversity loss (Hailer *et al*. 2006). Based on a population model, Gross (2000) found that a strategy to preferentially treat young animals with a contraceptive led to more genetic diversity being retained than either a strategy that preferentially treats older animals, or a strategy with periodic gathers and removals.

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

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

BLM is not aware of any studies that have quantified the heritability of a lack of response to immunocontraception such as PZP vaccine or GonaCon-Equine in horses or burros. 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 National Park, and Pryor Mountains Herd Management Area), 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, and is not expected to be used in the type of widespread or prolonged manner that might be required to cause a detectable evolutionary response.

Sterilization

Direct Effects of Neutering

No animals that appear to be distressed, injured, or in poor health or condition would be selected for neutering. Stallions would not typically be neutered within 72 hours of capture. The surgery would be performed by a veterinarian using general anesthesia and appropriate surgical techniques. The final determination of which specific animals would be gelded would be based on the professional opinion of the attending veterinarian in consultation with the Authorized Officer. Additional impact information, including technical material and associated references, is contained in Appendix J (Scientific Literature Review Effects of Spaying and Gelding/Neutering) and Appendix I (Standard Operating Procedures for Field Castration (Neutering)).

Individual impacts normally involve localized swelling and bleeding. Complications could occur as with any surgical procedure, including minor bleeding, swelling, inflammation, edema, infection, peritonitis, hydrocele, penile damage, excessive hemorrhage, eventration, and death. Serious complications are generally known within 3 or 4 hours of the procedure. It is expected that testosterone levels would decline over time after castration.

Indirect Effects of Neutering

Neutering is not expected to reduce the individual's survival rate. It could improve an individual's survival rate because that male is released from the cost of reproduction. Moreover, it is unlikely that a reduced testosterone level would compromise gelding survival in the wild, considering that wild mares survive with low levels of testosterone. Consistent with geldings not expending as much energy in attempts to obtain or defend a harem, it is expected that wild geldings may have a better body condition that wild, fertile stallions.

Reproductive stallions would still be a component of the population's age and sex structure. Neutering a subset of stallions would not prevent other stallions and mares from continuing with the typical range of social behaviors for sexually active adults. Having a post-gather herd with some geldings and a lower fraction of fertile mares necessarily reduces the absolute number of foals born per year, compared to a herd that includes more fertile mares. An additional benefit is that geldings that would otherwise be permanently removed from the range (for adoption, sale or other disposition) may be released back onto the range where they can engage in free-roaming behaviors.

Behavioral Effects of Neutering

Neutering an adult male would result in reduced testosterone production, which influences reproductive behaviors. Neutering of domestic horses most commonly takes place before or shortly after sexual maturity, and age-at-neutering can affect the degree to which stallion-like behavior is expressed later in life. Stallion behaviors in wild or pasture settings are better documented than gelding behaviors, but it inferences about how the behaviors of geldings will change, how quickly any change will occur after surgery, or what effect neutering an adult stallion and releasing him back in to a wild horse population will have on his behavior and that of the wider population must be surmised from the existing literature. Herding, forming harems, and reproductive behaviors would be expected to be less in a gelding than in a stallion. Aggression in geldings has not been fully quantified. The likely effects of neutering on geldings' social interactions, group membership, and home range can be inferred from available literature.

Neutering a wild horse does not change its status as wild horses under the WFRHBA. In terms of whether geldings would continue to exhibit the free-roaming behavior that defines wild horses, BLM does expect that geldings would continue to roam unhindered in the HMA. BLM acknowledges that geldings may exhibit some behavioral differences after surgery, compared to intact stallions, but those differences are not be expected to remove the geldings' rebellious and feisty nature, or their defiance of man. While it may be that a neutered horse could have a different set of behavioral priorities than an intact stallion, the expectation is that geldings will choose to act upon their behavioral priorities in an unhindered way, just as is the case for an intact stallion. In this sense, a gelded male would be just as much 'wild' as defined by the WFRHBA as any intact stallion, even if his patterns of movement differ from those of an intact stallion.

Current Methods of Spaying

Mares that meet the body condition scores, health criteria, age limits, and timing constraints from capture would be spayed under direction of a veterinarian and the authorized officer. Spaying could be conducted at a facility. Additional procedural/impact information, including technical material and associated references, is contained in Appendix J (Scientific Literature Review Effects of Spaying and Neutering) and Appendix K (Spaying SOPs).

Spaying of mares could involve the colpotomy (vaginal) or flank laparoscopy methods. Inherent risks are associated with both surgical methods. Complications from both procedures could occur and could include pain/discomfort, infections/delayed vaginal or wound healings, minor/major bleeding, aborted/absorbed fetus, injury to cervix/bladder/bowels, or death to the mare. Pain management could be utilized to assist in a mare's recovery.

Ovariectomy via colpotomy is a relatively short surgery, with a relatively quick expected recovery time and no external incisions. Ovariectomy via flank laparoscopy involves is a relatively longer surgery, a lower post-operative rate of complications, it uses three external incisions, inflates the abdomen with air to improve the surgeon's visibility/operative space and the removal of the ovaries. Recovery and external wound healing is normally monitored for up to two weeks following surgery.

Effects of Spaying on Pregnancy and Foal

A mare's gestation period ranges from 335 to 340 days. There are few peer-reviewed studies documenting the effects of ovariectomy on the success of pregnancy in a mare. Studies have shown that abortion of a fetus could occur when ovaries are removed at in the first 120 days of a pregnancy. If the procedure were performed after the first 120 days of a gestation, the pregnancy would be maintained.

Direct Effects of Spaying

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).

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. Loesch *et al*. (2003) lists that following potential risks with colpotomy: pain and discomfort; injuries to the cervix, bladder, or a segment of bowel; delayed vaginal healing; eventration of the bowel; incisional site hematoma; intraabdominal adhesions to the vagina; and chronic lumbar or bilateral hind limb pain. Most horses, however, tolerate ovariectomy via colpotomy with very few complications, including feral horses (Collins and Kasbohm 2016). Evisceration is also a possibility, but these complications are considered rare (Prado and Schumacher, 2017). 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.

Behavioral Effects of Spaying

BLM expects that wild horse harem 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.

'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 spayed 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.

Indirect Effects of Spaying

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 a HMA (BLM H-4700-1, 2010) and there are no permanent physical barriers being proposed. However, the study would document the movement patterns of both herd segments to determine any difference in use areas and distances travelled.

Spaying a wild horse does not change its status as wild horses under the WFRHBA (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 HMA. Wild horse movements may be motivated by a number of biological impulses, including the search for forage, water, and social companionship that is not of a sexual nature. As such, a spayed animal would still be expected to have a number of internal reasons for moving across a landscape and, therefore, exhibiting 'free-roaming' behavior. Despite marginal uncertainty about subtle aspects of potential changes in habitat preference, there is no expectation that spaying wild horses will cause them to lose their free-roaming nature.

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. Long-term survival and recapture rates for released mares were similar for treated and untreated mares.

Except for additional non-reproducing mares and geldings present among herd numbers, the cumulative impacts would be the same as the proposed action (Section 4.2.1.1).

Genetic Effects of Spaying and Neutering

It is true that spayed females and neutered males are unable to contribute to the genetic diversity of the herd. BLM is not obligated to ensure that any given individual in a herd has the chance to sire a foal and pass on genetic material. Management practices in the BLM Wild Horse and Burro Handbook (2010) include measures to increase population genetic diversity in reproducing herds where monitoring reveals a cause for concern about low levels of observed heterozygosity. These measures include increasing the sex ratio to a greater percentage of fertile males than fertile females (and thereby increasing the number of males siring foals), and bringing new animals into a herd from elsewhere.

It is true that spayed mares and neutered males are unable to contribute to the genetic diversity of a herd, but that does mean that including some spayed mares or neutered males in the Onaqui Mountain HMA would necessarily lead to high levels of inbreeding, for the following reasons: because there would continue to be a core breeding population of mares and stallions present, because there were higher than average numbers of genetic variants in the herd at the last measurement (Cothran 2008), because additional wild 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 even after application of fertility control. Except for herds that are designated to be entirely non-breeding, BLM policy is that "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 and neutering. The most recent genetic diversity sampling in the Onaqui HMA herd was conducted in 2005 (Cothran 2008). Results from that sampling then indicated that the Onaqui herd had higher than average numbers of genetic variants in the markers used, but a low heterozygosity at the time. The geneticist who analyzed the samples recommended that BLM introduce two or three mares from any other herd to bolster heterozygosity (Cothran 2008). Since 2005, BLM has introduced a total of 18 mares and 6 stallions to the herd – numbers far greater than what had been recommended. In 2005, 2007, and 2011, BLM introduced five males and 12 females; three females; and one male and three females, respectively. Those animals came from a wide variety of source herds, including from Saylor Creek HMA (Idaho), Cedar Mountain HMA (Utah), Round Mountain HMA and Fox Hog HMA (California), Moriah HA and Goshute HA (Nevada), and from other HMAs managed by the Cedar City FO. Therefore, allowing for foals born to and sired by those introduced animals, the expectation is that by now the Onaqui herd has a much higher level of heterozygosity, and still has high levels of allelic diversity. The gather associated with this action will provide BLM with an opportunity to confirm that those animal introductions have increased the genetic diversity of the Onaqui HMA herd since 2005. Maintaining the herd at population levels between 121 and 210 is expected to allow for maintenance of adequate genetic diversity, even if some members of the herd are temporarily or permanently infertile. For example even if the herd were only to include 40 effectively breeding females and 60 effectively breeding males, the genetic effective population size would be 96 (based on the equation, $Ne = 4NmNf/(Nm + Nf)$), so the rate of heterozygosity loss per horse generation would be expected to be only 0.5%...one half of one percent (based on the equation, $H1 = (1-1/2Ne)H0$). Continued genetic diversity monitoring would allow for BLM to be alerted if, at any point in the future, genetic diversity levels become low to the point where BLM ought to introduce more animals.

Effects of Handling and Marking

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

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

Similar to Alternative A, the actions shown in Table 5 could continue over the next 10-15 years and would contribute to minor changes in available areas for foraging wild horses.

4.2.2.2 Other Resources

Same as the proposed action (Sections 4.2.1 through 4.2.1.8).

4.2.3 Alternative C – No Action

4.2.3.1 Wild Horses

With the no action alternative, the current PZP fertility control program would continue, but no gather(s) would occur and the wild horse population would continue to increase (Appendix C). Impacts would be the same as in the 2015 Fertility Control EA and DR disclosed under the proposed action in Section 4.2.1.1 under the PZP heading and in Section 4.2.2.1 under the GnRH heading.

Continued and increased movement of wild horses inside and adjacent to the HMA could be expected as the animals forage for sufficient resources, specifically water. Over-utilization of vegetation and other habitat resources would occur as wild horse populations continued to increase. Wild horse populations would be expected to eventually crash at some ecological threshold; however, wild horses, livestock, and wildlife would all experience suffering and possible death of individual animals as rangeland resources continued to degrade. Attainment of RMP objectives and Utah Standards for Rangeland Health would likely not be achieved and maintained over the long term. Impacts to the human environment (rights-of-ways, private land or other Federal landowners etc.) would be compounded should the current population of wild horses be allowed to remain and expand. Conflicts between/among different users/interests of the public land would increase. Other surface owners (private/state) would be less likely to be able to make use of effective use of vegetation or water resources that could be consumed by excess wild horses. More frequent use of areas adjacent to the HMA could occur as horses move outward from the HMA. Wild horses could use new areas. Social structure and diversity of the herd would be maintained without interruption of gathers.

The actions shown in Table 5 could continue over the next 10-15 years and would contribute to important changes in available areas for use by the public and needed for the resources. Cumulatively over the next 10-year period, rangeland resources could degrade due to the failure to manage wild horses in balance with available forage and especially water sources. Similar to Alternative A, the cumulative impacts would include future and expanded uses of all resources inside and adjacent to the HMA. Resource protective measures would continue to be reviewed and to be applied to actions under BLM jurisdiction.

4.2.3.2 Recreation/Social

Under the no action alternative, opportunities for viewing and photographing wild horses would remain at current levels or gradually increase over time within the HMA. However, impacts to rangeland health under the no action alternative would likely negatively impact the wild horse population, and subsequently result in an adverse impact on the viewing/photographing public and SRPs.

Safety concerns and conflicts between visitors and horses would likely continue under the no action alternative. However, due to BLM’s implementation of education and outreach efforts to HMA visitors via signing, monitoring, and enforcement, the conflicts may be somewhat reduced.

Cumulative impacts to these resources (recreation/social) would be similar to those in Section 4.2.3.1.

4.2.3.3 Soil/Vegetation

Soils

With the no action alternative, the wild horse population in HMA would continue to grow. Increased horse use throughout the HMA would continue to impact soils health, especially around riparian areas. As native plant health deteriorates and plants are lost, soil erosion would increase. Continued heavy wild horse use, especially around water sources, would cause further compaction, reduced infiltration, increased runoff and erosion, and loss of biological soil crusts. Compaction caused impacts would be greatest on moist soils and soils with few surface coarse fragments. The greatest disturbance impacts to crusts would occur when the soils are dry and on highly calcareous sites. The shallow soils typical of this region cannot tolerate much loss without losing productivity and thus the ability to be re-vegetated with native plants. Invasive, non-native plant species would increase and invade new areas following increased soil disturbance and reduced native plant vigor and abundance. Wild horses likely transport weed propagules, and this transport would increase as horse numbers increase. This would lead to both a shift in plant composition towards weedy species. With the no action alternative, the localized trampling associated with gather sites and temporary holding facilities would not occur, but this alternative would not make progress towards achieving and maintaining a TNEB.

Vegetation

For 2018, it is estimated that 4,320,600 pounds of vegetation would be removed from the landscape through horse grazing. This vegetation would not be available to wildlife or other allowable uses such as livestock grazing. Additionally, the population of wild horses would increase every year removing an even larger amount. Without some grazing relief by wild horses, the HMA would likely continue to experience a loss of perennial grass cover and diversity at mid and lower elevations. Indirectly, soil compaction and soil erosion may become issues that impact plant communities and could lead to an increase in invasive weeds.

Cumulative impacts to these resources (soils/vegetation) would be similar to those in Section 4.2.3.1.

4.2.3.4 Wetlands/Riparian Zones/Floodplains

With the no action alternative, the wild horse population in HMA would continue to grow. Increased wild horse use throughout the HMA would continue to adversely impact aquatic resources such as riparian areas. Many riparian areas in the HMA are not currently in proper functioning condition (BLM 2018f) and continued heavy wild horse use, especially around water sources, would result in continued decline or continued status of not properly functioning through the impacts to riparian vegetation and soils.

Cumulative impacts to these resources (wetlands/riparian zones/floodplains) would be similar to those in Section 4.2.3.1.

4.2.3.5 Migratory Birds

The loss or disturbance of bird nests/eggs/young due to helicopter trapping would be avoided by the No Action alternative. Otherwise, impacts from this alternative would be expected to be negative, with the continuation of the negative effects resulting from the high population levels of wild horses, including reductions in vegetative cover, plant diversity, biological crusts, and insect prey availability.

Cumulative impacts to this resource would be similar to those in Section 4.2.3.1.

4.2.3.6 Greater Sage-Grouse Habitat

The potential disturbance of sage-grouse young due to helicopter trapping would be avoided by the No Action alternative. Otherwise, impacts from this alternative would be expected to be negative, with the continuation of the negative effects resulting from the high population levels of wild horses, including reductions in vegetative cover, plant diversity, forage, biological crusts, and insect prey availability.

This alternative would not implement required adaptive management responses that initiate emergency gathers to reduce wild horse and burro populations within affected area to low end of AML, subject to funding and holding space availability (BLM 2015. ARMPA, Appendix I, Table I.1).

Cumulative impacts to this resource would be similar to those in Section 4.2.3.1.

4.2.3.7 Special Status Animal Species

The negligible risk of loss or disturbance of yellow-billed cuckoo nests/eggs/young due to helicopter trapping would be avoided by the No Action alternative. Otherwise, impacts from this alternative would be expected to be negative, with the continuation of the negative effects resulting from the high population levels of wild horses, including reductions in vegetative cover, plant diversity, biological crusts, and insect prey availability.

The loss or disturbance of sensitive species nests/dens/burrows due to helicopter trapping would be avoided by the No Action alternative. Otherwise, impacts from this alternative would be expected to be negative, with the continuation of the negative effects resulting from the high population levels of wild horses, including reductions in vegetative cover, plant diversity, biological crusts, and insect prey availability.

Cumulative impacts to this resource would be similar to those in Section 4.2.3.1.

4.2.3.8 Wildlife Excluding Special Status Species

Disturbances to big game species due to helicopter trapping, and the reduction in water availability due to water trapping, would be avoided by the No Action alternative. Otherwise, impacts from this alternative would be expected to be negative, with the continuation of the negative effects resulting from the high population levels of wild horses, including reductions in vegetative cover, plant diversity, and biological crusts, as well as continued competition for limited water resources.

Cumulative impacts to this resource would be similar to those in Section 4.2.3.1.

5.0 CONSULTATION AND COORDINATION

5.1 Introduction

Section 1.6.2 identifies the issues that are analyzed in detail in Chapter 4. The ID Team Checklist (Appendix C) provides the rationale for issues that were considered but not analyzed further. The issues were identified through the public and agency involvement process described in Sections 5.2 and 5.3 below.

5.2 Persons, Groups, and Agencies Consulted

Persons, agencies and organizations that were contacted or consulted during this EA are identified in Table 7.

Table 7. List of Contacts and Findings.

Name	Reason	Findings
Utah Public Lands Policy Coordinating Office	Coordination with State Government.	Is participating as a Cooperating Agency.
Utah Division of State History, State Historic Preservation Office	Consultation as required by NHPA (16 U.S.C. 470)	Submitted under the small scale undertakings protocol agreement. Class III inventory will be conducted upon selection of trap locations. SHPO concurred with a No Historic Properties Affected determination.
Utah School and Institutional Trust Lands Administration (SITLA)	Coordination with State of Utah - SITLA. Based on a February 03, 2016 Agreement in that BLM agreed to, "Subject to congressional appropriations… identify and attempt to remove up to fifty (50) wild horses from SITLA-identified SITLA lands in the state of Utah on an annual basis."	On 8/09/2017, SITLA and BLM officials met to discussion current and proposed gathers on BLM state-wide. The Onaqui Mountain gather was specifically discussed as a SITLA priority. Is participating as a Cooperating Agency. Refer to additional discussion in Section 5.4.
Tooele County	Coordination with County Government.	Refer to additional discussion in Section 5.4.
Juab County	Coordination with County Government.	Refer to additional discussion in Section 5.4.
Forest Service	Coordination with Federal Agency.	Refer to additional discussion in Section 5.4.
US Fish and Wildlife	Coordination with Federal Agency.	Refer to additional discussion in Section 5.4.
Dugway Proving Ground	Coordination with DOD and dispatch (ground and air operations).	Coordination will be ongoing regarding any logistics for any future gather operations or inventory flights. Is participating as a Cooperating Agency. Refer to additional discussion in Section 5.4.
Pueblo of Jemez, Skull Valley Band of Goshute, Confederated Tribe of Goshute, Paiute Indian Tribe of Utah, and Ute Indian Tribe.	Consultation as required by the American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996) and NHPA (16 U.S.C. 470).	Invitation to consult letters were sent on 8/23/2017. Comments or concerns were not received.
WDD Media List	Coordination with Media.	Press Releases were issued on 9/29/2017 at the scoping phase. Tooele Transcript Bulletin inquired about the proposal. Other concerns

Name	Reason	Findings
		were not expressed. Press releases will be issued at the comment period, at decision, and at gather operations. Coordination is ongoing.
WDD Wild Horse Advocacy List	Coordination with interested public (individuals and organizations).	Press release was sent to list on 9/29/2017. Press releases will be issued at the comment period, at decision, and at gather operations. Emails will also be sent to the list at the comment period, at decision, and at gather operations. Coordination is ongoing.
Grazing Permittees Refer to project mailing list.	Coordination with permittees with grazing allotments that intersect the HMA.	Permittees were notified via letter dated 9/27/2017. Concerns were not expressed. Letters will also be issued at the comment period, at decision, and at gather operations. Coordination is ongoing.
Project Mailing List (Wild Horse Advocacy Groups, Grazing Permittees, State Agencies, Counties, SRP holders, and Dugway Proving Grounds.	Coordination with interested public.	An interested public letter was sent on 9/27/2017. The recipients were notified of a 30-day scoping period and were provided the link to the EA on the NEPA register. Letters will also be issued at the comment period, at decision, and at gather operations. Coordination is ongoing.

5.3 Preparers

An IDT prepared the document and analyzed the impact of the alternatives upon the various resources (Table 8). They considered the affected environment and documented their assessment in the IDT Checklist (Appendix C).

Table 8. List of Preparers

Name	Title	Resource Represented
Tami Howell Trent Staheli	Wild Horse Specialist	Wild Free-roaming Wild Horse and Burro Act. Compliance, Wild Horses, and Team Lead
Ray Kelsey	Outdoor Recreation Planner	Recreation
Cassie Mellon	Aquatic Ecologist Assistant Field Manager, Renewable Resources	Water Resources and Riparian/Wetlands
Jerry Bullock	Rangeland Management Specialist	Livestock Grazing
Nancy Williams	Wildlife Biologist	Migratory Birds, Sage Grouse Habitat, Special Status Animal Species, and Wildlife.
Michael Sheehan	Archeologist	NHPA Compliance and Cultural Resources
Lisa Reid	Public Affairs Specialist	Outreach
Pamela Schuller	Environmental Coordinator	NEPA Compliance

Refer also to the specialists as identified on the IDT Checklist (Appendix C).

5.4 Cooperating Agencies

BLM (as lead agency), contacted five (5) agencies from State, local and Federal governments and invited them to participate as a Cooperating Agency in preparing this EA (Section 1.1)

(Table 9). The agencies prepared and were signatory to a MOU (BLM 2018) that identified agency roles and responsibilities in preparing this EA.

Table 9. Cooperating Agency Confirmation.

Agency	Confirmation
State of Utah's Public Lands Policy Coordinating Office	9/27/2017 via email and MOU signature on 1/8/2018.
State of Utah's School and Institutional Trust Lands Administration	10/2/2017 via letter and MOU signature on 3/16/2018.
Dugway Proving Ground, West Desert Test Center	11/6/2017 via face-to-face and MOU signature on 3/28/2018.

While not originally identified, BLM reached out the Forest Service, Uinta-Wasatch-Cache National Forest (USFS) on 11/21/2017 because there were citizen reports of Onaqui Mountain HMA wild horses present on USFS administered land. On 2/26/2018, the USFS declined to participate as a cooperating agency.

Similarly, the BLM reached out to the Fish and Wildlife Service, Utah Ecological Services Field Office, but they did not respond to the BLM's invitation.

While, the Tooele and Juab county commissions expressed interest in the project, neither commission elected to participate as a Cooperating Agency or be signature to the MOU.

The cooperating agencies reviewed and provided comments on the EA during May 2018.

5.5 Public Involvement

This project was posted to the NEPA Register[9] on 10/2/2017. This was the initial public outreach that announced the project and SLFO's proposal to prepare an EA.

5.5.1 Scoping Period

In addition to the NEPA Register, a scoping period notification letter was sent to all members of the project mailing list on 9/23/2017. The SLFO ran a 30-day public scoping period (10/2/2017-10/31/2017) on the proposal and considered input on issues and alternatives in preparing the EA. Additional information is detailed in Sections 1.6 through 1.6.3 and in the Scoping Report (BLM 2018a).

5.5.2 Comment Period

The SLFO conducted a 30-day public comment period on the content of the EA and unsigned FONSI. Public comments and BLM's responses to those comments is contained in the Comment Report (BLM 2018d).

5.5.3 Modifications Based on Public Comment and Internal Review

The public comment period and corresponding internal review identified necessary corrections or clarifications to this EA. These modifications include:

1. When warranted corrections to grammar, sentence structure, and formatting were made throughout the EA. In general, these changes were made without further clarification.

[9] The NEPA Register is an online public notification board of proposals under consideration by the BLM. It can be accessed at: https://eplanning.blm.gov/epl-front-office/eplanning/lup/lup_register.do.

Examples include: updates to the Table of Contents, changes in font size, pagination or formatting style, and redundancies. The current month/year was replaced onto the title page and the page headers to distinguish from the comment period version of the EA. Content was moved to streamline the length of the document to comply with Secretarial Order 3355.

2. Sections 1.1-1.6.1 – were revised to add clarity to the action before BLM. Redundancies were removed.
3. Section 1.5 – content regarding the BLM Manuals, Handbooks (H), IM and IBs were moved to a new appendix (B).
4. Section 1.6.1 – was revised to include a discussion about the December 2018 Public Hearing in Vernal, Utah.
5. Section 1.6.3 – was revised to include reference to the Comment Report.
6. Sections 2.1-2.5 – were revised to include more information regarding each of the alternatives. Clarity was needed based on public comments that were received.
7. Section 3.3.1 – was revised to include additional information on the 2017 population inventory flight and how population numbers were calculated. Updated population estimates to include 2018 and 2019 foals.
8. Section 3.3.3 - Additional information was added to the vegetation analysis.
9. Section 3.3.6 – was revised to clarify/correct acreages of greater sage-grouse habitats in the analysis area. Also included additional analysis of habitat data.
10. Section 4.2.1.1 – was revised regarding foal weaning, genetic effects of PZP vaccination, and PZP treatment history and effectiveness.
11. Section 4.2.1.3 – was revised to include additional discussion of wild horse impacts to vegetation/foraging.
12. Section 4.2.1.6 – was revised to include the reasonably foreseeable development scenario for oil and gas.
13. Section 4.2.2.1 – was revised to include discussions regarding GonaCon (vaccine formulations, direct/indirect effects, reversibility/ovary effects, existing pregnancies/foals/birth phenology; and behavioral, genetics); current fertility control formulations, and sterilization (direct/indirect of neutering and spaying, current methods, behaviors, pregnancy/foals, survival, genetics, and handling/marking).
14. Sections 4.2.3.1-4.2.3.2 – were revised to discuss other landowner's use of vegetation/water resources in less productive rangelands.
15. Section 5.2 – the findings were reviewed/updated in Table 7.
16. Sections 5.5.1-5.5.3 – were updated based on the results of the comment period.
17. Section 6.0 – was revised to include seven new appendices. Some content from the body of the EA was moved to appendices.
18. Appendix A – Figure 3 was added to provide information from the population flight inventory.

19. Appendix B – Policies/Guidance was moved here.
20. Appendix C – was reviewed and updated for the results of consultation.
21. Appendix D – the WinEquus modeling was finalized.
22. Appendix E – moved other aspects of the proposed action (helicopter gathering, bait/water trapping, temporary holding, transport/corrals, adoption/sale preparation, and public viewing/notifications, and monitoring) here.
23. Appendix H – added a fertility control vaccines and sex ratio manipulations literature review.
24. Appendix J – added a spaying/neutering literature review.
25. Appendix K – added a spaying SOP.
26. Appendix L – added a gather SOP.
27. Appendix M – acronyms and abbreviations were moved here.
28. Appendix N – references were moved here and updated.

6.0 APPENDICES

A. Figures (Maps)
B. Policies/Guidance
C. Interdisciplinary Team Checklist
D. Population Modeling Report
E. Additional Components of the Proposed Action
F. Wild Horse Program Activities After Gather/Trapping Activities
G. Fertility Control Implementation and Monitoring Procedures
H. Literature Review on Effects of Fertility Control Vaccines and Sex Ratio Manipulations
I. Standard Operating Procedures for Field Castration (Neutering)
J. Literature Review Effects of Spaying and Gelding/Neutering
K. Standard Operating Procedures for Spaying
L. Standard Operating Procedures for Gathers
M. Acronyms/Abbreviations
N. References

Appendix A, Figures (Maps)

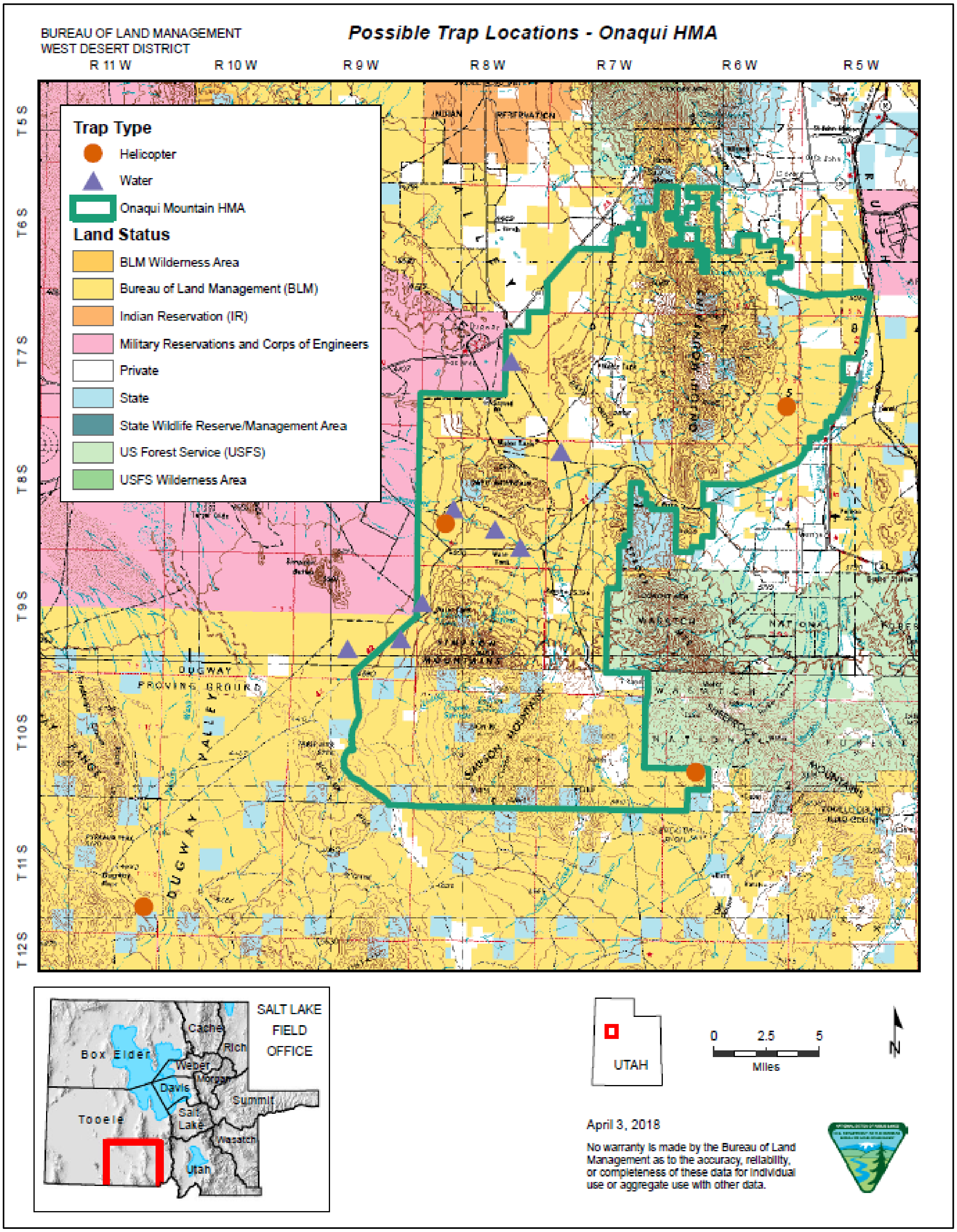

Figure 1. HMA Boundary and Possible Gather Site Locations.

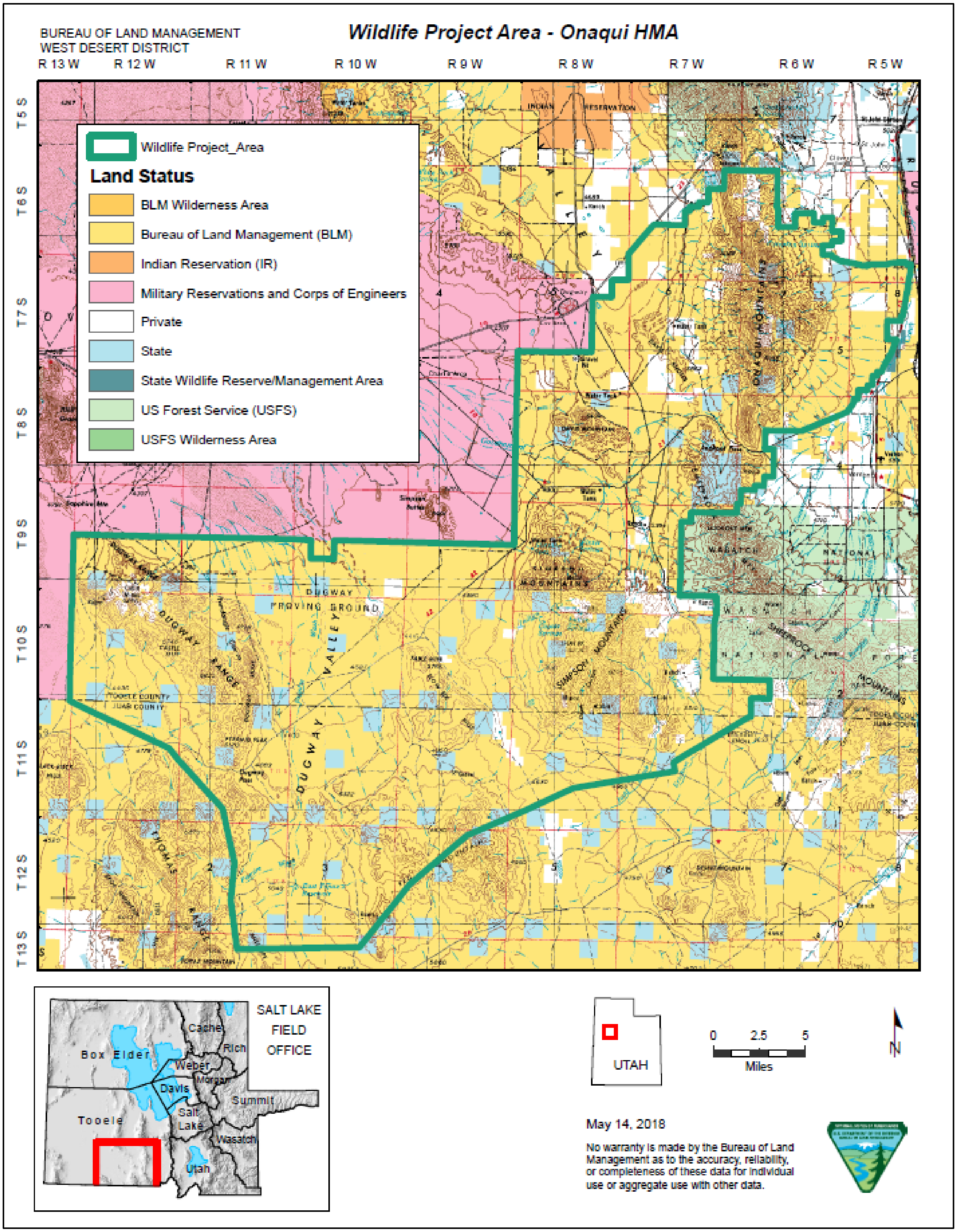

Figure 2. Wildlife Project Area

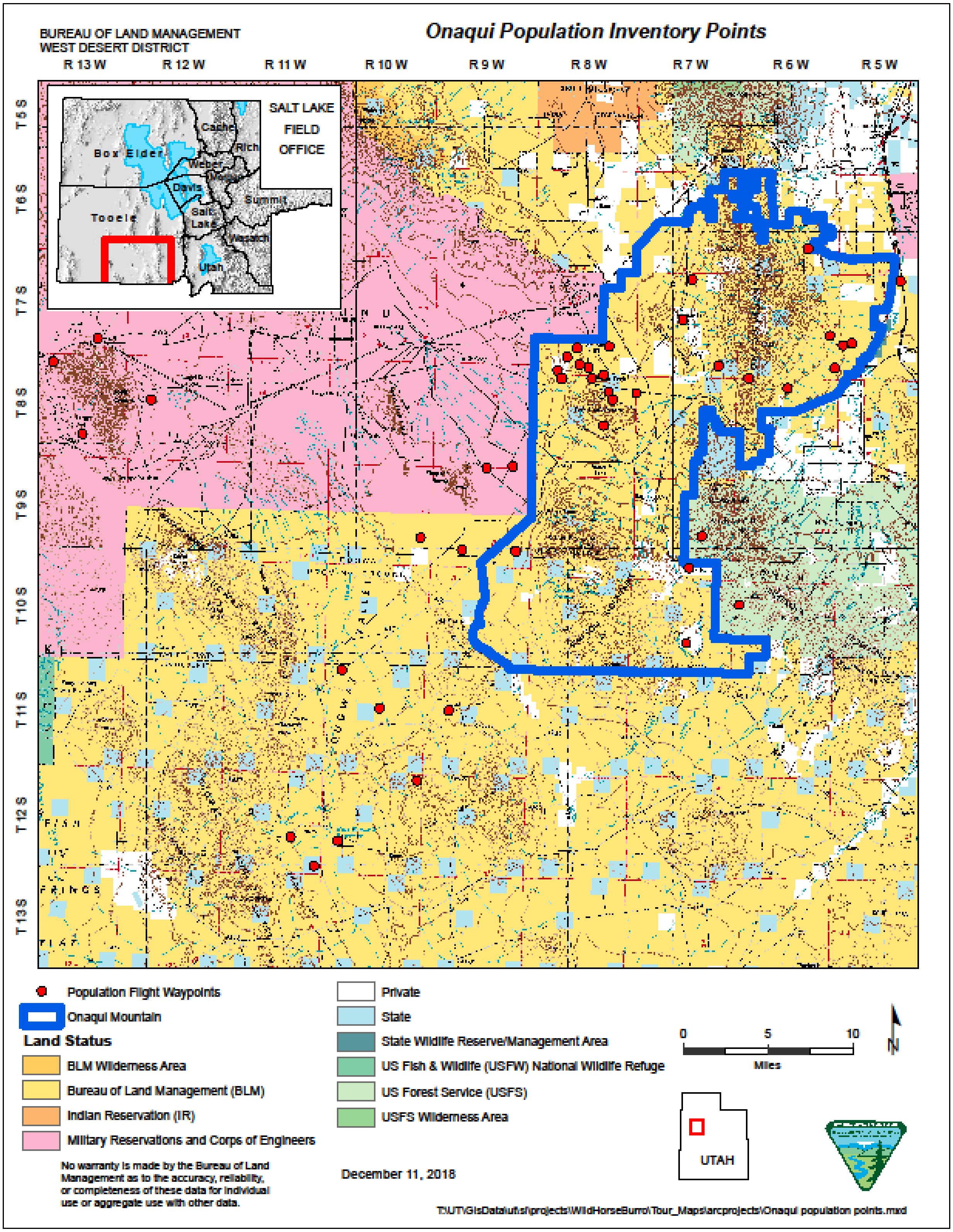

Figure 3. Locations of horses during population inventory flight.

Appendix B, Policies/Guidance

Statutes (As Amended)

Federal Land Policy and Management Act (FLPMA) of 1976

Wild Free-Roaming Horses and Burros Act (WFRHBA) of 1971

Instruction Memoranda (IM)[10]

IM 2015-151 – Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers (BLM 2015).

IM 2015-152 – Exception to Policy in BLM Handbook H-4700-1 and Manual 4720.41: Helicopter Gather of Wild Horses and Burros between March 1 and June 30 (BLM 2015)

Information Bulletin (IB)[11]

IB 2017-010 – Implementing BLM Utah's Greater Sage-Grouse Adaptive Management Triggers (BLM 2017)

Manuals[12]

MS-4700 – Wild Free-Roaming Horses and Burros Management

MS-4710 – Management Considerations Relating to Wild Free-Roaming Horses and Burros

MS-4720 – Removal of Excess Wild Horses and Burros

MS-4740 – Motor Vehicles and Aircraft in the Management of Wild Horses and Burros

Handbooks[13]

H-4700-1 – Wild Horses and Burros Management

H-4740-1 – Wild Horse and Burro Program Aviation Management

Studies/Reports

Statistical Analysis for 2017 Horse Survey of Onaqui Mountain HMA. (USGS, Unpublished Data).

Onaqui Mountain HMA Monitoring Data Sheets (BLM 2018b).

State of Utah Plans

The State of Utah Resource Management Plan (Emery and Johnson 2018) identifies considerations, objectives, policies and guidelines regarding the management of multiple resources and land uses within Utah, including wild horse herds. The State of Utah supports phasing out long-term holding and the application of funding towards on-range management/adoption; removing excess animals from the range to achieve AML; maintaining AML numbers by using fertility control to slow population growth at levels where removals equal the adoption demand; and adjusting AML numbers where appropriate. Among others, the

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[10] BLM instruction memoranda can be accessed online at: https://www.blm.gov/media/blm-policy/instruction-memorandum.

[11] BLM information bulletins can be accessed online at: https://www.blm.gov/media/blm-policy/information-bulletin.

[12] BLM manuals can be accessed online at: https://www.blm.gov/media/blm-policy/manuals.

[13] BLM handbooks can be accessed online at: https://www.blm.gov/media/blm-policy/handbooks.

State's policies also include managing for a healthy herd that results in a TNEB and establishing time limits for removal of trespass animals.

The Conservation Plan for Greater Sage-Grouse in Utah (UDWR 2013b) identifies the State's plan to address threats facing the greater sage-grouse while balancing the economic and social needs of Utah residents (incentive-based and reasonable/cooperative regulatory programs). The State's plan (at .9.2) is to address incompatible grazing strategies through established rangeland management practices consistent with maintenance or enhancement of habitat. Alternatives A and B are consistent with the State's management goal to protect, maintain, improve, and enhance greater sage-grouse populations and habitats within established management areas. Alternative C does not achieve or maintain the State's goals over the long-term in a manner that maximizes or protects greater sage-grouse habitats.

Tooele County Plans

The Tooele County General Plan (Tooele County 2016, as revised 2017) identifies the HMA in a multiple use zone (MU-40). Chapter 19 of the Tooele County Resource Management Plan (Tooele County 2017) identifies the County's resource management plan with existing conditions, desired future conditions, and monitoring. The wild horse gather and maintenance activities as proposed is consistent with the County desired conditions and policy statements for recreation management. Specific objectives are currently not identified for wild horses. Chapter 29.2 indicates that Tooele County desires wild horse populations to be actively managed to avoid resource damage and impacts to private property. Chapter 29.3.3 describes the County's wish to participate in public land management processes with regard to wild horse management, including active participation in herd management activities, and coordination with the BLM during planning activities. Wild horse population control is consistent with the County's desired future state, management objectives, and role as a cooperating agency.

Juab County Plans

The Juab County Resource Management Plan (Juab County 2017) identifies specific objectives for wild horse populations in chapter 2 and chapter 4. Chapter 2.6.1.2 states that wild horse and wild burro populations shall be maintained at or below objectives adopted on January 1, 2015. Chapter 4.4.1 indicates that Juab County regards the land that comprises the grazing districts and allotments in the non-WSA lands with wilderness character as more valuable for grazing than for conversion to wild horse HMA. Chapter 1.5.3 describes that Juab County desires to provide meaningful involvement early and often through their role as a cooperating agency in the NEPA process. Wild horse population control is consistent with the County's policies, management goals and objectives, and role as a cooperating agency.

Appendix C, Interdisciplinary Team Checklist

DETERMINATION OF STAFF:

NP = not present in the area impacted by the proposed or alternative actions
NI = present, but not affected to a degree that detailed analysis is required
PI = present with potential for relevant impact that need to be analyzed in detail in the EA

Determi-nation	Resource	Rationale for Determination	Assigned Date
NI	Air Quality	The project is small scale and would not conflict with Utah's Dept. of Air Quality's (DAQ) State Implementation Plan (SIP). The National Ambient Air Quality Standards (NAAQS) would not be exceeded. The HMA is located within an attainment air shed as defined in the Utah Division of Air Quality's 2017 Annual Report (UDAQ 2018). Emissions from vehicle traffic (air and land) and fugitive dust created during gather, maintenance activities could be created but would be considered part of back ground emissions. Protective measures would be applied.	Pamela Schuller 9/18/18
NP	Areas of Critical Environmental Concern	The HMA does not intersect ACECs.	Pamela Schuller 8/16/17
NI	Cultural Resources	The project would not affect cultural resources. A Class 1 literature search and Class III intensive pedestrian inventory would be completed for trap/staging locations. If historic properties are identified, sites would be avoided by selecting new trap/staging areas. Protective measures would be applied. A Class III inventory was completed. A determination of No Historic Properties Affected was submitted to the SHPO under the small-scale undertakings PA in August 2018.	Michael Sheehan 9/19/18
NI	Environmental Justice	As defined in EO 12898, minority, low income populations and disadvantaged groups may be present within the county and may use the HMA. However, the project would not cause any disproportionately high and adverse effects on minority or low income populations. Public use of or adjacent to the HMA would not be changed. Local traffic might be controlled during gather activities but would resume to normal use.	Pamela Schuller 8/16/17
NI	Farmlands (Prime or Unique)	Soil units designated as farmland by the NRCS may be present in the HMA or at the trap/staging locations. None of the HMA meets the requirements for prime farmland because the soils are not irrigated.	Jerry Bullock 9/7/17
NP	Fish Habitat	Fish habitat is not present within the HMA.	Cassie Mellon 9/17/17
NI	Fuels/Fire Management	Fire and fuels management would not be impacted by the proposal. Protective measures would be applied.	Randy Kyes 8/21/17
NI	Geology / Mineral Resources/ Energy Production	Existing mining or energy operations located within or adjacent to the analysis area would not be changed or affected by the alternatives. Existing authorizations would not change.	Mike Nelson 10/30/17
NI	Greenhouse Gas Emissions	It is anticipated that greenhouse gas emissions associated with this action and its alternative(s) would be negligible.	Pamela Schuller 8/16/17
NI	Invasive Species/Noxious Weeds (EO 13112)	Gather operations have the potential to increase the amount and distribution of noxious weeds. However, the use of protection measures (e.g., weed-free hay) would reduce these impacts. Protective measures would be applied.	Mark Williams 9/18/17

Determi-nation	Resource	Rationale for Determination	Assigned Date
NI	Lands/Access	Access with motorized vehicles/equipment should be kept to existing roads. Gather sites and temporary holding facilities should be selected that have existing access and adequate distance from electrical power poles and/or lines. Existing rights-of-way within the analysis are would not be changed. Protective measures would be applied.	Mary Higgins 9/7/17
NI	Livestock Grazing	Livestock grazing occurs within and adjacent to the HMA. Grazing permit terms and conditions would not be altered or affected. BLM would continue coordination efforts with existing livestock grazing permittees.	Jerry Bullock 9/7/17
PI	Migratory Birds	Migratory bird species are present throughout the HMA. Pre-implementation surveys would be performed and protective measures would be applied where appropriate.	Nancy Williams 3/13/18
NI	National Historic Trails	Public access or use of the Pony Express NHT would not be limited. Gather sites and temporary holding facilities would not be located on segments or important NHT features.	Ray Kelsey 9/7/17
NI	Native American Religious Concerns	The following Tribes were invited to consult on this project via certified letter on 8/23/2017: Pueblo of Jemez, Skull Valley Band of Goshute, Confederated Tribe of Goshute, Paiute Indian Tribe of Utah, and Ute Indian Tribe. Comments were not received and concerns were not expressed. Consultation is ongoing.	Pamela Schuller4/2/18
NI	Paleontology	There are no known paleontological resources within the HMA.	Mike Nelson 10/30/17
NI	Property Boundary Evaluation	Trap/staging locations would be temporary. Cadastral survey is not warranted.	Mike Nelson 10/30/17
PI	Recreation	The HMA wild horse herd is popular with professional and amateur photographers throughout the country. Human interest and visitation to the herd has increased substantially, possibly due to the internet and social media. BLM has issued 5 commercial SRPs for wild horse photography within the HMA. Potential impacts are discussed in the Recreation section.	Ray Kelsey 9/14/17
PI	Greater Sage-Grouse Habitat	The HMA includes PHMA, as well as a lek and nesting/brood-rearing and winter habitats. This population has been identified as declining. As per the ARMPA and UT IB 2017-010, adaptive management actions must be implemented. Protective measures would be applied.	Nancy Williams 3/13/18
NI	Socio-Economics	The HMA would still receive use by county residents and other visitors including recreationists regardless of alternative selected. Refer to the Economic Profile System Reports prepared on 8/17/17 (EPS 2017) (Agriculture, Public Land Amenities, Demographics, Federal Land Payments, Government Employment, Land Use, Mining, Including Oil & Gas, Non-Labor Income, Service Sectors, Socioeconomic Measures, Timber and Wood Products, Industries that Include Travel & Tourism, Summary). Additional information is contained in the general plans for Tooele and Juab counties. Land uses in HMA and in Tooele and Juab counties would continue. RMP allocations would not be altered. Refer also to the recreation, wildlife and livestock program discussions as well as the Scoping Report (BLM 2018a) and Comment Report (BLM 2018d) for economic related information.	Pamela Schuller 10/18/18
NI	Threatened, Endangered, Candidate or	Listed species or their critical habitats are not known to occur within the HMA or at trap/staging locations. No T&E species are present within the project boundary. Pohl’s milkvetch is a special status plant.	Mark Williams 9/18/17

Determi-nation	Resource	Rationale for Determination	Assigned Date
	Special Status Plant Species	Known populations would be avoided. Protective measures would be applied.	
PI	Threatened, Endangered, Candidate or Special Status Animal Species	Aquatic listed or candidate species are not present. The federally threatened western yellow-billed cuckoo may occur within the HMA; no critical habitat has been designated within the HMA. Pre-implementation surveys would be performed and protective measures would be applied where appropriate. Special status species do occur within the HMA. Pre-implementation surveys would be performed and protective measures would be applied where appropriate.	Cassie Mellon 9/17/17 Nancy Williams 3/20/18
NI	Travel/ Transportation	Access with motorized vehicles should be kept to existing roads. Protective measures would be applied.	Mary Higgins 9/7/17
PI	Soils and Vegetation Excluding Special Status Species	Trap locations are temporary. Horses and equipment could cause surface disturbances but these would be temporary in nature. Protective measures would be applied.	Jerry Bullock 9/7/17 Mark Williams 9/18/17
NI	Visual Resources	The alternatives are not expected to result in surface disturbances or have any impact on visual resources.	Ray Kelsey 9/7/17
NI	Wastes (hazardous or solid)	Solid or liquid materials brought on site to support operations will be stored in original containers, used as per manufacturer's directions, and removed from the site as soon as is practicable or at the conclusion of the gather/maintenance activities. Wastes will not be disposed of on site. Should solid or hazardous materials be released during the gather/maintenance activities, they will be remediated immediately. Should solid or hazardous wastes be discovered in quantities in excess of reportable quantities (RQs), as a result of the gather/maintenance activities, they will be reported to BLM and the State. Protective measures would be applied.	Alan Jones 4/12/18
NI	Water Resources/ Quality (drinking/surface / ground)	Surface water is limited in the HMA and additional impacts are not expected. Ground water resources would not be impacted by this project. Protective measures to locate gather sites away from natural water sources and trucking in water would be applied.	Cassie Mellon 2/27/18
PI	Wetlands/ Riparian Zones & Floodplains	Springs, wetland/riparian areas and floodplains within the HMA are currently impacted by the wild horses. Protective measures would be applied.	Cassie Mellon 9/17/17
NP	Wild and Scenic Rivers	No suitable or designated WSR segments are present in the HMA.	Ray Kelsey 9/7/17
NP	Wilderness/WSA	Wilderness or WSAs are not present in the HMA.	Ray Kelsey 9/7/17
NI	Lands with Wilderness Characteristics	The alternatives do not involve surface disturbances, are temporary and dispersed in nature, and would not impact the presence or absence of wilderness characteristics.	Ray Kelsey 9/7/17
PI	Wild Horses and Burros	The HMA wild horse population is currently estimated at over 510 AML for this HMA is 121 to 210. It is anticipated that horses would be removed from the HMA to bring the population back to low AML as called for in the ARMPA and the AML Decision Record. Protective measures (CAWP policies) would be applied.	Trent Staheli 9/1/17 Tami Howell 10/18/18
PI	Wildlife Excluding Special Status Species	The HMA contains crucial seasonal habitats for pronghorn and mule deer. Protective measures would be applied.	Nancy Williams 3/20/18

Determi-nation	Resource	Rationale for Determination	Assigned Date
NI	Woodland / Forestry	There would be no impacts to this resource from this federal action. Access to/use of woodland product sale areas would not be limited.	Mark Williams 9/18/17
Protective measures are detailed in Section 2.2.1.			

Appendix D, Population Modeling Report

WinEquus runs for Onaqui HMA – 20 September 2018

Use Granites survival and foaling rates (=16.5% pop growth)

Garage93 starting age distribution

Starting population of 510

Set advanced options – population size exact

Gather proportion = 80%

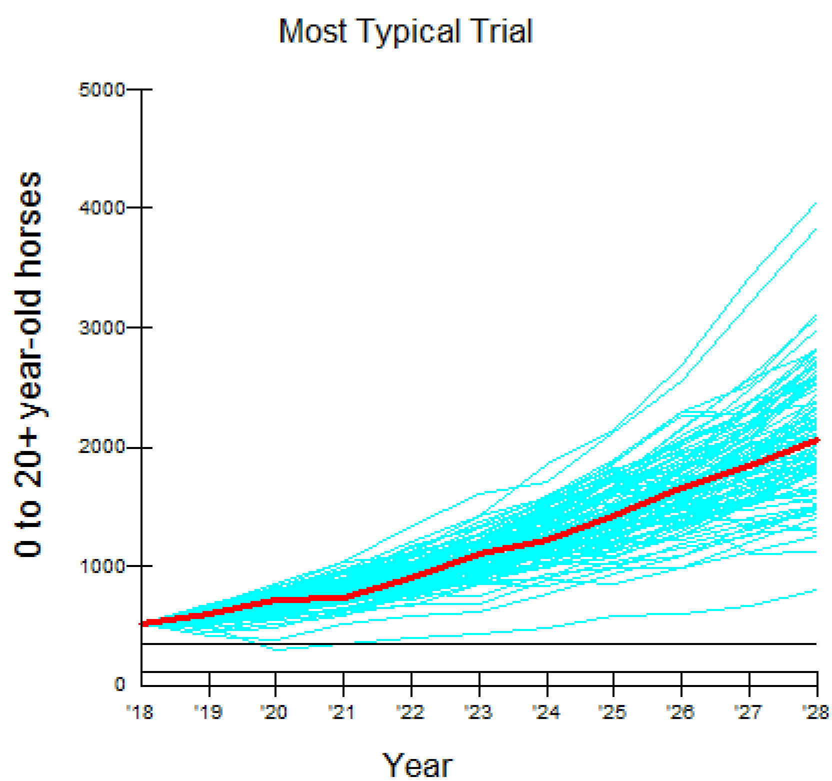
Removals/gather in 2019 but start model in 2018

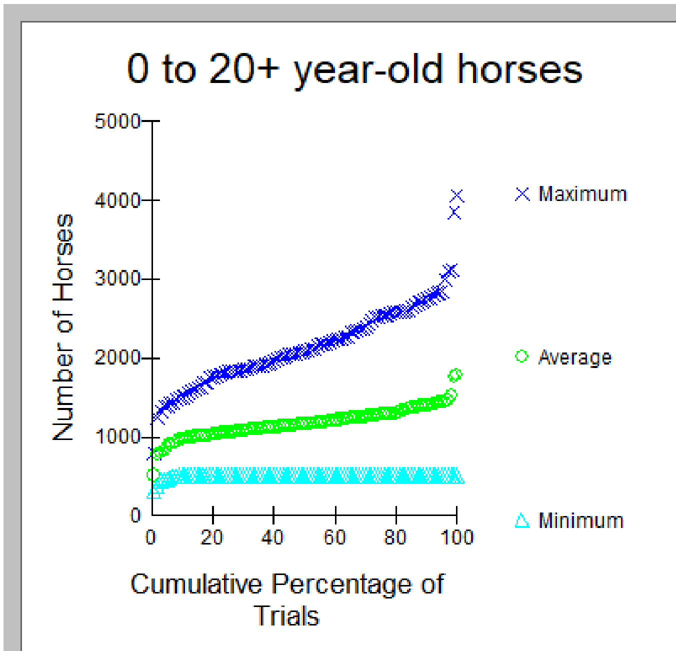
Percent of population that can be gathered = 80%

Treat with PZP every year, proportion is 80% of the whole population – so treat 100% of those gathered

No Action

No other parameters to input.



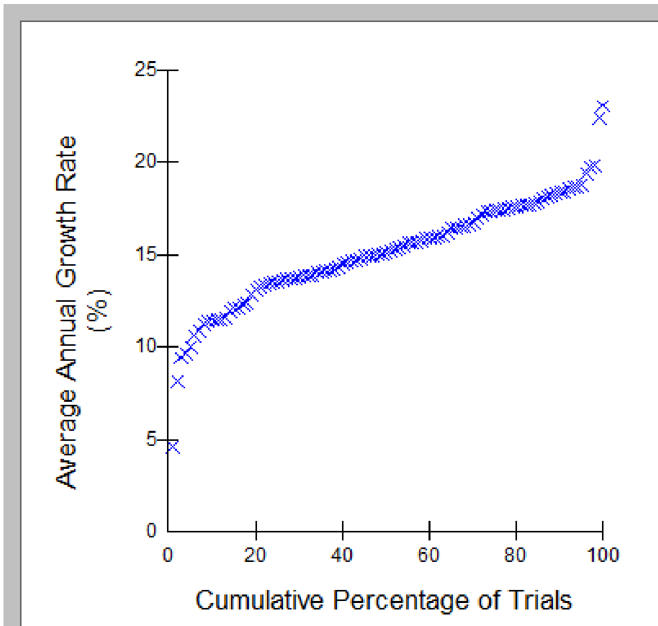


Population Sizes in 11 Years*

	Minimum	Average	Maximum
Lowest Trial	299	510	802
10th Percentile	510	976	1514
25th Percentile	510	1056	1837
Median Trial	510	1162	2101
75th Percentile	510	1283	2548
90th Percentile	510	1400	2767
Highest Trial	510	1791	4062

* 0 to 20+ year-old horses

Explanation



Average Growth Rate in 10 Years

Lowest Trial	4.6%
10th Percentile	11.5%
25th Percentile	13.6%
Median Trial	15.2%
75th Percentile	17.5%
90th Percentile	18.4%
Highest Trial	23.1%

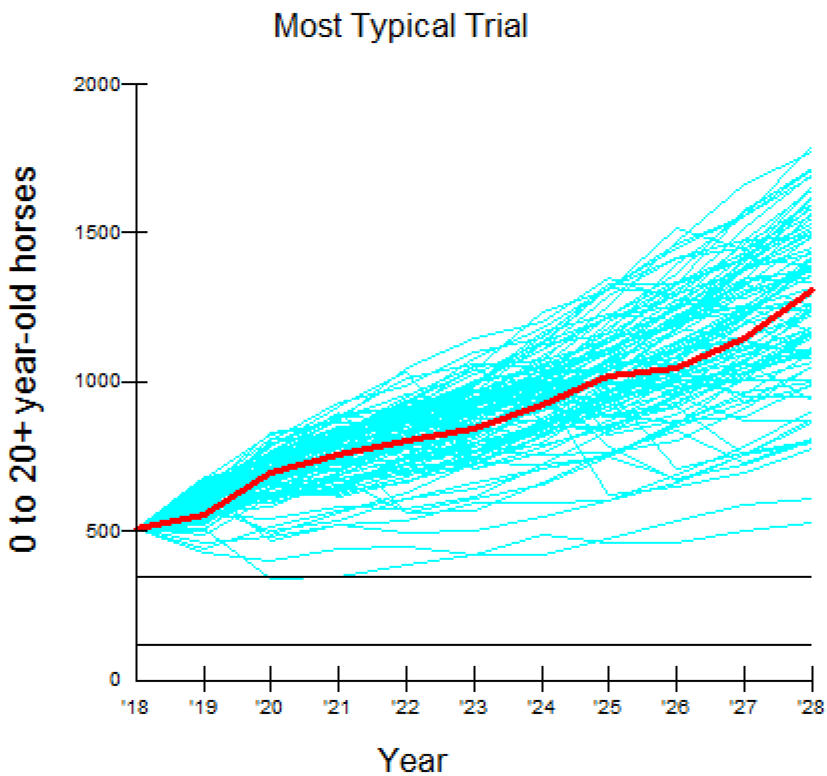
PZP Only: no removal

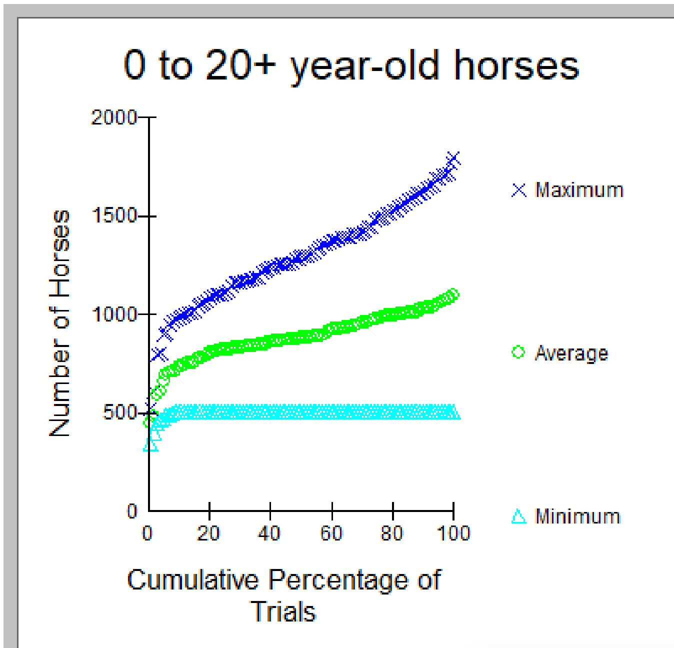
Specific years: every one 2018-2028

Efficacy is set to pzp-22 booster: 76%, 72%, 65%

Treat 1-3 and >=9 year olds; 100% of those gathered

Gather for fertility treatment regardless of population size: Yes





Population Sizes in 11 Years*

	Minimum	Average	Maximum
Lowest Trial	342	451	527
10th Percentile	510	738	988
25th Percentile	510	820	1116
Median Trial	510	883	1301
75th Percentile	510	980	1488
90th Percentile	510	1030	1634
Highest Trial	510	1094	1794

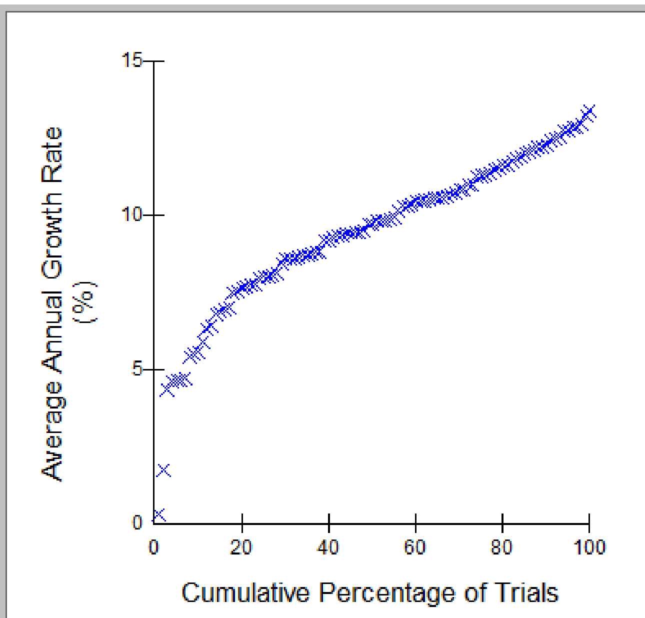
* 0 to 20+ year-old horses

Explanation

Explanation

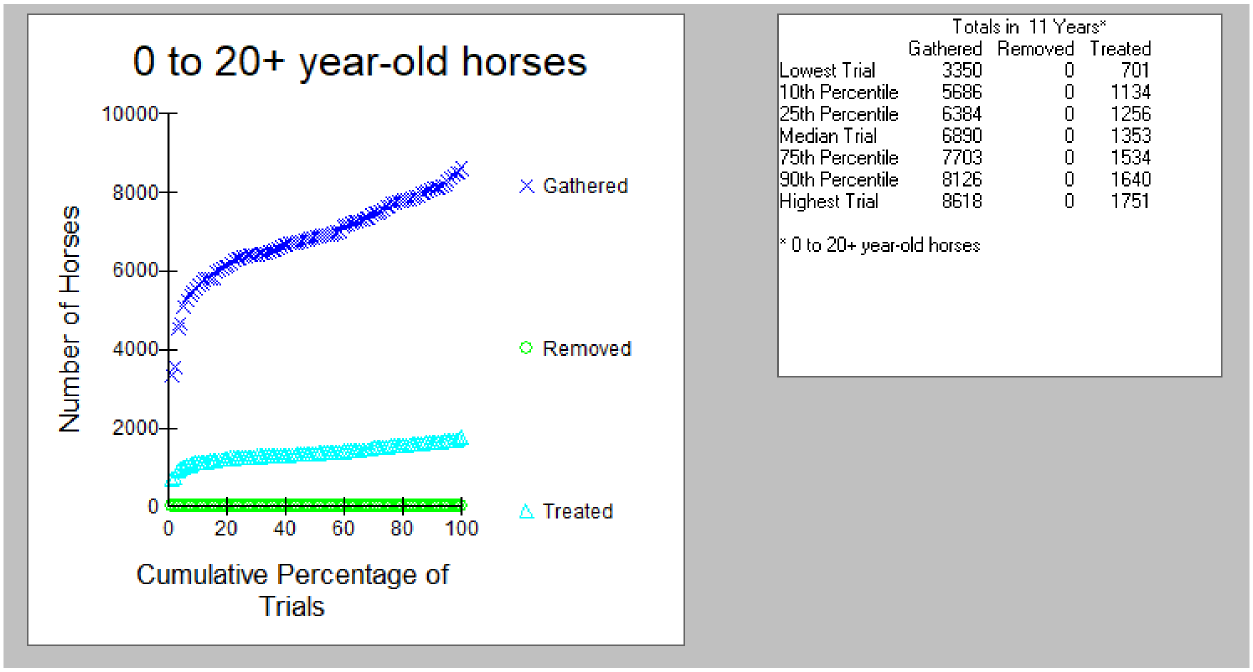
In 11 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 342 and the highest was 1794. In half the trials, the minimum population size in 11 years was less than 510 and the maximum was less than 1301. The average population size across 11 years ranged from 451 to 1094.

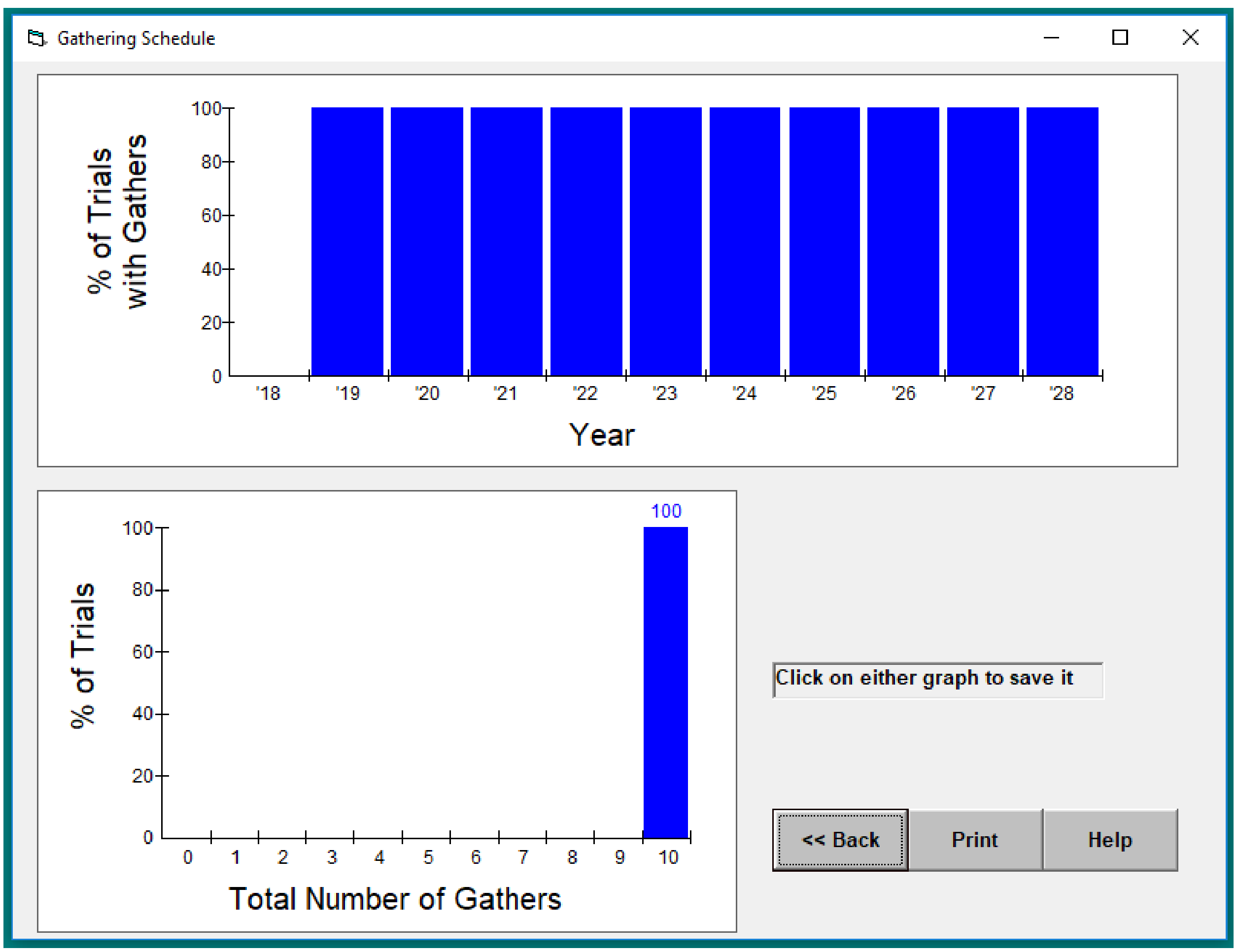
OK



Average Growth Rate in 10 Years

Lowest Trial	0.3%
10th Percentile	5.7%
25th Percentile	8.0%
Median Trial	9.8%
75th Percentile	11.3%
90th Percentile	12.3%
Highest Trial	13.4%


0 to 20+ year-old horses
Number of Horses
10000
8000
6000
4000
2000
0
0 20 40 60 80 100
Cumulative Percentage of Trials
Gathered
Removed
Treated
Totals in 11 Years*
Gathered Removed Treated
Lowest Trial 3350 0 701
10th Percentile 5686 0 1134
25th Percentile 6384 0 1256
Median Trial 6890 0 1353
75th Percentile 7703 0 1534
90th Percentile 8126 0 1640
Highest Trial 8618 0 1751
* 0 to 20+ year-old horses


Gathering Schedule
% of Trials with Gathers
100
80
60
40
20
0
'18 '19 '20 '21 '22 '23 '24 '25 '26 '27 '28
Year
% of Trials
100
0 1 2 3 4 5 6 7 8 9 10
Total Number of Gathers
Click on either graph to save it
<< Back
Print
Help

Alternative 1: PZP to selected ages

Treat 100% of gathered 1,2,3, and >=9 year olds

Efficacy is set to pzp-22 booster: 76%, 72%, 65%, 0%, 0%

-This overestimates PZP effect since it's not as effective in year 1

-Meaning that the population growth estimate is biased low

Gather when pop exceeds 300 (if you set it to 220 WinEquus has a removal almost every year)

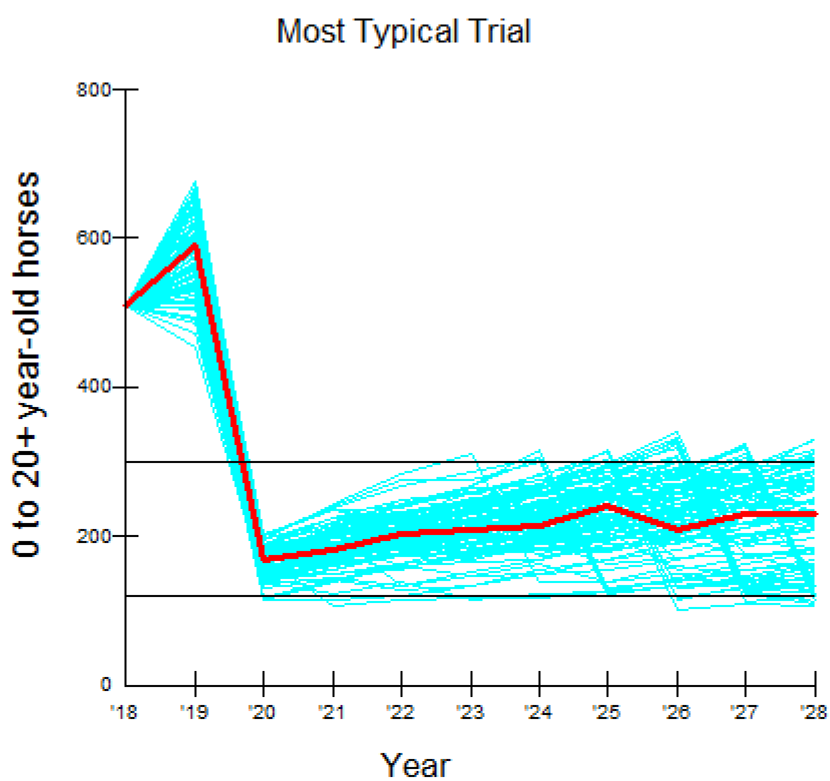
Reduce population to 121 animals.

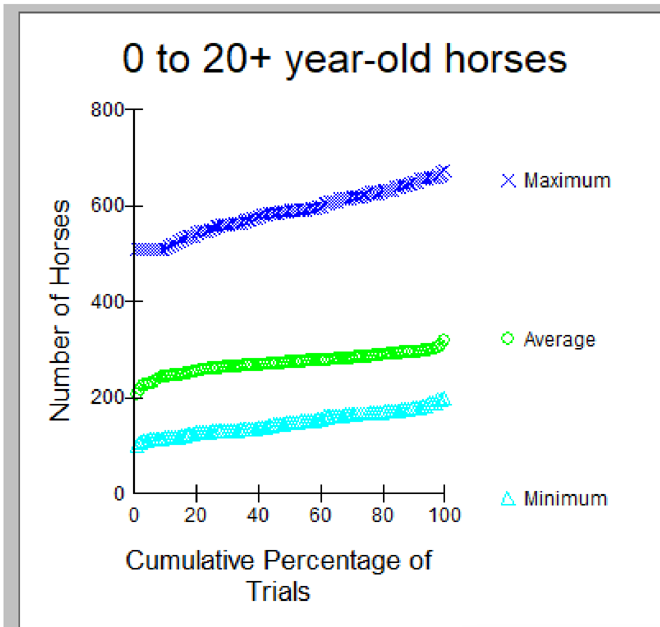
Gather for fertility treatment regardless of population size: Yes

Specific years: every one 2019-2028

Gate cut, but set male removals to 88% for all ages, which gives 60/40 sex ratio.

Note that darting is considered a gather, so there's a gather every year.





Population Sizes in 11 Years*	Minimum	Average	Maximum
Lowest Trial	102	206	510
10th Percentile	116	244	514
25th Percentile	130	261	555
Median Trial	148	274	591
75th Percentile	168	286	628
90th Percentile	179	296	650
Highest Trial	200	319	675

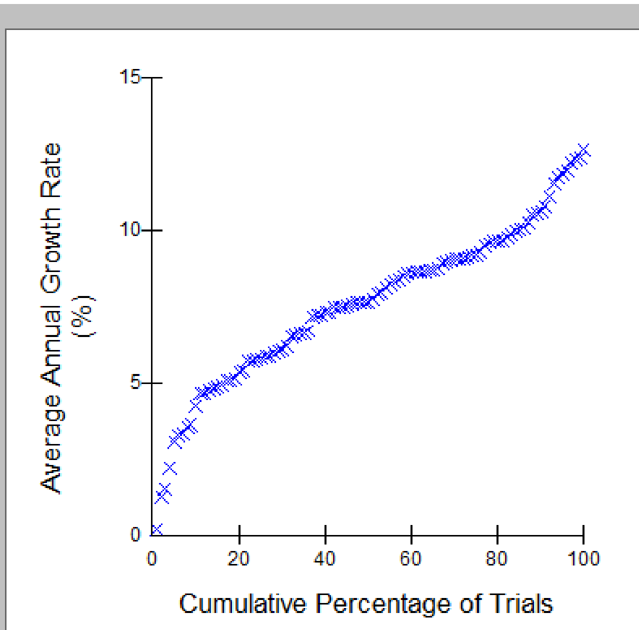
* 0 to 20+ year-old horses

Explanation

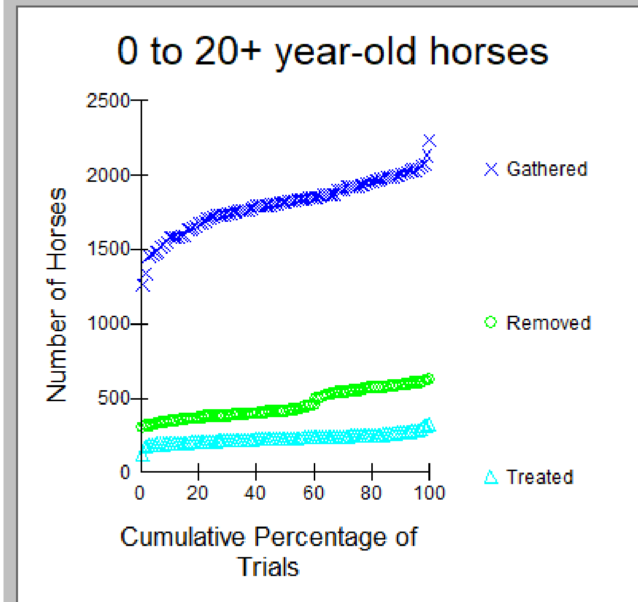
Explanation

In 11 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 102 and the highest was 675. In half the trials, the minimum population size in 11 years was less than 148 and the maximum was less than 591. The average population size across 11 years ranged from 206 to 319.

OK



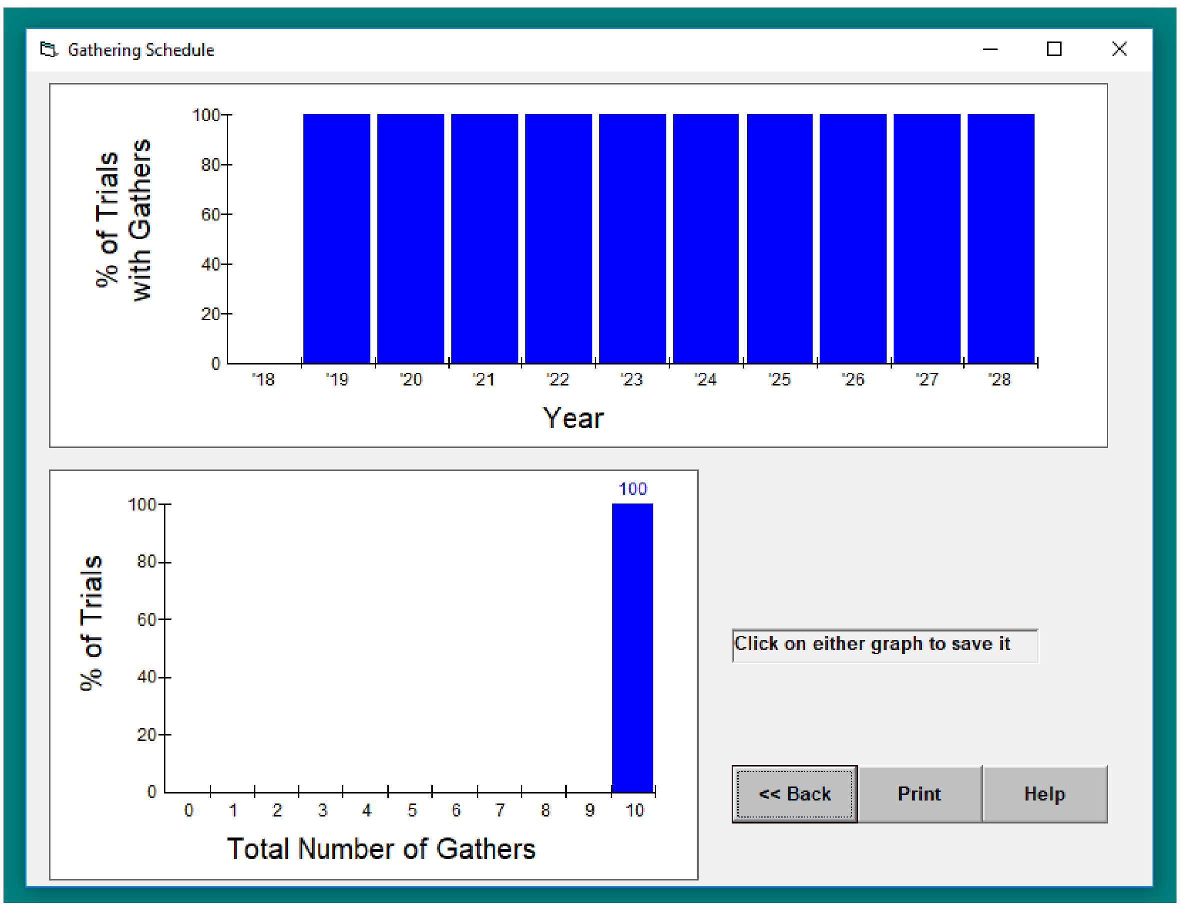
Average Growth Rate in 10 Years	
Lowest Trial	0.2%
10th Percentile	4.5%
25th Percentile	5.8%
Median Trial	7.7%
75th Percentile	9.2%
90th Percentile	10.7%
Highest Trial	12.6%



Totals in 11 Years*

	Gathered	Removed	Treated
Lowest Trial	1260	302	120
10th Percentile	1580	343	195
25th Percentile	1728	376	211
Median Trial	1826	412	230
75th Percentile	1930	550	244
90th Percentile	2014	587	269
Highest Trial	2232	625	322

* 0 to 20+ year-old horses



Alternative 2: PZP to all ages

Treat 100% of all gathered age classes older than foals.

Efficacy is set to pzp-22 booster: 76%, 72%, 65%, 0%, 0%

-This overestimates PZP effect since it's not as effective in year 1

-Meaning that the population growth estimate is biased low

Gather when pop exceeds 300 (if you set it to 220 WinEquus has a removal almost every year)

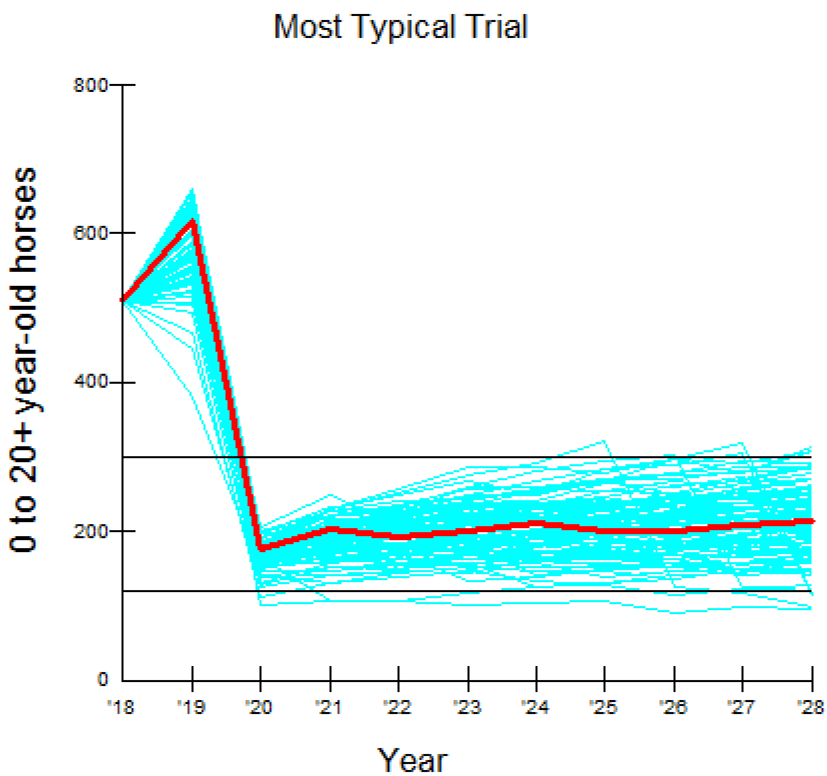
Reduce population to 121 animals.

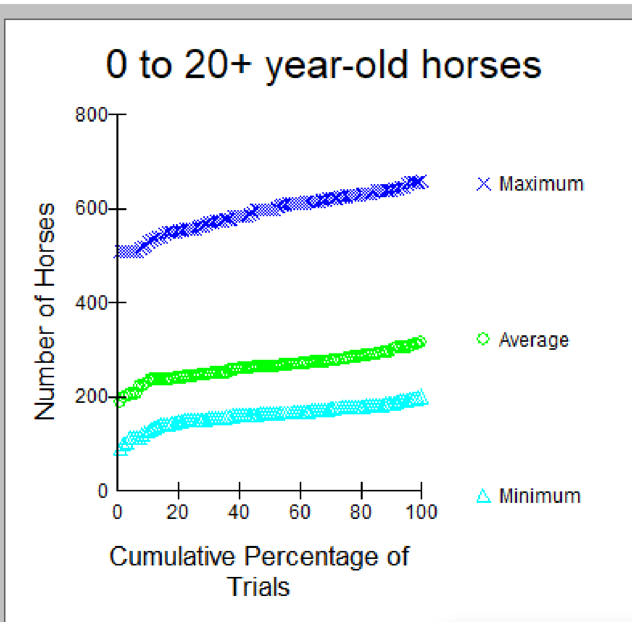
Gather for fertility treatment regardless of population size: Yes

Specific years: every one 2019-2028

Gate cut, but set male removals to 88% for all ages, which gives 60/40 sex ratio.

Note that darting is considered a gather, so there's a gather every year.





Population Sizes in 11 Years*

	Minimum	Average	Maximum
Lowest Trial	90	188	510
10th Percentile	129	233	532
25th Percentile	151	245	561
Median Trial	166	265	600
75th Percentile	178	282	628
90th Percentile	187	300	642
Highest Trial	201	315	660

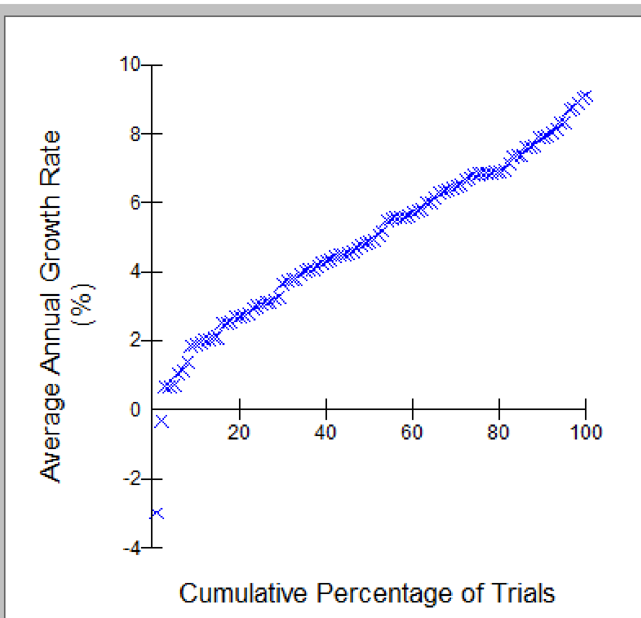
* 0 to 20+ year-old horses

Explanation

Explanation

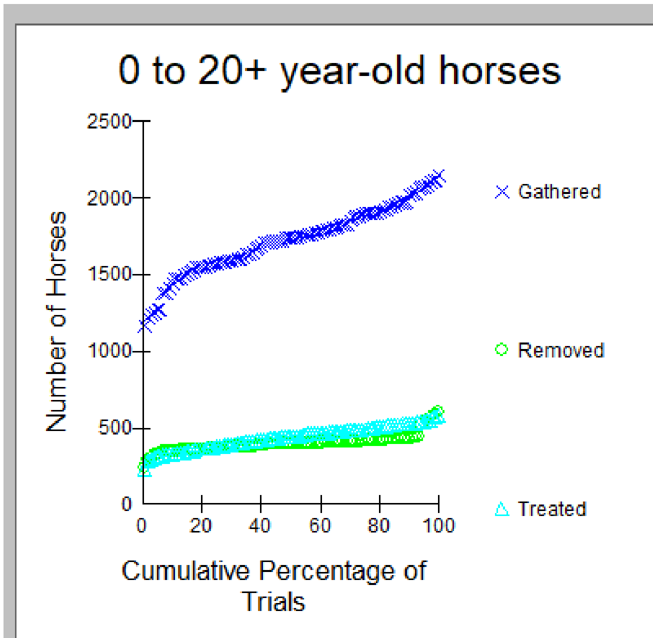
In 11 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 90 and the highest was 660. In half the trials, the minimum population size in 11 years was less than 166 and the maximum was less than 600. The average population size across 11 years ranged from 188 to 315.

OK



Average Growth Rate in 10 Years

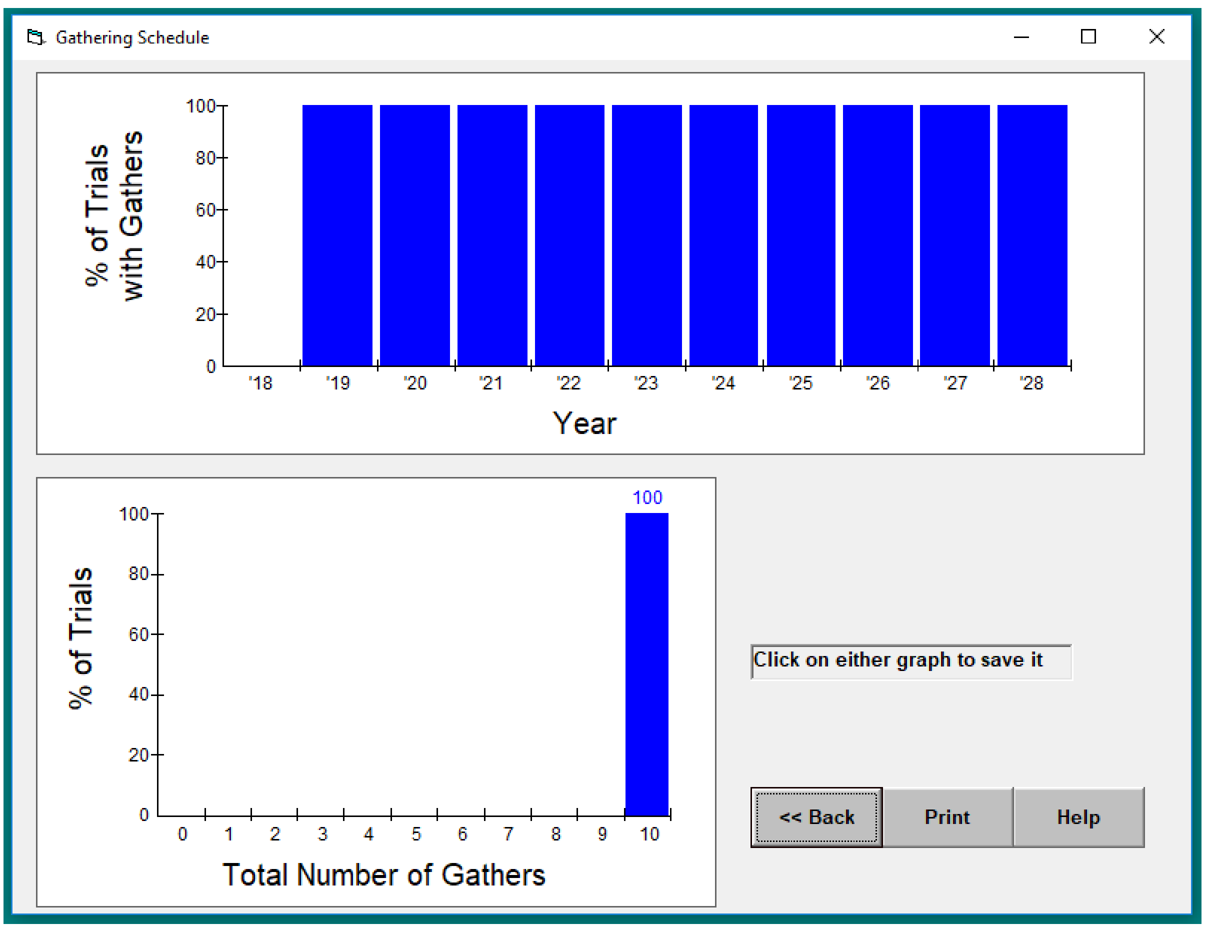
Lowest Trial	-3.0%
10th Percentile	1.9%
25th Percentile	3.1%
Median Trial	4.9%
75th Percentile	6.8%
90th Percentile	7.9%
Highest Trial	9.1%



Totals in 11 Years*

	Gathered	Removed	Treated
Lowest Trial	1164	235	231
10th Percentile	1460	347	328
25th Percentile	1578	368	376
Median Trial	1742	400	446
75th Percentile	1904	416	491
90th Percentile	2030	435	530
Highest Trial	2148	600	582

* 0 to 20+ year-old horses



Alternative 3: GonaCon to selected ages

Treat 100% of gathered 1,2,3, and >=9 year olds

Efficacy is set to GonaCon booster: 100%, 84%, 84%, 84%, 0%

-This overestimates GonaCon effect since it's not as effective in year 1

-Meaning that the population growth estimate is biased low

Gather when pop exceeds 300 (if you set it to 220 WinEquus has a removal almost every year)

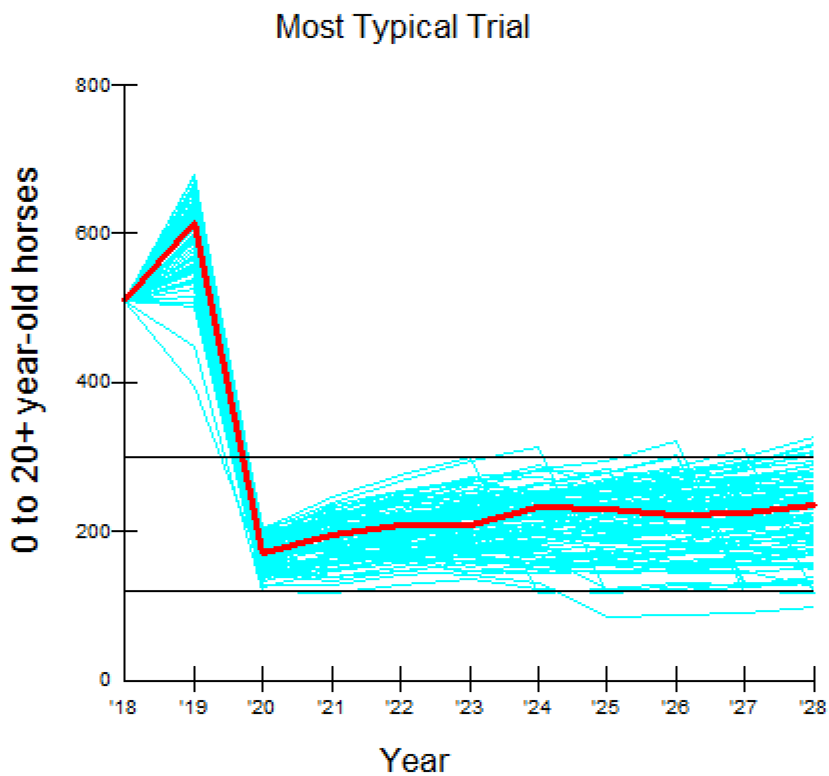
Reduce population to 121 animals.

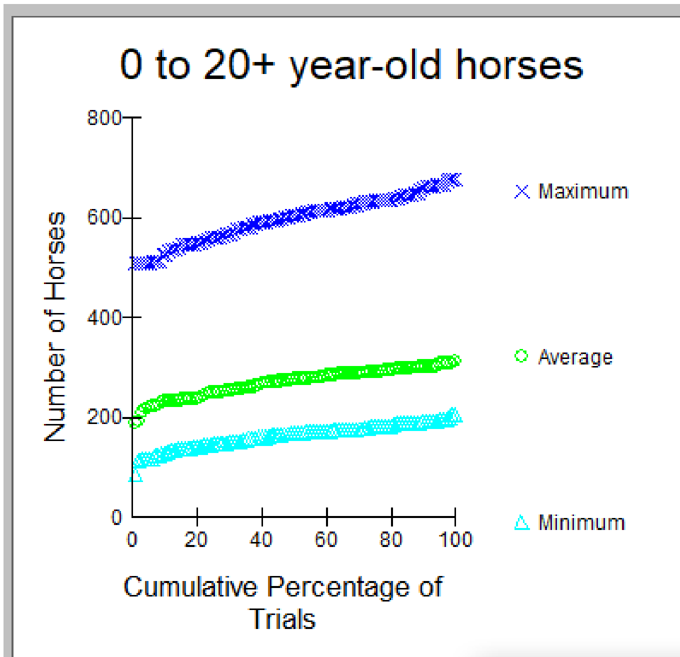
Gather for fertility treatment regardless of population size: Yes

Specific years: every one 2019-2028

Gate cut, but set male removals to 88% for all ages, which gives 60/40 sex ratio.

Note that darting is considered a gather, so there's a gather every year.





Population Sizes in 11 Years*	Minimum	Average	Maximum
Lowest Trial	85	190	510
10th Percentile	130	233	530
25th Percentile	148	250	562
Median Trial	168	277	606
75th Percentile	182	293	636
90th Percentile	191	301	662
Highest Trial	207	312	678

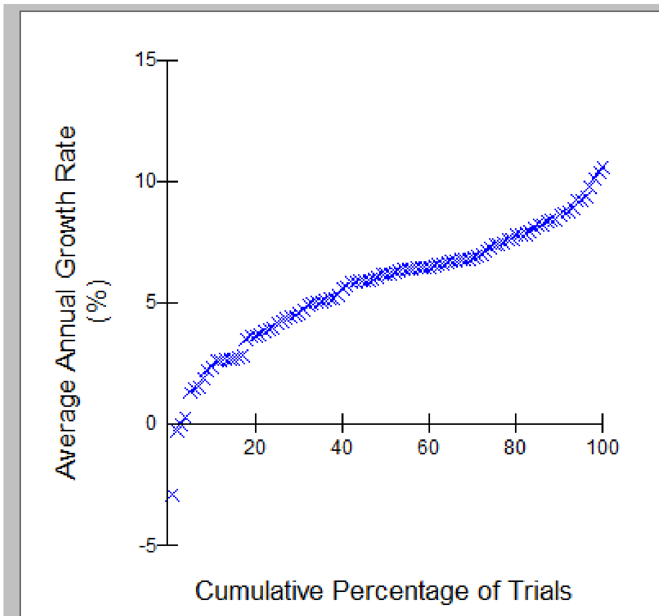
* 0 to 20+ year-old horses

Explanation

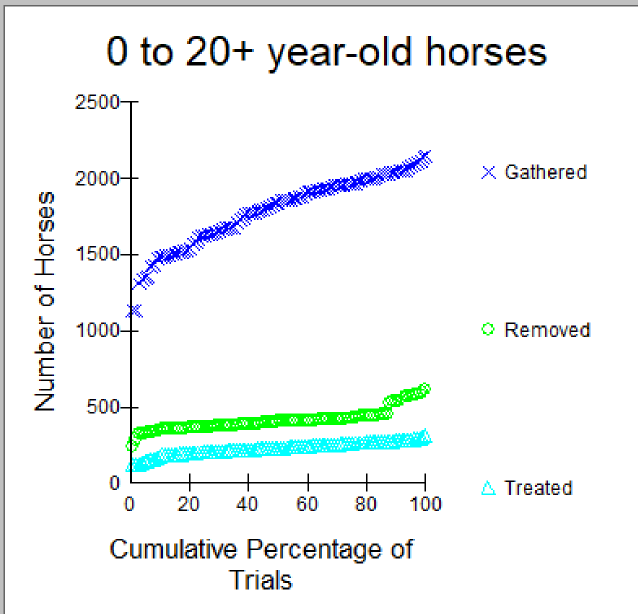
Explanation

In 11 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 85 and the highest was 678. In half the trials, the minimum population size in 11 years was less than 168 and the maximum was less than 606. The average population size across 11 years ranged from 190 to 312.

OK



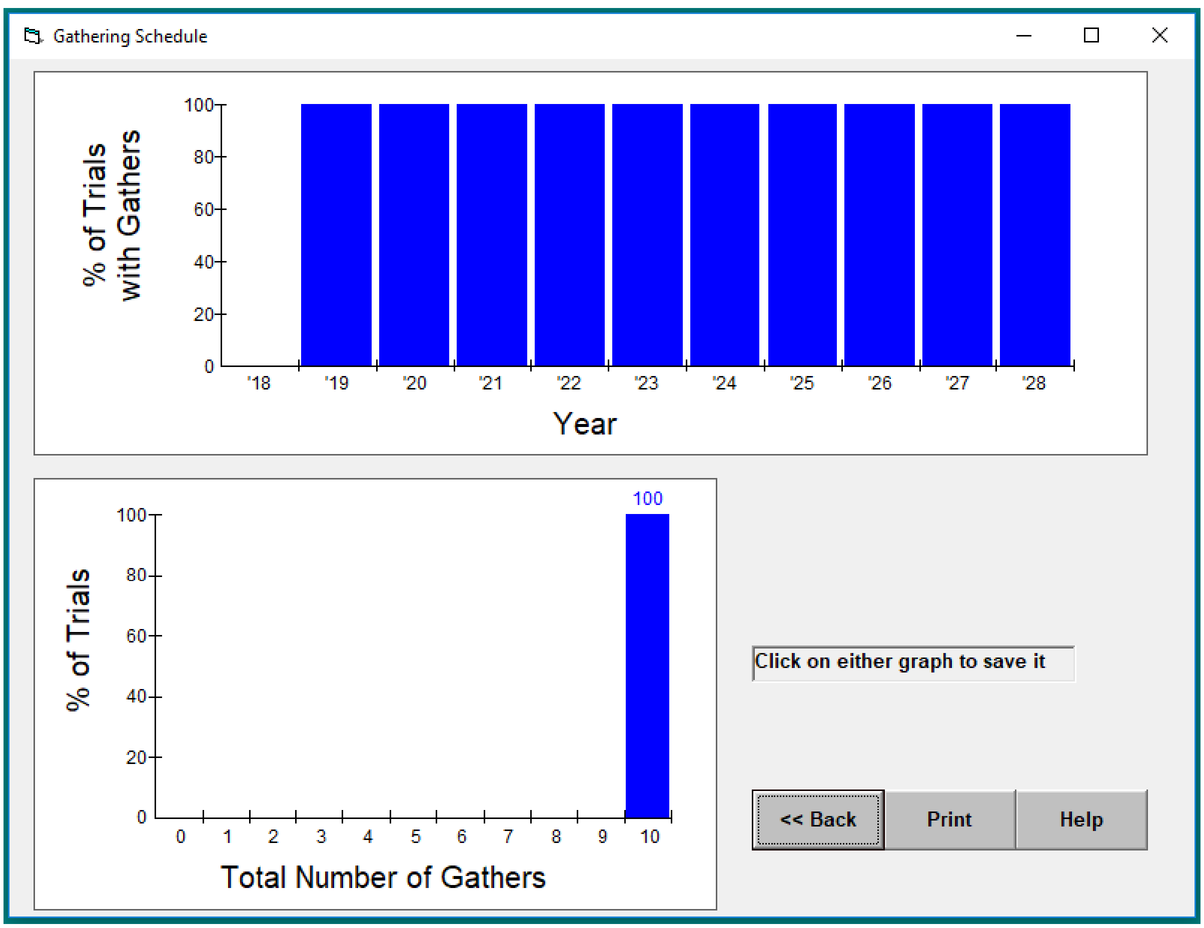
Average Growth Rate in 10 Years	
Lowest Trial	-2.9%
10th Percentile	2.5%
25th Percentile	4.2%
Median Trial	6.2%
75th Percentile	7.4%
90th Percentile	8.7%
Highest Trial	10.6%



Totals in 11 Years*

	Gathered	Removed	Treated
Lowest Trial	1131	236	118
10th Percentile	1488	350	178
25th Percentile	1628	368	203
Median Trial	1849	404	230
75th Percentile	1974	430	264
90th Percentile	2050	538	276
Highest Trial	2153	611	313

* 0 to 20+ year-old horses



Alternative 4: GonaCon to all ages

Treat 100% of all gathered age classes older than foals.

Efficacy is set to GonaCon booster: 100%, 84%, 84%, 84%, 0%

-This overestimates GonaCon effect since it's not as effective in year 1

-Meaning that the population growth estimate is biased low

Gather when pop exceeds 300 (if you set it to 220 WinEquus has a removal almost every year)

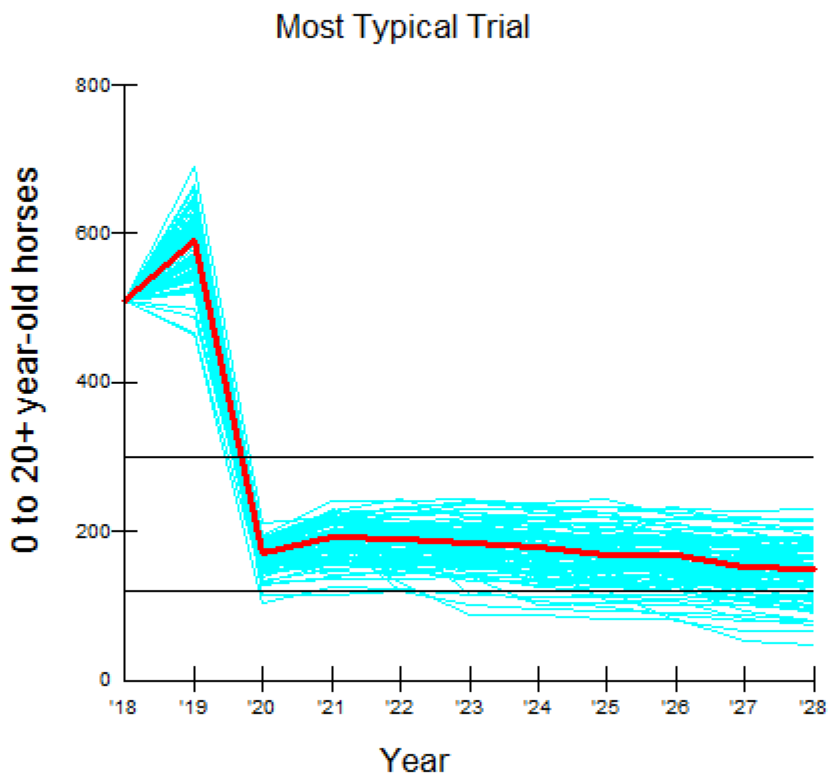
Reduce population to 121 animals.

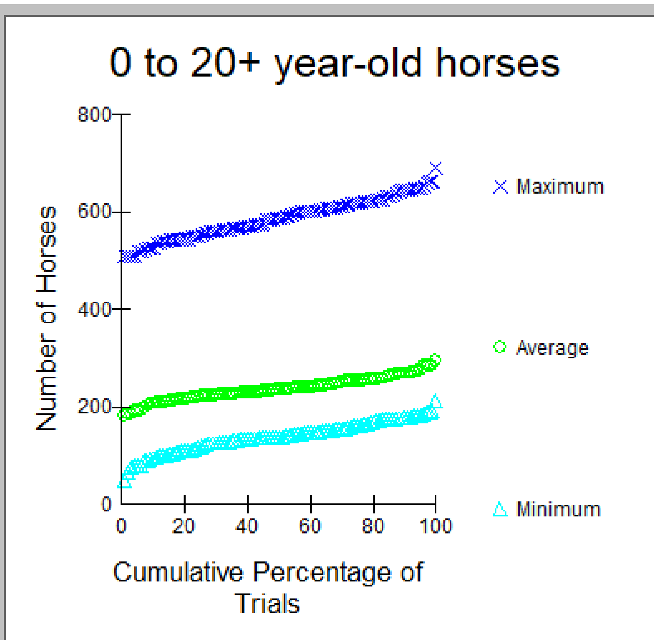
Gather for fertility treatment regardless of population size: Yes

Specific years: every one 2019-2028

Gate cut, but set male removals to 88% for all ages, which gives 60/40 sex ratio.

Note that darting is considered a gather, so there's a gather every year.



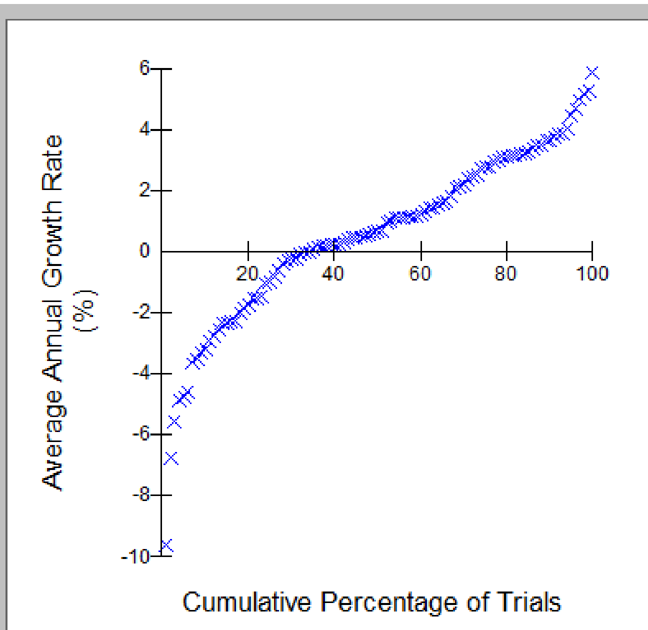


Population Sizes in 11 Years*

	Minimum	Average	Maximum
Lowest Trial	48	181	510
10th Percentile	96	208	533
25th Percentile	120	222	556
Median Trial	138	236	588
75th Percentile	162	256	620
90th Percentile	179	270	648
Highest Trial	213	297	691

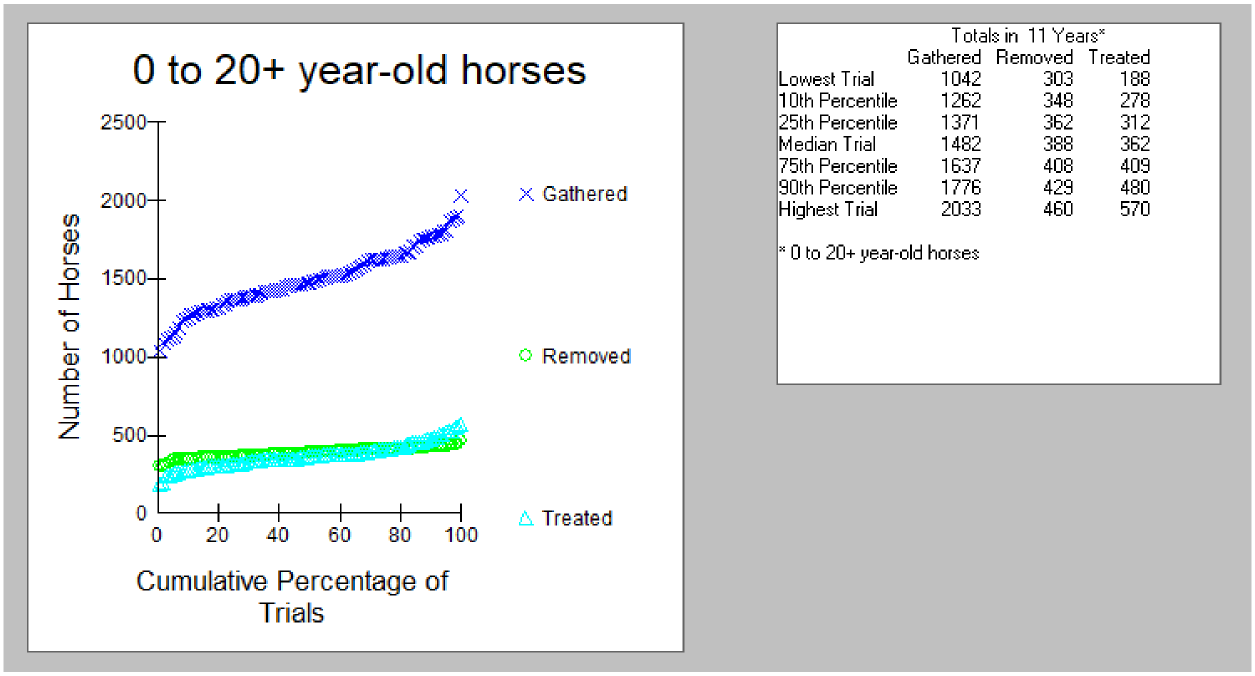
* 0 to 20+ year-old horses

Explanation



Average Growth Rate in 10 Years

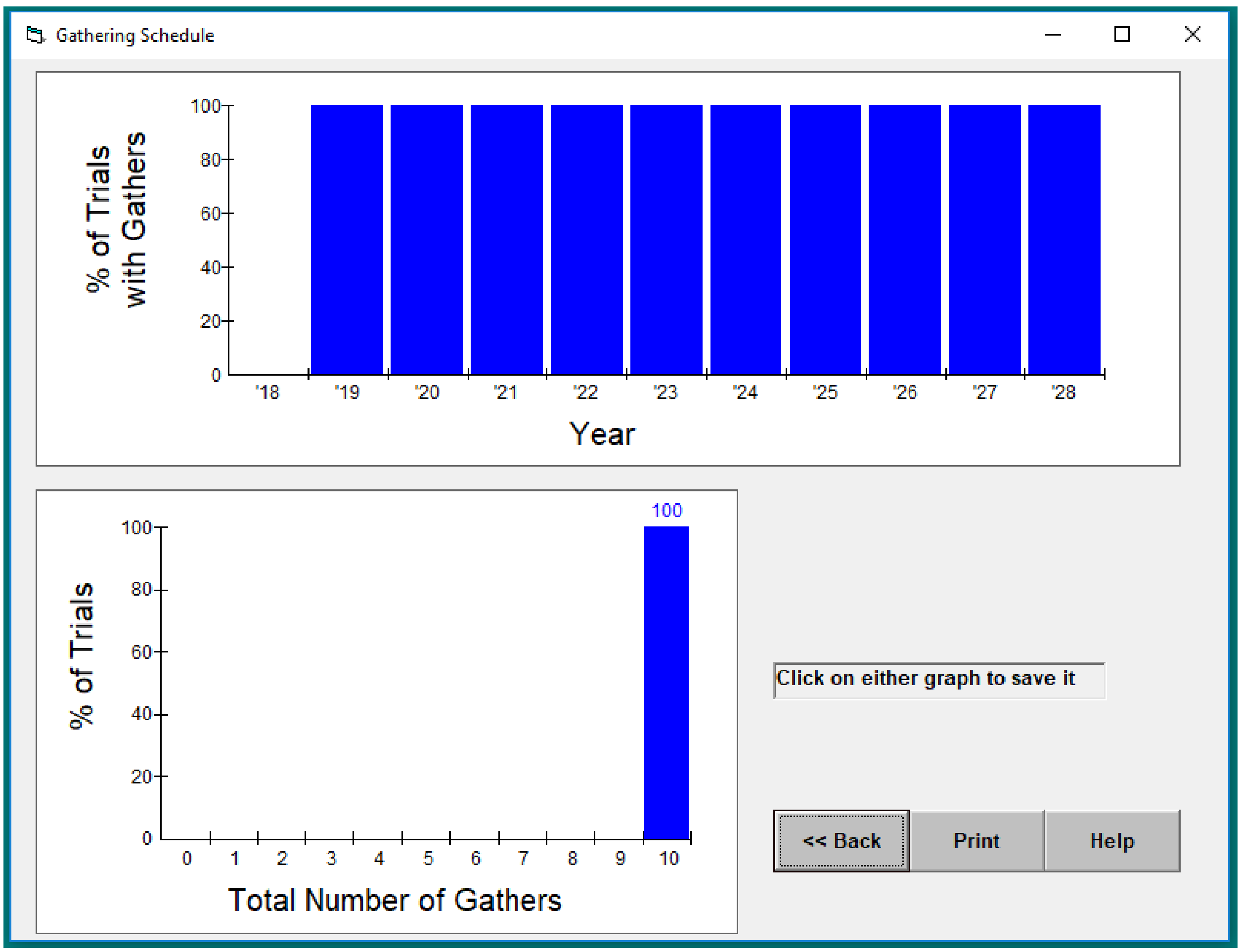
Lowest Trial	-9.6%
10th Percentile	-3.1%
25th Percentile	-0.9%
Median Trial	0.7%
75th Percentile	2.8%
90th Percentile	3.7%
Highest Trial	5.9%



Totals in 11 Years*

	Gathered	Removed	Treated
Lowest Trial	1042	303	188
10th Percentile	1262	348	278
25th Percentile	1371	362	312
Median Trial	1482	388	362
75th Percentile	1637	408	409
90th Percentile	1776	429	480
Highest Trial	2033	460	570

* 0 to 20+ year-old horses



Alternative 5: Sterilize selected ages

Treat 100% of gathered 1,2,3, and >=9 year olds

Efficacy is set to: 100%, 100%, 100%, 100%, 100%

Gather when pop exceeds 210

Reduce population to 121 animals.

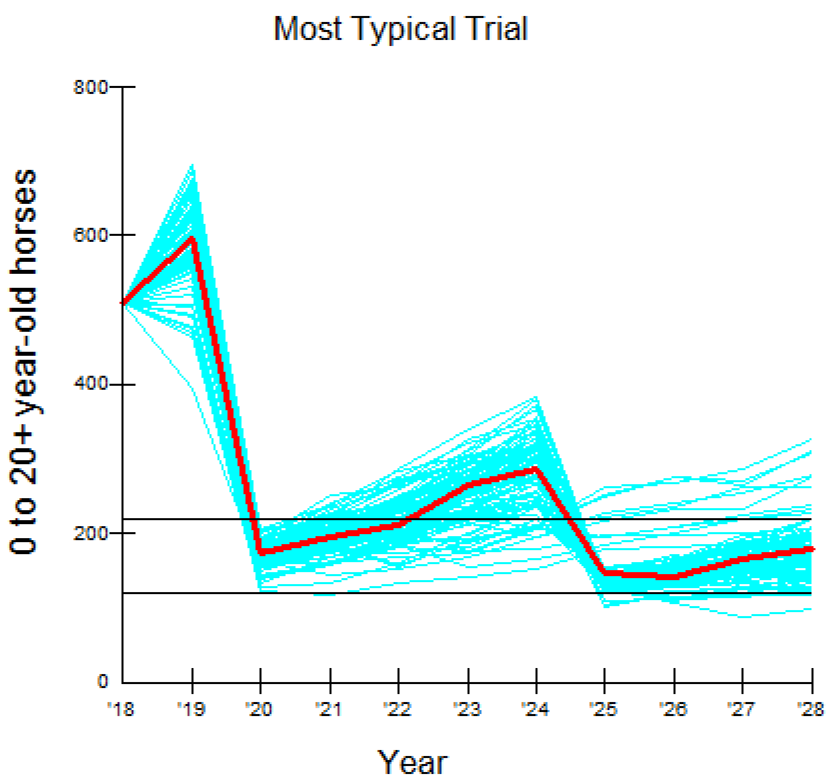
Minimum gather interval = 5 years.

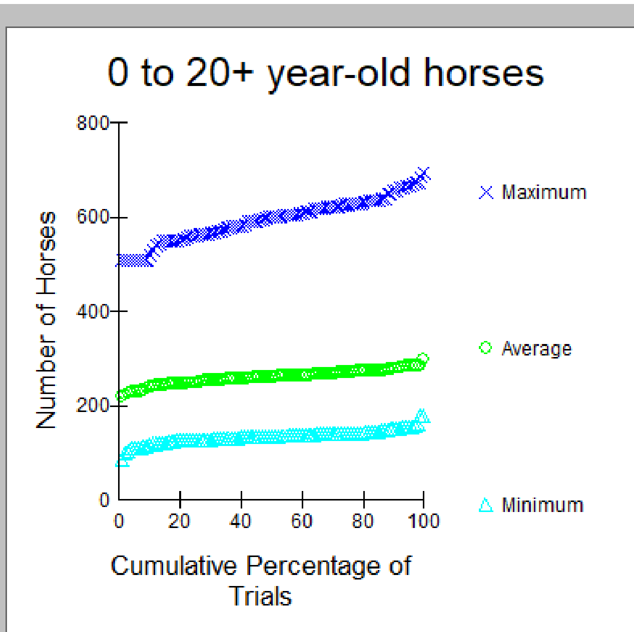
Initial gather year: 2019

Gather for fertility treatment regardless of population size: No.

Gate cut, but set male removals to 88% for all ages, which gives 60/40 sex ratio.

Note that there's no darting, so gathers only happen twice.





Population Sizes in 11 Years*

	Minimum	Average	Maximum
Lowest Trial	88	219	510
10th Percentile	118	240	526
25th Percentile	128	249	563
Median Trial	135	262	602
75th Percentile	142	272	628
90th Percentile	152	280	656
Highest Trial	179	298	696

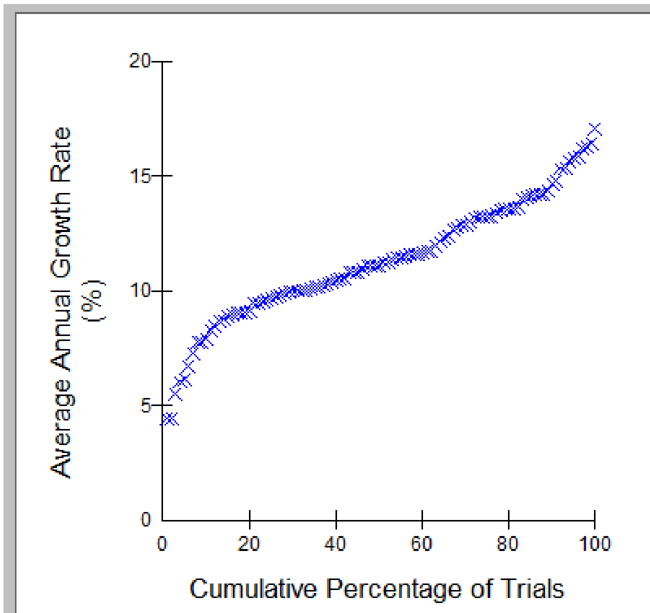
* 0 to 20+ year-old horses

Explanation

Explanation

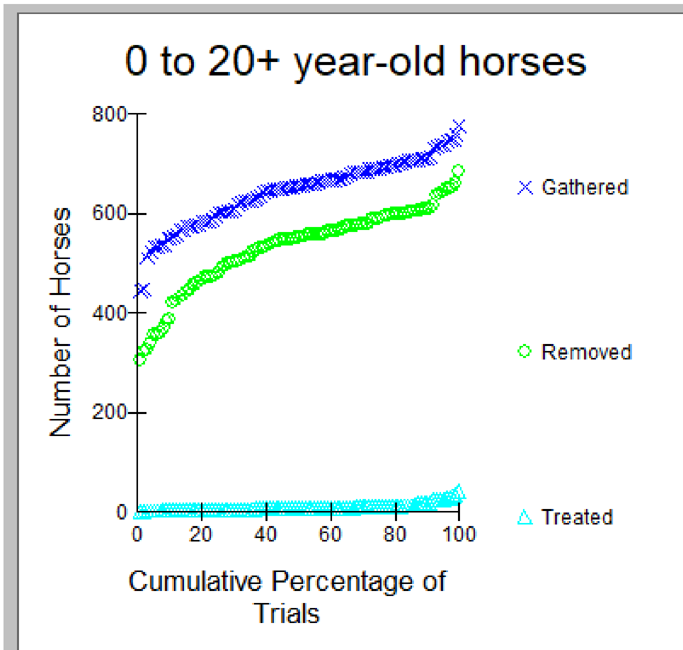
In 11 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 88 and the highest was 696. In half the trials, the minimum population size in 11 years was less than 135 and the maximum was less than 602. The average population size across 11 years ranged from 219 to 298.

OK



Average Growth Rate in 10 Years

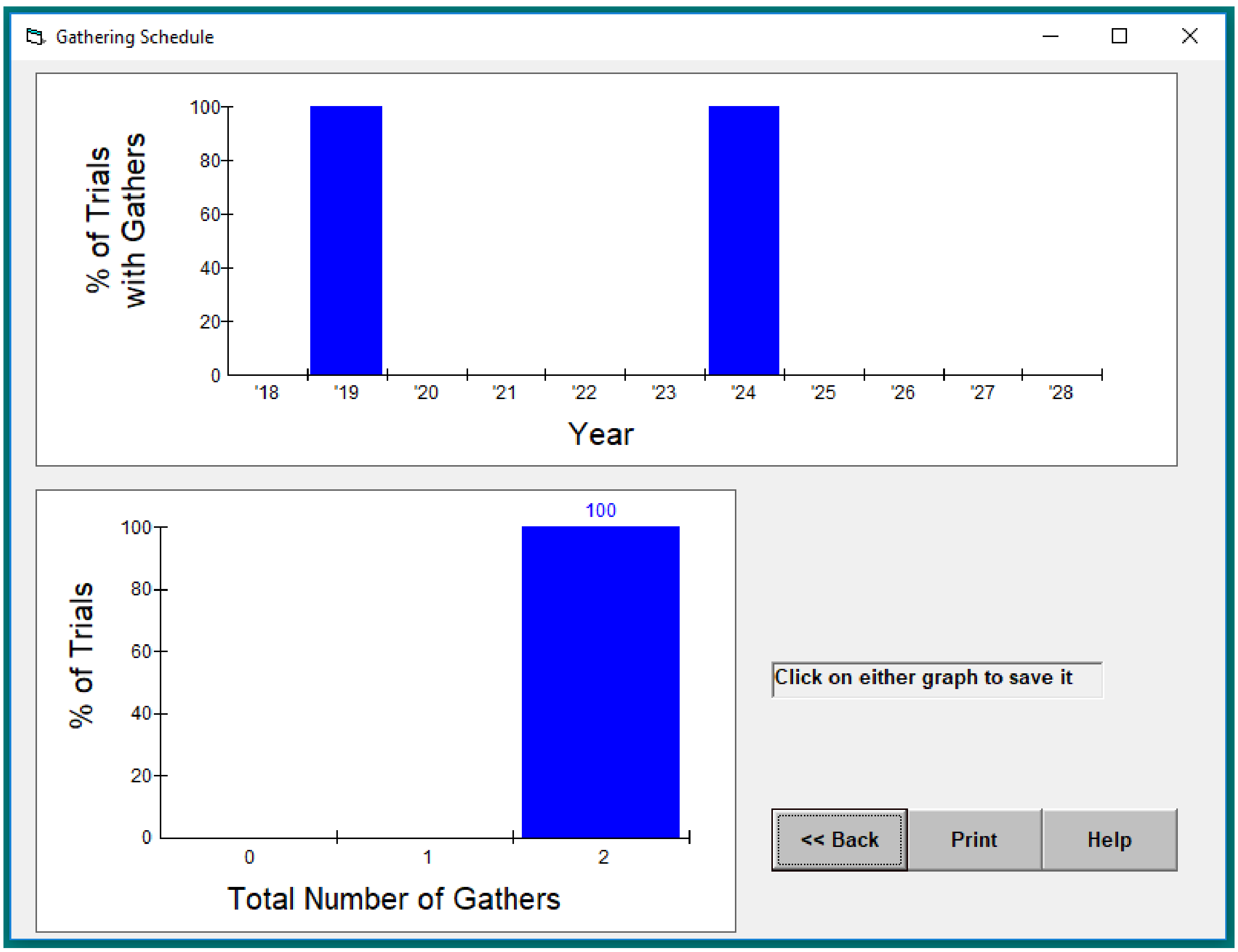
Lowest Trial	4.5%
10th Percentile	8.1%
25th Percentile	9.7%
Median Trial	11.2%
75th Percentile	13.3%
90th Percentile	14.8%
Highest Trial	17.0%



Totals in 11 Years*

	Gathered	Removed	Treated
Lowest Trial	445	307	2
10th Percentile	554	404	4
25th Percentile	604	484	6
Median Trial	657	552	8
75th Percentile	693	592	10
90th Percentile	714	610	20
Highest Trial	778	684	43

* 0 to 20+ year-old horses



Alternative 6: Sterilize all ages

Treat 100% of gathered 1,2,3, and >=9 year olds

Efficacy is set to: 100%, 100%, 100%, 100%, 100%

Gather when pop exceeds 210

Reduce population to 121 animals.

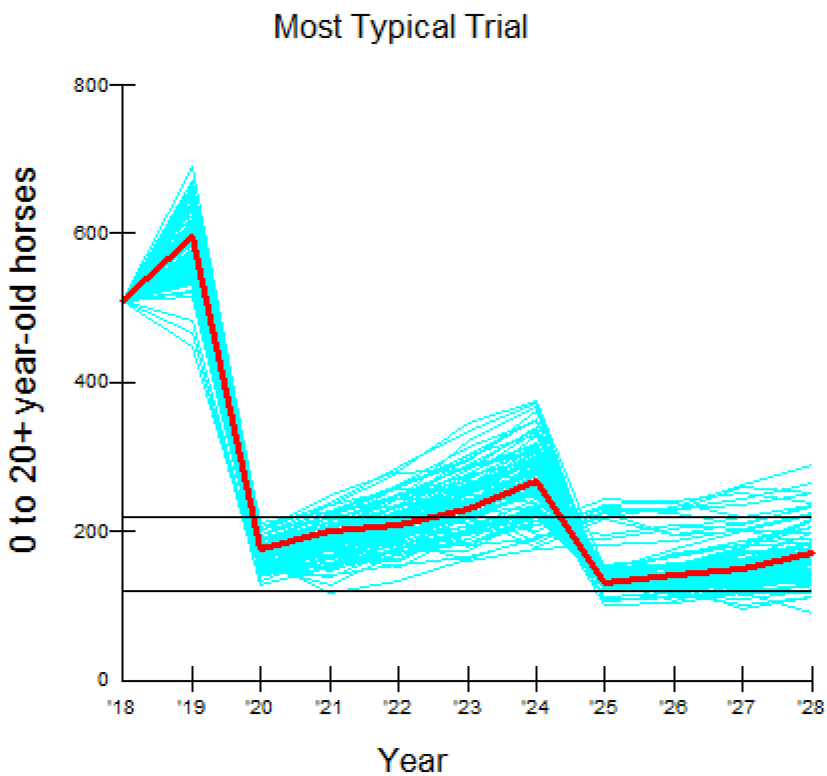
Minimum gather interval = 5 years.

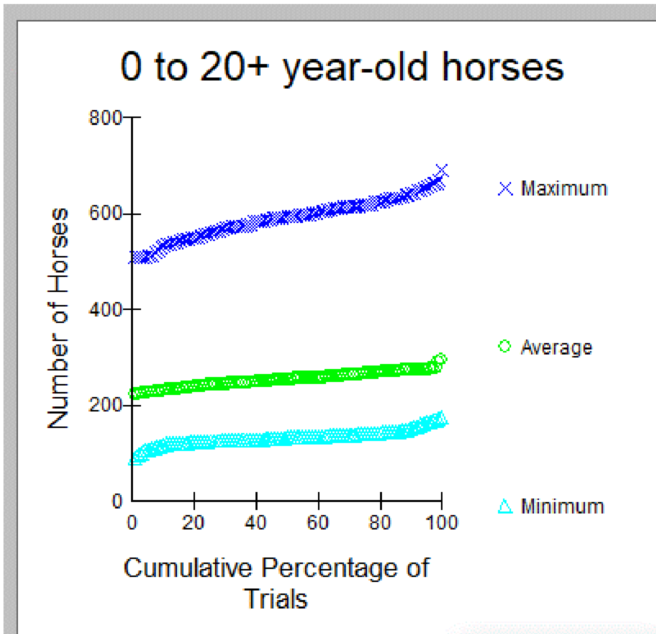
Initial gather year: 2019

Gather for fertility treatment regardless of population size: No.

Gate cut, but set male removals to 88% for all ages, which gives 60/40 sex ratio.

Note that there’s no darting, so gathers only happen twice.





Population Sizes in 11 Years*	Minimum	Average	Maximum
Lowest Trial	91	222	510
10th Percentile	118	231	534
25th Percentile	126	244	562
Median Trial	133	254	596
75th Percentile	141	267	620
90th Percentile	154	274	643
Highest Trial	176	294	690

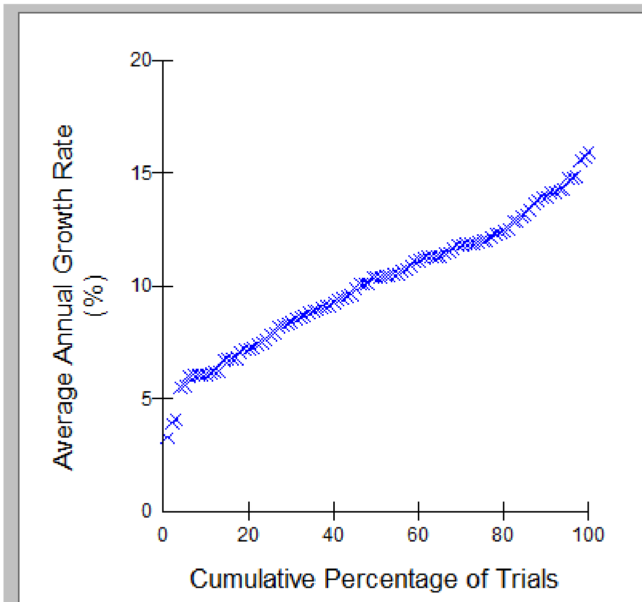
* 0 to 20+ year-old horses

Explanation

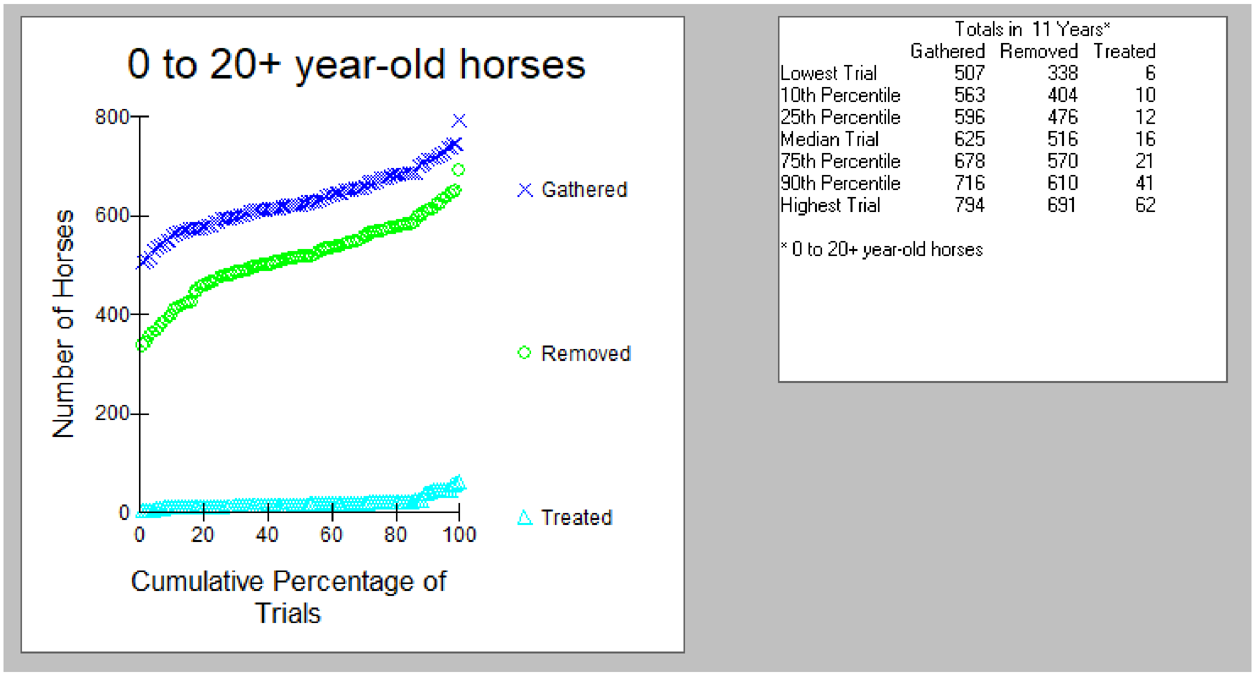
Explanation

In 11 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 91 and the highest was 690. In half the trials, the minimum population size in 11 years was less than 133 and the maximum was less than 596. The average population size across 11 years ranged from 222 to 294.

OK



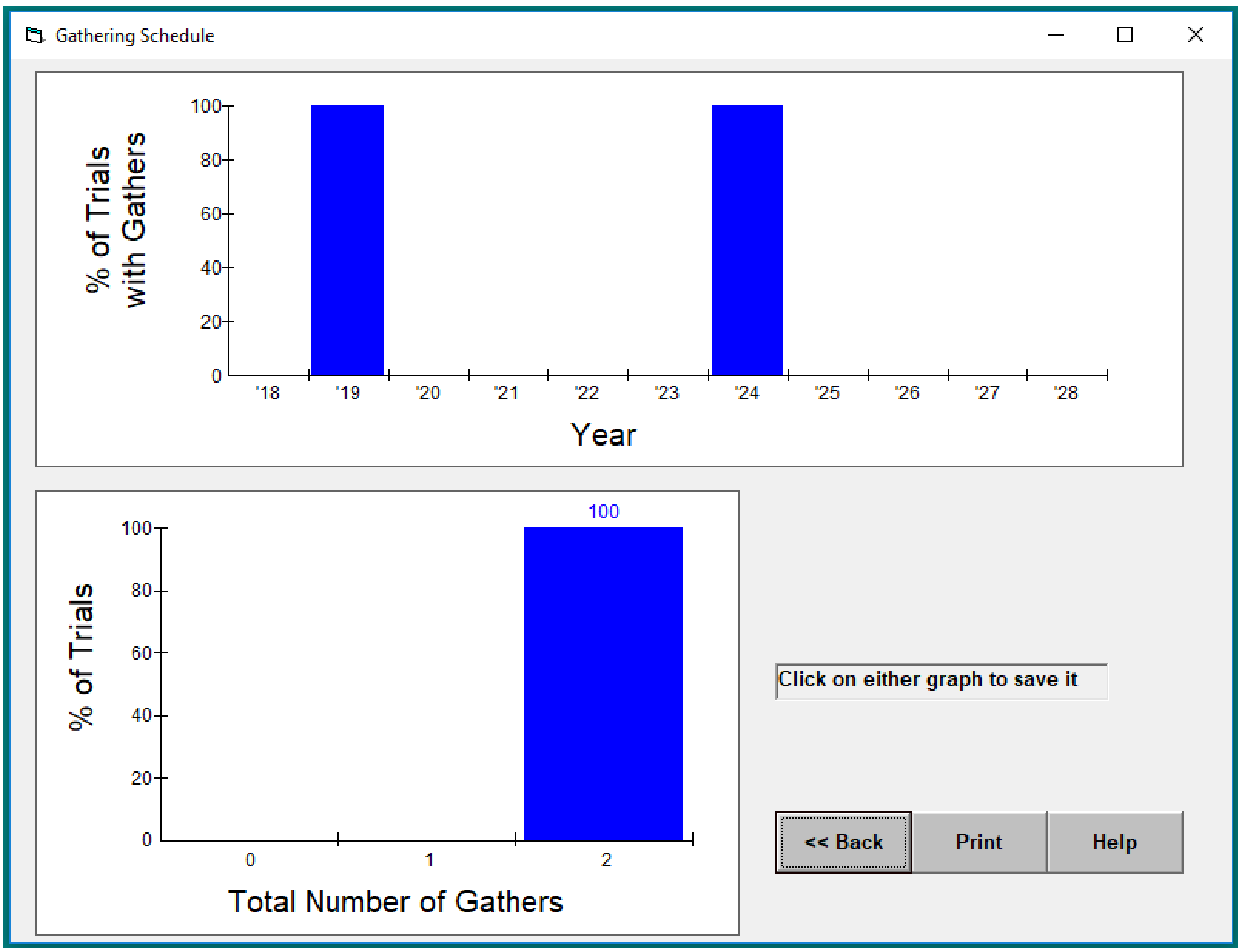
Average Growth Rate in 10 Years	
Lowest Trial	3.3%
10th Percentile	6.1%
25th Percentile	7.9%
Median Trial	10.4%
75th Percentile	12.0%
90th Percentile	14.0%
Highest Trial	15.9%



Totals in 11 Years*

	Gathered	Removed	Treated
Lowest Trial	507	338	6
10th Percentile	563	404	10
25th Percentile	596	476	12
Median Trial	625	516	16
75th Percentile	678	570	21
90th Percentile	716	610	41
Highest Trial	794	691	62

* 0 to 20+ year-old horses



Appendix E, Additional Components of the Proposed Action

In addition to the proposed action described in Section 2.2, the follow are components of the Proposed Action, including helicopter gathering, bait/water trapping, gather related temporary holding facilities (corrals); transport, off-range corrals, and adoption and/or sale preparation; public viewing opportunities and notifications; and monitoring.

Helicopter Gathering

If the local conditions require a helicopter drive-trap operation, the BLM would use a contractor or in-house gather team to perform the gather activities in cooperation with BLM and other appropriate staff. The contractor would be required to conduct all helicopter operations in a safe manner and in compliance with Federal Aviation Administration (FAA) regulations 14 CFR § 91.119 and BLM IM No. 2010-164.

Helicopter drive trapping involves use of a helicopter to herd wild horses into a temporary trap. The CAWP would be implemented to ensure that the gather is conducted in a safe and humane manner, and to minimize potential impacts or injury to the wild horses. Traps would be set in an area with high probability of access by wild horses using the topography, if possible, to assist with capturing excess wild horses residing within the area. Traps consist of a large catch pen with several connected holding corrals, jute-covered wings and a loading chute. The jute-covered wings are made of material, not wire, to avoid injury to the wild horses. The wings form an alley way used to guide the wild horses into the trap. Trap locations are changed during the gather to reduce the distance that the animals must travel. A helicopter is used to locate and herd wild horses to the trap location. The pilot uses a pressure and release system while guiding them to the gather site, allowing them to travel at their own pace. As the herd approaches the trap the pilot applies pressure and a prada horse (aka Judas horse) is released guiding the wild horses into the trap. Once wild horses are gathered they are removed from the trap and transported to a temporary holding facility where they are sorted.

If helicopter drive-trapping operations are needed to capture the targeted animals, the BLM would assure that an Animal and Plant Health Inspection Service (APHIS) veterinarian or contracted licensed veterinarian is on-site during the gather to examine animals and make recommendations to BLM for care and treatment of wild horses. The BLM staff would be present on the gather at all times to observe animal condition, ensure humane treatment of wild horses, and ensure contract requirements are met.

Bait/Water Trapping

Bait and/or water trapping may be used if circumstances require it or best fits the management action to be taken. Bait and/or water trapping generally require a longer window of time for success than helicopter drive trapping. Although the trap would be set in a high probability area for capturing wild horses residing within the area, and at the most effective time periods, time is required for the wild horses to acclimate to the trap and/or decide to access the bait/water.

Trapping involves setting up portable panels around an existing water source or in an active wild horse area, or around a pre-set water or bait source. The portable panels would be set up to allow wild horses to go freely in and out of the corral until they have adjusted to it. When the wild horses fully adapt to the corral, it is fitted with a gate system. The acclimation of the wild horses creates a low stress trapping method. During this acclimation period, the wild horses would experience some stress due to the panels being setup and perceived access restriction to the bait/water source.

When actively trapping wild horses, the gather site would be staffed or checked on a daily basis by either BLM personnel or authorized contractor staff. Wild horses would be either removed immediately or fed and watered for up to several days prior to transport to a holding facility. Existing roads would be used to access the gather sites.

Gathering excess wild horses using bait/water trapping could occur at any time of the year and traps would remain in place until the target number of animals are removed. Generally, bait/water trapping is most effective when a specific resource is limited, such as water during the summer months. For example, in some areas, a group of wild horses may congregate at a given watering site during the summer because few perennial water resources are available nearby. Under those circumstances, water trapping could be a useful means of reducing the number of wild horses at a given location, which can also relieve the resource pressure caused by too many wild horses. As the proposed bait and/or water trapping in this area is a low stress approach to gathering wild horses, such trapping can continue into the foaling season without harming the mares or foals.

Gather Related Temporary Holding Facilities (Corrals)

Wild horses that are gathered would be transported from the gather sites to a temporary holding corral in goose-neck trailers. In some cases, the gather site may also be used as the temporary holding corral. At the temporary holding corral, wild horses would be sorted into different pens based on sex. The wild horses would be aged and provided good quality hay and water. Mares and their un-weaned foals would be kept in pens together. At the temporary holding facility, a veterinarian, when present, would provide recommendations to the BLM regarding care and treatment of the gathered wild horses. Any animals affected by a chronic or incurable disease, injury, lameness or serious physical defect (such as severe tooth loss or wear, club foot, and other severe congenital abnormalities) would be humanely euthanized using methods acceptable to the American Veterinary Medical Association (AVMA). All wild horses being returned to the HMA would be held at the temporary holding site until gather operations have concluded.

Transport, Off-Range Corrals, and Adoption and/or Sale Preparation

All gathered wild horses would be removed and transported to BLM holding facilities where they would be inspected by facility staff, and if needed, a contract veterinarian to observe health and ensure that the animals are being humanely cared for that are under BLM control.

Those wild horses that are removed from the range and are identified to not return to the range would be transported to the receiving off-range corrals (ORC, formerly short-term holding facility) in a goose-neck stock trailer or straight-deck semi-tractor trailers. Trucks and trailers used to haul the wild horses would be inspected prior to use to ensure wild horses can be safely transported. Wild horses would be segregated by age and sex when possible and loaded into separate compartments. Mares and their un-weaned foals may be shipped together in the same compartment or separated for transportation and reunited at the receiving ORC. Transportation of recently captured wild horses is limited to a maximum of 12 hours.

Upon arrival, recently captured wild horses are off-loaded by compartment and placed in holding pens where they are provided good quality hay and water. Most wild horses begin to eat and drink immediately and adjust rapidly to their new situation. At the ORC, a veterinarian provides recommendations to the BLM regarding care, treatment, and if necessary, euthanasia of the recently captured wild horses. Wild horses in very thin condition or animals with injuries are sorted and placed in hospital pens, fed separately, and/or treated for their injuries.

After recently captured wild horses have transitioned to their new environment, they are prepared for adoption, sale, or transport to off-range pastures. Preparation involves freeze-marking the animals with a unique identification number, vaccination against common diseases, castration, and de-worming. At ORC facilities, a minimum of 700 square feet of space is provided per animal. Additional discussion about the BLM’s Wild Horse Program activities after a gather (Adoption, Sale with Limitation, Off-Range Pastures, and Euthanasia and Sale Without Limitation) are included in Appendix F.

Public Viewing Opportunities and Notifications

Opportunities for public observation of the gather activities on public lands would be provided, when and where feasible, and would be consistent with WO IM No. 2013-058 and the Visitation Protocol and Ground Rules for Helicopter WH&B Gathers. This protocol is intended to establish observation locations that reduce safety risks to the public during helicopter gathers (BLM 2015). Due to the nature of bait and water trapping operations, public viewing opportunities may only be provided at holding corrals.

The BLM would continue to provide public notification of gathers, new proposals, applicable NEPA analyses, and other decisions, per BLM protocols. The BLM commits to public notifications in order to keep them informed of current information, gathers, monitoring, etc.

Monitoring

The BLM would continue to conduct monitoring activities in the HMA, including the monitoring of individual and herd health (including mares after fertility control vaccine treatments), genetic diversity (via hair sampling), population size (via flight and ground inventories), population growth rate assessments, and rangeland, wildlife habitat, and riparian conditions.

Appendix F, Wild Horse Program Activities After Gather/Trapping Activities

Adoption

Adoption applicants are required to have at least a 400 square foot corral with panels that are at least six feet tall. Applicants are required to provide adequate shelter, feed, and water. The BLM retains title to the horse for one year and inspects the horse and facilities during this period. After one year, the applicant may take title to the horse, at which point the horse becomes the property of the applicant. Adoptions are conducted in accordance with 43 CFR Subpart 4750.

Sale with Limitation

Buyers must fill out an application and be pre-approved before they may buy a wild horse. A sale-eligible wild horse is any animal that is more than 10 years old; or has been offered unsuccessfully for adoption at least 3 times. The application also specifies that all buyers are not to sell to slaughter buyers or anyone who would sell the animals to a commercial processing plant. Sale of wild horses are conducted in accordance with the 1971 WFRHBA and congressional limitations that are presently in place.

Off-Range Pastures

During the past 5 years, the BLM has removed approximately 19,000 excess wild horses or burros from the Western States. Most animals not immediately adopted or sold have been transported to Off-Range pastures in the Midwest given current Congressional prohibitions on selling excess animals without limitations, or on euthanizing healthy animals for which no adoption or sale demand exists as required by the WFRHBA.

When shipping wild horses for adoption, sale, or Off-Range Pastures (ORPs) the animals may be transported for up to a maximum of 24 hours. Immediately prior to transportation, and after every 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 two pounds of good quality hay per 100 pounds of body weight with adequate space to allow all animals to eat at one time.

Potential impacts to wild horses from transport to adoption, sale or Off-range Pastures (ORP) are similar to those previously described. One difference is that when shipping wild horses for adoption, sale or ORP, animals may be transported for a maximum of 24 hours. Immediately prior to transportation, and after every 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 2 pounds of good quality hay per 100 pounds of body weight with adequate bunk space to allow all animals to eat at one time. The rest period may be waived in situations where the anticipated travel time exceeds the 24-hour limit but the stress of offloading and reloading is likely to be greater to the animals than the stress involved in the additional period of uninterrupted travel.

Off-range pastures are designed to provide excess wild horses with humane, and in some cases life-long care in a natural setting off the public rangelands. There wild horses are maintained in grassland pastures large enough to allow free-roaming behavior (i.e., the horses are not kept in corrals) and with the forage, water, and shelter necessary to sustain them in good condition. About 33,429 wild horses that are in excess of the current adoption or sale demand (because of age or other factors such as economic recession), are currently located on private land pastures in Oklahoma, Kansas, and South Dakota [SAB1], And Iowa, Missouri, Wyoming, Montana, Nebraska, & Utah. Establishment of an ORP is subject to a separate NEPA and decision-making process. Located in mid or tall grass prairie regions of the United States, these ORPs are highly productive grasslands compared to the more arid western rangelands. These pastures comprise about 256,000 acres (an average of about 10-11 acres per animal). Of the animals currently located in ORP, less than one percent is age 0-4 years, 49 percent are age 5-10 years, and about 51 percent are age 11+ years.

Mares and sterilized stallions (geldings) are segregated into separate pastures except at one facility where geldings and mares coexist. Although the animals are placed in ORP, they remain available for adoption or sale to qualified individuals; and foals born to pregnant mares in ORP are gathered and weaned when they reach about 8-12 months of age and are also made available for adoption. The ORP contracts specify the care that wild horses must receive to ensure they remain healthy and well-cared for. Handling by humans is minimized to the extent possible, although regular on-the-ground observation by the ORP contractor and periodic counts of the wild horses to ascertain their well-being and safety are conducted by BLM personnel and/or veterinarians. A very small percentage of the animals may be humanely euthanized if they are in very poor condition due to age or other factors. Natural mortality of wild horses in ORP averages approximately 8% per year, but can be higher or lower depending on the average age of the horses pastured there (GAO-09-77, Page 52). Wild horses residing on ORP facilities live longer, on the average, than wild horses residing on public rangelands.

Euthanasia and Sale Without Limitation

Under the WFRHBA, healthy excess wild horses can be euthanized or sold without limitation if there is no adoption demand for the animals. However, while euthanasia and sale without limitation are allowed under the statute, these activities have not been permitted under current Congressional appropriations for over a decade and are consequently inconsistent with BLM policy. If Congress should remove this prohibition, then excess horses removed from the HMA could potentially be sold without limitations or humanely euthanized, as required by statute, if no adoption or sale demand exists for some of the removed excess horses.

Any old, sick or lame horses unable to maintain an acceptable body condition (greater than or equal to a Henneke BCS of 3) or with serious physical defects would be humanely euthanized either before gather activities begin or during the gather operations. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy WO IM 2015-070 or most current edition.

Appendix G, Fertility Control Implementation and Monitoring Procedures

Standard Operating Procedures for Population-Level Fertility Control Treatments.

The following implementation and monitoring requirements are part of the proposed action:

Implementation

1. PZP or GonaCon-Equine vaccine would be administered through darting by trained BLM personnel or collaborating 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. All mares targeted for treatment will be clearly identifiable through photographs to enable darters and HMA managers to positively identify the animals during the project and at the time of removal during subsequent gathers.
3. 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).
4. 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. GonaCon-Equine is administered delivered using 2.0 cc Pneu-Darts.
5. 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.
6. Delivery of the vaccine would be by intramuscular injection into the left or right hip/gluteal muscles while the mare is standing still.
7. 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.
8. No attempts would be taken in high wind (greater than 15 mph) 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.
9. 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.
10. 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.
11. 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.
12. 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. 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.

13. 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.

Monitoring and Tracking of Treatments

1. A Fertility Control Application Data sheet would 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 would submit an Application Report and accompanying narrative and data sheets would be forwarded to the national program office. A copy of the form and data sheets and any photos taken would be maintained at the field office. Additional information such as foaling history, injection site reactions and band affiliation may be tracked and kept at the field office.

2. A tracking system would be maintained by national program office detailing the quantity of fertility control issued, the quantity used, the number of treated mares by HMA, field office, and State along with the freeze-mark(s) applied by HMA and date.

3. The BLM would monitor mares after fertility control treaments for any adverse effects.

Appendix H, Literature Review on Effects of Fertility Control Vaccines and Sex Ratio Manipulations

Various forms of fertility control can be used in wild horses and wild burros, with the goals of maintaining herds at or near AML, reducing fertility rates, and reducing the frequency of gathers and removals. The WFRHBA of 1971 specifically provides for contraception and sterilization (section 3.b.1). Fertility control measures have been shown to be a cost-effective and humane treatment to slow increases in wild horse populations or, when used in combination with gathers, to reduce horse population size (Bartholow 2004, de Seve and Boyles-Griffin 2013, Fonner and Bohara 2017). Although fertility control treatments may be associated with a number of potential physiological, behavioral, demographic, and genetic effects, those impacts are generally minor and transient, do not prevent overall maintenance of a self-sustaining population, and do not generally outweigh the potential benefits of using contraceptive treatments in situations where it is a management goal to reduce population growth rates (Garrott and Oli 2013).

An extensive body of peer-reviewed scientific literature details the impacts of fertility control methods on wild horses and burros. No finding of excess animals is required for BLM to pursue contraception in wild horses or wild burros, but NEPA analysis has been required. The Verification Report details some of the many NEPA analyses related to projects with fertility control, but this review focuses on peer-reviewed scientific literature. The summary that follows first examines effects of fertility control vaccine use in mares, then of sex ratio manipulation. This review does not examine effects of spaying and neutering. Cited studies are generally limited to those involving horses and burros, except where including studies on other species helps in making inferences about physiological or behavioral questions not yet addressed in horses or burros specifically. While most studies reviewed here refer to horses, burros are extremely similar in terms of physiology, such that expected effects are comparable, except where differences between the species are noted.

On the whole, the identified impacts are generally transient and affect primarily the individuals treated. Fertility control that affects individual horses and burros does not prevent BLM from ensuring that there will be self-sustaining populations of wild horses and burros in single herd management areas (HMAs), in complexes of HMAs, and at regional scales of multiple HMAs and complexes. Under the WFRHBA of 1971, BLM is charged with maintaining self-reproducing populations of wild horses and burros. The National Academies of Sciences (2013) encouraged BLM to manage wild horses and burros at the spatial scale of "metapopulations" – that is, across multiple HMAs and complexes in a region. In fact, many HMAs have historical and ongoing genetic and demographic connections with other HMAs, and BLM routinely moves animals from one to another to improve local herd traits and maintain high genetic diversity.

All fertility control methods affect the behavior and physiology of treated animals (NAS 2013), and are associated with potential risks and benefits, including effects of handling, frequency of handling, physiological effects, behavioral effects, and reduced population growth rates (Hampton *et al*. 2015). Contraception alone does not remove excess horses from an HMA's population, so one or more gathers are usually needed in order to bring the herd down to a level close to AML. Horses are long-lived, potentially reaching 20 years of age or more in the wild. Except in cases where extremely high fractions of mares are rendered infertile over long time periods of (i.e., 10 or more years), fertility control methods such as immunocontraceptive vaccines and sex ratio manipulation are not very effective at reducing population growth rates to the point where births equal deaths in a herd. However, even more modest fertility control activities can reduce the frequency of horse gather activities, and costs to taxpayers. Bartholow (2007) concluded that the application of 2-year or 3-year contraceptives to wild mares could reduce operational costs in a project area by 12-20%, or up to 30% in carefully planned population management programs. Because applying contraception to horses requires capturing and handling, the risks and costs associated with capture and handling of horses may be comparable to those of gathering for removal, but with expectedly lower adoption and long-term holding costs. Population growth suppression becomes less expensive if fertility control is long-lasting (Hobbs *et al*. 2000).

In the context of BLM wild horse and burro management, fertility control vaccines and sex ratio manipulation rely on reducing the number of reproducing females. Taking into consideration available literature on the subject, the National Academies of Sciences concluded in their 2013 report that forms of fertility control vaccines were two of the three 'most promising' available methods for contraception in wild horses and burros (NAS 2013). That report also noted that sex ratio manipulations where herds have approximately 60% males and 40% females can expect lower annual growth rates, simply as a result of having a lower number of reproducing females.

<u>Fertility Control Vaccines</u>

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

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

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

BLM has followed SOPs for fertility control vaccine application (BLM IM 2009-090). Herds selected for fertility control vaccine use should have annual growth rates over 5%, have a herd size over 50 animals, and have a target rate of treatment of between 50% and 90% of female wild horses or burros. The IM requires that treated mares be identifiable via a visible freeze brand or individual color markings, so that their vaccination history can be known. The IM calls for follow-up population surveys to determine the realized annual growth rate in herds treated with fertility control vaccines.

Vaccine Formulations: Porcine Zona Pellucida (PZP)

PZP vaccines have been used on dozens of horse herds by the National Park Service, US Forest Service, Bureau of Land Management, and Native American tribes and PZP vaccine use is approved for free-ranging wild and feral horse herds in the United States (EPA 2012). PZP use can reduce or eliminate the need for gathers and removals, if very high fractions of mares are treated over a very long time period (Turner *et al*. 1997). PZP vaccines have been used extensively in wild horses (NAS 2013), and in feral burros on Caribbean islands (Turner *et al*. 1996, French *et al*. 2017). PZP vaccine formulations are produced as ZonaStat-H, an EPA-registered commercial product (EPA 2012, SCC 2015), 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), and as Spayvac, where the PZP protein is enveloped in liposomes (Killian *et al*. 2008, Roelle *et al*. 2017, Bechert and Fraker 2018). 'Native' PZP proteins can be purified from pig ovaries (Liu *et al*. 1989). Recombinant ZP proteins may be produced with molecular techniques (Gupta and Minhas 2017, Joonè *et al*. 2017a, Nolan *et al*. 2018a).

When advisories on the product label (EPA 2015) are followed, the product is safe for users and the environment (EPA 2012). 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.

For maximum effectiveness, PZP is administered within the December to February timeframe. When applying ZonaStat-H, first the primer with modified Freund's Complete adjuvant is given and then the booster with Freund's Incomplete adjuvant is given 2-6 weeks later. Preferably, the timing of the booster dose is at least 1-2 weeks prior to the onset of breeding activity. Following the initial 2 inoculations, only annual boosters are required. For 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 until there is more demonstration that PZP-22 can be reliably delivered via dart.

Vaccine Formulations: Gonadotropin Releasing Hormone (GnRH)

GonaCon (which is produced under the trade name GonaCon-Equine for use in feral horses and burros) is approved for use by authorized federal, state, tribal, public and private personnel, for application to free-ranging wild horse and burro herds in the United States (EPA 2013, 2015). GonaCon has been used on feral horses in Theodore Roosevelt National Park and on wild horses administered by BLM (BLM 2015). GonaCon has been produced by USDA-APHIS (Fort Collins, Colorado) in several different formulations, the history of which is reviewed by Miller *et al*. (2013). GonaCon vaccines present the recipient with hundreds of copies of GnRH as peptides on the surface of a linked protein that is naturally antigenic because it comes from invertebrate hemocyanin (Miller *et al.* 2013). Early GonaCon formulations linked many copies of GnRH to a protein from the keyhole limpet (GonaCon-KHL), but more recently produced formulations where the GnRH antigen is linked to a protein from the blue mussel (GonaCon-B) proved less expensive and more effective (Miller *et al*. 2008). GonaCon-Equine is in the category of GonaCon-B vaccines.

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

Miller *et al*. (2013) reviewed the vaccine environmental safety and toxicity. When advisories on the product label (EPA 2015) are followed, the product is safe for users and the environment (EPA 2009b). EPA waived a number of tests prior to registering the vaccine, because GonaCon was deemed to pose low risks to the environment, so long as the product label is followed (Wang-Cahill *et al*., in press).

GonaCon-Equine can safely be reapplied as necessary to control the population growth rate; booster dose effects may lead to increased effectiveness of contraception, which is generally the intent. Even after booster treatment of GonaCon-Equine, it is expected that most, if not all, mares would return to fertility at some point. Although it is unknown what would be the expected rate for the return to fertility rate in mares boosted more than once with GonaCon-Equine, a prolonged return to fertility would be consistent with the desired effect of using GonaCon (e.g., effective contraception).

The adjuvant used in GonaCon, Adjuvac, generally leads to a milder reaction than Freund's Complete Adjuvant (Powers *et al*. 2011). Adjuvac contains a small number of killed Mycobacterium avium cells (Miller *et al*. 2008, Miller *et al*. 2013). The antigen and adjuvant are emulsified in mineral oil, such that they are not all presented to the immune system right after injection. It is thought that the mineral oil emulsion leads to a 'depot effect' that is associated with slow or sustained release of the antigen, and a resulting longer-lasting immune response (Miller *et al*. 2013). Miller *et al*. (2008, 2013) have speculated that, in cases where memory-B leukocytes are protected in immune complexes in the lymphatic system, it can lead to years of immune response. Increased doses of vaccine may lead to stronger immune reactions, but only to a certain point; when Yoder and Miller (2010) tested varying doses of GonaCon in prairie dogs, antibody responses to the 200µg and 400µg doses were equal to each other but were both higher than in response to a 100µg dose.

<u>Direct Effects: PZP Vaccines</u>

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). PZP vaccines do not appear to interact with other organ systems, as antibodies specific to PZP protein do not crossreact with tissues outside of the reproductive system (Barber and Fayrer-Hosken 2000).

Research has demonstrated that contraceptive efficacy of an injected liquid PZP vaccine, such as ZonaStat-H, is approximately 90% or more for mares treated twice in the first year (Turner and Kirkpatrick 2002, Turner *et al*. 2008). The highest success for fertility control has been reported when the vaccine has been applied November through February. High contraceptive rates of 90% or more can be maintained in horses that are given a booster dose annually (Kirkpatrick *et al*. 1992). Approximately 60% to 85% of mares are successfully contracepted for one year when treated simultaneously with a liquid primer and PZP-22 pellets (Rutberg *et al*. 2017). Application of PZP for fertility control would reduce fertility in a large percentage of mares for at least one year (Ransom *et al*. 2011). The contraceptive result for a single application of the liquid PZP vaccine primer dose along with PZP vaccine pellets (PZP-22), based on winter applications, can be expected to fall in the approximate efficacy ranges as follows (based on Figure 2 in Rutberg *et al*. 2017). Below, the approximate efficacy is measured as the relative decrease in foaling rate for treated mares, compared to control mares:

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

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

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

The 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 over many years to be treated to totally prevent population-level growth (e.g., Turner and Kirkpatrick 2002). Gather efficiency does not usually exceed 85% via helicopter, and may be less with bait and water trapping, so there will almost always 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.

<u>Direct Effects: GnRH Vaccines</u>

GonaCon-Equine is one of several vaccines that have been engineered to create an immune response to the gonadotropin releasing hormone peptide (GnRH). GnRH is a small peptide that plays an important role in signaling the production of other hormones involved in reproduction in both sexes. When combined with an adjuvant, a 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.

GnRH is highly conserved across mammalian taxa, so some inferences about the mechanism and effects of GonaCon-Equine in horses can be made from studies that used different anti-GnRH vaccines, in horses and other taxa. Other commercially available anti-GnRH vaccines include: Improvac (Imboden *et al*. 2006, Botha *et al*. 2008, Janett *et al*. 2009a, Janett *et al*. 2009b, Schulman *et al*. 2013, Dalmau *et al*. 2015), made in South Africa; Equity (Elhay *et al*. 2007), made in Australia; Improvest, for use in swine (Bohrer *et al*. 2014); Repro-BLOC (Boedeker *et al*. 2011); and Bopriva, for use in cows (Balet *et al*. 2014). Of these, GonaCon-Equine, Improvac, and Equity are specifically intended for horses. Other anti-GnRH vaccine formulations have also been tested, but did not become trademarked products (e.g., Goodloe 1991, Dalin *et al* 2002, Stout *et al*. 2003, Donovan *et al*. 2013, Schaut *et al*. 2018, Yao *et al*. 2018). The effectiveness and side-effects of these various anti-GnRH vaccines may not be the same as would be expected from GonaCon-Equine use in horses. Results could differ as a result of differences in the preparation of the GnRH antigen, and the choice of adjuvant used to stimulate the immune response. For some formulations of anti-GnRH vaccines, a booster dose is required to elicit a contraceptive response, though GonaCon can cause short-term contraception in a fraction of treated animals from one dose (Powers *et al*. 2011, Gionfriddo *et al*. 2011a, Baker *et al*. 2013, Miller *et al.* 2013).

GonaCon can provide multiple years of infertility in several wild ungulate species, including horses (Killian *et al*., 2008; Gray *et al*., 2010). 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).

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

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

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

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

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

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

Reversibility and Effects on Ovaries: PZP Vaccines

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 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 to BLM).

The purpose of applying PZP vaccine 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 individual 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 in each of 5-7 years was observed by Nuñez *et al*. (2010, 2017). In a graduate thesis, Knight (2014) suggested that repeated treatment with as few as three to four years of PZP treatment may lead to longer-term sterility, and that sterility may result from PZP treatment before puberty. Repeated treatment with PZP led long-term infertility in Przewalski’s horses receiving as few as one PZP booster dose (Feh 2012). However, even if some number of mares become sterile as a result of PZP treatment, that potential result would be consistent with the contraceptive purpose that motivates BLM’s potential use of the vaccine.

In some number of individual 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, Nolan *et al*. 2018b). Joonè *et al*. (2017a) noted reversible effects on ovaries in mares treated with one primer dose and booster dose. Joonè *et al*. (2017c) and Nolan *et al*. (2018b) documented decreased anti-Mullerian hormone (AMH) levels in mares treated with native or recombinant PZP vaccines; AMH levels are thought to be an indicator of ovarian function. Bechert *et al*. (2013) found that ovarian function was affected by the SpayVac PZP vaccination, but that there were no effects on other organ systems. Mask *et al*. (2015) demonstrated that equine antibodies that resulted from SpayVac immunization could bind to oocytes, ZP proteins, follicular tissues, and ovarian tissues. It is possible that result is specific to the immune response to SpayVac, which may have lower PZP purity than ZonaStat or PZP-22 (Hall *et al*. 2016). However, in studies with native ZP proteins and recombinant ZP proteins, Joonè *et al*. (2017a) found transient effects on ovaries after PZP vaccination in some treated mares; normal estrus cycling had resumed 10 months after the last treatment. SpayVac is a patented formulation of PZP in liposomes that led to multiple years of infertility in some breeding trials (Killian *et al*. 2008, Roelle *et al*. 2017, Bechert and Fraker 2018), but unacceptably poor efficacy in a subsequent trial (Kane 2018). Kirkpatrick *et al*. (1992) noted effects on horse ovaries after three years of treatment with PZP. Observations at Assateague Island National Seashore indicated that the more times a mare is consecutively treated, the longer the time lag before fertility returns, but that even mares treated 7 consecutive years did eventually return to ovulation (Kirkpatrick and Turner 2002). Other studies have reported that continued PZP vaccine applications 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 *et al*. (2003) demonstrated T-cell clusters on ovaries, but no loss of ovarian function after ZP protein immunization in macaques.

<u>Reversibility and Effects on Ovaries: GnRH Vaccines</u>

The NAS (2013) review pointed out that single doses of GonaCon-Equine do not lead to high rates of initial effectiveness, or long duration. Initial effectiveness of one dose of GonaCon-Equine vaccine appears to be lower than for a combined primer plus booster dose of the PZP vaccine ZonaStat-H (Kirkpatrick *et al*. 2011), and the initial effect of a single GonaCon dose can be limited to as little as one breeding season. However, preliminary results on the effects of boostered doses of GonaCon-Equine indicate that it can have high efficacy and longer-lasting effects in free-roaming horses (Baker *et al*. 2017) than the one-year effect that is generally expected from a single booster of ZonaStat-H.

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

Not all mares should be expected to respond to the GonaCon-equine vaccine; some number should be expected to continue to become pregnant and give birth to foals. In studies where mares were exposed to stallions, the fraction of treated mares that are effectively contracepted in the year after anti-GnRH vaccination varied from study to study, ranging from ~50% (Baker *et al*. 2017), to 61% (Gray *et al*. 2010), to ~90% (Killian *et al*. 2006, 2008, 2009). Miller *et al*. (2013) noted lower effectiveness in free-ranging mares (Gray *et al*. 2010) than captive mares (Killian *et al*. 2009). Some of these rates are lower than the high rate of effectiveness typically reported for the first year after PZP vaccine treatment (Kirkpatrick *et al*. 2011). In the one study that tested for a difference, darts and hand-injected GonaCon doses were equally effective in terms of fertility outcome (McCann *et al*. 2017).

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

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

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

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

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

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

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

GonaCon appeared to confer two years of contraception (Miller *et al*. 2000). Ten of 30 domestic cows treated became pregnant within 30 weeks after the first dose of Bopriva (Balet *et al*. 2014).

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

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

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

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

<u>Effects on Existing Pregnancies, Foals, and Birth Phenology: PZP Vaccines</u>

Although fetuses are not explicitly protected under the WFRHBA of 1971, as amended, it is prudent to analyze the potential effects of fertility control vaccines on developing fetuses and foals. Any impacts identified in the literature have been found to be transient, and do not influence the future reproductive capacity of offspring born to treated females.

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). Studies on Assateague Island (Kirkpatrick and Turner 2002) showed that once female offspring born to mares treated with PZP during pregnancy eventually breed, they produce healthy, viable foals. It is possible that there may be transitory effects on foals born to mares or jennies treated with PZP. For example, in mice, Sacco *et al*. (1981) found that antibodies specific to PZP can pass from mother mouse to pup via the placenta or colostrum, but that did not apparently cause any innate immune response in the offspring: the level of those antibodies were undetectable by 116 days after birth. There was no indication in that study that the fertility or ovarian function of those mouse pups was compromised, nor is BLM aware of any such results in horses or burros. Unsubstantiated, speculative connections between PZP treatment and 'foal stealing' has not been published in a peer-reviewed study and thus cannot be verified. '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 spayed 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, such as where Nuñez made observations, which calls into question whether inferences drawn from island herds can be applied to western wild horse herds. Ransom *et al*. (2013), though, did identify a potential shift in reproductive timing as a possible drawback to prolonged treatment with PZP, stating that treated mares foaled on average 31 days later than non-treated mares. Results from Ransom *et al*. (2013), however, showed that over 81% of the documented births in that study were between March 1 and June 21, i.e., within the normal, peak, spring foaling season. Ransom *et al*. (2013) pointedly advised that managers should consider carefully before using PZP in small refugia or rare species. Wild horses and burros managed by BLM do not generally occur in isolated refugia, nor are they at all rare species. The US Fish and Wildlife Service denied a petition to list wild horses as endangered (USFWS 2015). Moreover, any effect of shifting birth phenology was not observed uniformly: in two of three PZP-treated wild horse populations studied by Ransom *et al*. (2013), foaling season of treated mares extended three weeks and 3.5 months, respectively, beyond that of untreated mares. In the other population, the treated mares foaled within the same time period as the untreated mares. Furthermore, Ransom *et al*. (2013) found no negative impacts on foal survival even with an extended birthing season. If there are shifts in birth phenology, though, it is reasonable to assume that some negative effects on foal survival for a small number of foals might result from particularly severe weather events (Nuñez *et al*. 2018).

Effects on Existing Pregnancies, Foals, and Birth Phenology: GnRH Vaccines

Although fetuses are not explicitly protected under the WFRHBA of 1971, as amended, it is prudent to analyze the potential effects of fertility control vaccines on developing fetuses and foals. Any impacts identified in the literature have been found to be transient, and do not influence the future reproductive capacity of offspring born to treated females.

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

GonaCon had no apparent effect on pregnancies in progress, foaling success, or the health of offspring, in horses that were immunized in October (Baker *et al*. 2013), elk immunized 80-100 days into gestation (Powers *et al*. 2011, 2013), or deer immunized in February (Miller *et al*. 2000). Kirkpatrick *et al*. (2011) noted that anti-GnRH immunization is not expected to cause hormonal changes that would lead to abortion in the horse, but this may not be true for the first 6 weeks of pregnancy (NAS 2013). Curtis *et al*. (2011) noted that GonaCon-KHL treated white tailed deer had lower twinning rates than controls, but speculated that the difference could be due to poorer sperm quality late in the breeding season, when the treated does did become pregnant. Goodloe (1991) found no difference in foal production between treated and control animals.

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

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

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

<u>Effects of Marking and Injection</u>

Standard practices require that immunocontraceptive-treated animals be readily identifiable, either via brand marks or unique coloration (BLM 2010). 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 the long-term stress that can result from food and water limitation on the range (e.g., Creel *et al*. 2013). Handling may include freeze-marking, for the purpose of identifying that mare and identifying her vaccine treatment history. Under past management practices, captured mares experienced increased stress levels from handling (Ashley and Holcombe 2001), but BLM has instituted guidelines to reduce the sources of handling stress in captured animals (BLM 2015).

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. Whether injection is by hand or via darting, GonaCon-Equine is associated with some degree of inflammation, swelling, and the potential for abscesses at the injection site (Baker *et al*. 2013). Swelling or local reactions at the injection site are generally expected to be minor in nature, but some may develop into draining abscesses. Use of remotely delivered vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached. The dart-delivered PZP formulation produced injection-site reactions of varying intensity, though none of the observed reactions appeared debilitating to the animals (Roelle and Ransom 2009) but that was not observed with dart-delivered GonaCon (McCann *et al*. 2017).

Joonè *et al*. (2017a) found that injection site reactions had healed in most mares within 3 months after the booster dose, and that they did not affect movement or cause fever.

Long-lasting 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. Mares treated with one formulation of GnRH-KHL vaccine developed pyogenic abscesses (Goodloe 1991). Miller *et al*. (2008) noted that the water and oil emulsion in GonaCon will often cause cysts, granulomas, or sterile abscesses at injection sites; in some cases, a sterile abscess may develop into a draining abscess. In elk treated with GonaCon, Powers *et al*. (2011) noted up to 35% of treated elk had an abscess form, despite the injection sites first being clipped and swabbed with alcohol. Even in studies where swelling and visible abscesses followed GonaCon immunization, the longer term nodules observed did not appear to change any animal's range of movement or locomotor patterns (Powers *et al*. 2013, Baker *et al*. 2017). The result that other formulations of anti-GnRH vaccine may be associated with less notable injection site reactions in horses may indicate that the adjuvant formulation in GonaCon leads a single dose to cause a stronger immune reaction than the adjuvants used in other anti-GnRH vaccines. Despite that, a booster dose of GonaCon-Equine appears to be more effective than a primer dose alone (Baker *et al*. 2017). Horses injected in the hip with Improvac showed only transient reactions that disappeared within 6 days in one study (Botha *et al*. 2008), but stiffness and swelling that lasted 5 days were noted in another study where horses received Improvac in the neck (Imboden *et al*. 2006). Equity led to transient reactions that resolved within a week in some treated animals (Elhay *et al*. 2007). Donovan *et al*. noted no reactions to the canine anti-GnRH vaccine (2013). In cows treated with Bopriva there was a mildly elevated body temperature and mild swelling at injection sites that subsided within 2 weeks (Balet *et al*. 2014).

<u>Indirect Effects: PZP Vaccines</u>

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

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

Because successful fertility control in a given herd reduces 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 may change a herd's age structure, with a relative increase in the fraction of older animals in the herd. Reducing the numbers of wild horses that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild horses, and thereby could eliminate the need to send additional excess horses from this area to off-range holding corrals or pastures for long-term holding.

A principle motivation for use of contraceptive vaccines or sex ratio manipulation is to reduce population growth rates and maintain herd sizes at AML. Where successful, this should allow for continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse and burro habitat quality, and well-being of animals living on the range. As the population nears or is maintained at the level necessary to achieve a TNEB, vegetation resources would be expected to recover, improving the forage available. With rangeland conditions more closely approaching a TNEB, and with a less concentrated distribution of wild horses and burros across the HMA, there should also be less trailing and concentrated use of water sources. Lower population density should 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. Among mares in the herd that remain fertile, a higher level of physical health and future reproductive success would be expected in areas where lower horse and burro population sizes lead to increases in water and forage resources. While it is conceivable that widespread and continued treatment with fertility control vaccines 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.

Indirect Effects: GnRH Vaccines

As noted above to PZP vaccines, an expected long-term, indirect effect on wild horses treated with fertility control would be an improvement in their overall health. Body condition of anti-GnRH-treated females was equal to or better than that of control females in published studies. Ransom *et al*. (2014b) observed no difference in mean body condition between GonaCon-B treated mares and controls. Goodloe (1991) found that GnRH-KHL treated mares had higher survival rates than untreated controls. In other species, treated deer had better body condition than controls (Gionfriddo *et al*. 2011b), treated cats gained more weight than controls (Levy *et al*. 2011), as did treated young female pigs (Bohrer *et al*. 2014).

Following resumption of fertility, the proportion of mares that conceive and foal could be increased due to their increased fitness; this has been called by some a 'rebound effect.' Elevated fertility rates have been observed after horse gathers and removals (Kirkpatrick and Turner

1991). More research is needed to document and quantify these hypothesized effects. If repeated contraceptive treatment leads to a prolonged contraceptive effect, then that may minimize or delay the hypothesized rebound effect. Selectively applying contraception to older animals and returning them to the HMA could reduce long-term holding costs for such horses, which are difficult to adopt, and could negate the compensatory reproduction that can follow removals (Kirkpatrick and Turner 1991).

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

Reduced population growth rates and smaller population sizes could also allow for continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse habitat quality. As the local horse abundance nears or is maintained at the level necessary to achieve a TNEB, vegetation resources would be expected to recover, improving the forage available to wild horses and wildlife throughout the HMA or HMAs. With rangeland conditions more closely approaching a TNEB, and with a less concentrated distribution of wild horses across the HMA, there should also be less trailing and concentrated use of water sources. Lower population density would be expected to lead to reduced competition among wild horses using the water sources, and less fighting among horses accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild horses. Wild horses would also have to travel less distance back and forth between water and desirable foraging areas. Should GonaCon-Equine treatment, including booster doses, continue into the future, with treatments given on a schedule to maintain a lowered level of fertility in the herd, the chronic cycle of overpopulation and large gathers and removals might no longer occur, but instead a consistent abundance of wild horses could be maintained, resulting in continued improvement of overall habitat conditions and animal health. While it is conceivable that widespread and continued treatment with GonaCon-Equine could reduce the birth rates of the population to such a point that birth is consistently below mortality, that outcome is not likely unless a very high fraction of the mares present are all treated with primer and booster doses, and perhaps repeated booster doses.

<u>Behavioral Effects: PZP Vaccines</u>

Behavioral difference, compared to mares that are fertile, should be considered as potential results of successful contraception. The NAS report (2013) noted that all forms of fertility suppression have effects on mare behavior, mostly because of the lack of pregnancy and foaling, and concluded that fertility control vaccines were among the most promising fertility control methods for wild horses and burros. The resulting impacts may be seen as neutral in the sense that a wide range of natural behaviors is already observable in untreated wild horses, or mildly adverse in the sense that effects are expected to be transient and to not affect all treated animals.

PZP vaccine-treated mares may continue estrus cycles throughout the breeding season. Ransom and Cade (2009) delineated wild horse behaviors. Ransom *et al.* (2010) found no differences in how PZP-treated and untreated mares allocated their time between feeding, resting, travel, maintenance, and most social behaviors in three populations of wild horses, which is consistent with Powell's (1999) findings in another population. Likewise, body condition of PZP-treated and control mares did not differ between treatment groups in Ransom *et al.*'s (2010) study. Nuñez (2010) found that PZP-treated mares had higher body condition than control mares in another population, presumably because energy expenditure was reduced by the absence of pregnancy and lactation. Knight (2014) found that PZP-treated mares had better body condition, lived longer and switched harems more frequently, while mares that foaled spent more time concentrating on grazing and lactation and had lower overall body condition.

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

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

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

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

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

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

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

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

<u>Behavioral Effects: GnRH Vaccines</u>

The result that GonaCon treated mares may have suppressed estrous cycles throughout the breeding season can lead treated mares to behave in ways that are functionally similar to pregnant mares. Where it is successful in mares, GonaCon and other anti-GnRH vaccines are expected to induce fewer estrous cycles when compared to non-pregnant control mares. This has been observed in many studies (Garza *et al*. 1986, Curtis *et al*. 2001, Dalin *et al*. 2002, Killian *et al*. 2006, Dalmau *et al*. 2015). Females treated with GonaCon had fewer estrous cycles than control or PZP-treated mares (Killian *et al*. 2006) or deer (Curtis *et al*. 2001). Thus, any concerns about PZP treated mares receiving more courting and breeding behaviors from stallions (Nuñez *et al*. 2009, Ransom *et al*. 2010) are not generally expected to be a concern for mares treated with anti-GnRH vaccines (Botha *et al*. 2008).

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

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

With respect to treatment with GonaCon or other anti-GnRH vaccines, it is probably less likely that treated mares will switch harems at higher rates than untreated animals, because treated mares are similar to pregnant mares in their behaviors (Ransom *et al*. 2014b). Indeed, Gray *et al*. (2009a) found no difference in band fidelity in a free-roaming population of horses with GonaCon treated mares, despite differences in foal production between treated and untreated mares. Ransom *et al*. (2014b) actually found increased levels of band fidelity after treatment, though this may have been partially a result of changes in overall horse density and forage availability.

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

Genetic Effects of Fertility Control Vaccines

In HMAs where large numbers of wild horses have recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses, contraception is not expected to cause an unacceptable loss of genetic diversity or an unacceptable increase in the inbreeding coefficient. In any diploid population, the loss of genetic diversity through inbreeding or drift can be prevented by large effective breeding population sizes (Wright 1931) or by introducing new potential breeding animals (Mills and Allendorf 1996). The NAS 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 alleviated 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 (NAS 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with admixtures from domestic breeds. As a result, in most HMAs, applying fertility control to a subset of mares is not expected to cause irreparable loss of genetic diversity. Improved longevity and an aging population are expected results of contraceptive treatment that can provide for lengthening generation time; this result would be expected to slow the rate of genetic diversity loss (Hailer *et al*. 2006). Based on a population model, Gross (2000) found that a strategy to preferentially treat young animals with a contraceptive led to more genetic diversity being retained than either a strategy that preferentially treats older animals, or a strategy with periodic gathers and removals.

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

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

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

BLM is not aware of any studies that have quantified the heritability of a lack of response to immunocontraception such as PZP vaccine or GonaCon-Equine in horses or burros. 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 National Park, and Pryor Mountains Herd Management Area), 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, and is not expected to be used in the type of widespread or prolonged manner that might be required to cause a detectable evolutionary response.

Sex Ratio Manipulation

Skewing the sex ratio of a herd so that there are more males than females is an established BLM management technique for reducing population growth rates. As part of a wild horse and burro gather process, the number of animals returned to the range may include more males, the number removed from the range may include more females, or both. By reducing the proportion of breeding females in a population (as a fraction of the total number of animals present), the technique leads to fewer foals being born, and relative to the total herd size.

Sex ratio is typically adjusted in such a way that 60 percent of the horses are male. In the absence of other fertility control treatments, this 60:40 sex ratio can temporarily reduce population growth rates from approximately 20% to approximately 15% (Bartholow 2004). While such a decrease in growth rate may not appear to be large or long-lasting, the net result can be that fewer foals being born, at least for a few years – this can extend the time between gathers, and reduce impacts on-range, and costs off-range. Any impacts of sex ratio manipulation are expected to be temporary because the sex ratio of wild horse and burro foals at birth is approximately equal between males and females (NAS 2013), and it is common for female foals to reproduce by their second year (NAS 2013). Thus, within a few years after a gather and selective removal that leads to more males than females, the sex ratio of reproducing wild horses and burros will be returning toward a 50:50 ratio.

Having a larger number of males than females is expected to lead to several demographic and behavioral changes as noted in the NAS report (2013), including the following. Having more fertile males than females should not alter the fecundity of fertile females. Wild mares may be distributed in a larger number of smaller harems. Competition and aggression between males may cause a decline in male body condition. Female foraging may be somewhat disrupted by elevated male-male aggression. With a greater number of males available to choose from, females may have opportunities to select more genetically fit sires. There would also be an increase the genetic effective population size because more stallions would be breeding and existing females would be distributed among many more small harems. This last beneficial impact is one reason that skewing the sex ratio to favor males is listed in the BLM wild horse and burro handbook (BLM 2010) as a method to consider in herds where there may be concern about the loss of genetic diversity; having more males fosters a greater retention of genetic diversity.

Infanticide is a natural behavior that has been observed in wild equids (Feh and Munktuya 2008, Gray 2009), but there are no published accounts of infanticide rates increasing as a result of having a skewed sex ratio in wild horse or wild burro herds. Any comment that implies such an impact would be speculative.

The BLM wild horse and burro management handbook (BLM 2010) discusses this method. The handbook acknowledges that there may be some behavioral impacts of having more males than females. The handbook includes guidelines for when the method should be applied, specifying that this method should be considered where the low end of the AML is 150 animals or greater, and with the result that males comprise 60-70 percent of the herd. Having more than 70 percent males may result in unacceptable impacts in terms of elevated male-male aggression. In NEPA analyses, BLM has abided by these guidelines, for example:

In the 2015 Cold Springs HMA Population Management Plan EA (DOI-BLM-V040-2015-022), the low end of AML was 75. Under the preferred alternative, 37 mares and 38 stallions would remain on the HMA. This is well below the 150 head threshold noted above.

In the 2017 Stinkingwater HMA Population Management Plan EA (DOI-BLM-ORWA-B050-2017-0002-EA), BLM clearly identified that sex ratio skewing was not appropriate because the herd size was only 40 animals.

It is relatively straightforward to speed the return of skewed sex ratios back to a 50:50 ratio. The BLM wild horse and burro handbook (BLM 2010) specifies that, if post-treatment monitoring reveals negative impacts to breeding harems due to sex ratio manipulation, then mitigation measures could include removing males, not introducing additional males, or releasing a larger proportion of females during the next gather.

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Appendix I, Standard Operating Procedures for Field Castration (Neutering)

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

<u>Pre-surgery Animal Selection, Handling and Care</u>

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

Neutering Procedure

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

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

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

Selected stallions would be shipped to the facility, gelded, and returned to the range within 30 days. Gelded animals would be monitored periodically for complications for approximately 7-10 days following release. This monitoring may be completed either through aerial reconnaissance, if available, or field observations from major roads and trails. The goal of this monitoring is to detect complications if they are occurring and determine if the horses are freely moving about the HMA. All adults would have been freeze-marked at the first gather with a digit freeze mark number high on their hip to facilitate post-treatment and routine field monitoring. Post-gather monitoring would be used to document whether or not geldings form bachelor bands or intermix with the breeding population as expected. Other periodic observations of the long-term outcomes of neutering would be recorded during routine resource monitoring work. Such observations would include but not be limited to band size, social interactions with other geldings and harem bands, distribution, forage utilization and activities around key water sources. Periodic population inventories and future gather statistics would assist BLM to determine if managing a portion of the herd as non-breeding animals is an effective approach to slowing the annual population growth rate by replacing breeding males with sterilized animals, and thereby extending the gather cycle when used in conjunction with other population control techniques.

Appendix J, Literature Review Effects of Spaying and Gelding/Neutering[14]

Various forms of fertility control can be used in wild horses and wild burros, with the goals of maintaining herds at or near AML, reducing fertility rates, and reducing the frequency of gathers and removals. The WFRHBA of 1971 specifically provides for contraception and sterilization (16 U.S.C. 1333 section 3.b.1). Fertility control measures have been shown to be a cost-effective and humane treatment to slow increases in wild horse populations or, when used in combination with gathers, to reduce horse population size (Bartholow 2004, de Seve and Boyles-Griffin 2013, Fonner and Bohara 2017). Population growth suppression becomes less expensive if fertility control is long-lasting (Hobbs *et al*. 2000), such as with spaying and neutering. In this review, 'spaying' is defined to be the sterilization of a female horse (mare) or burro (jenny). Usually this is accomplished by removal of the ovaries, but other methods such as tubal ligation that lead to sterility may also be considered a form of spaying. Unlike in dog and cat spaying, spaying a horse or burro does not entail removal of the uterus. Here, 'neutering' is defined to be the sterilization of a male horse (stallion) or burro (jack), either by removal of the testicles (castration, also known as gelding/) or by vasectomy, where the testicles are retained but no sperm leave the body by severing or blocking the vas deferens or epididymis.

In the context of BLM wild horse and burro management, spaying and neutering are successful to the extent that they reduce the number of reproducing females. By definition, spaying females is 100% effective as a fertility control method for that female. Neutering males can be effective in one of two ways. First, neutered males may continue to guard fertile females, preventing the females from breeding with fertile males. Second, if neutered males are included in a herd that has a high male-to-female sex ratio, then the neutered males may comprise some of the animals within the appropriate management level (AML) of that herd, which would effectively reduce the number of females in the herd. Although these and other fertility control treatments may be associated with a number of potential physiological, behavioral, demographic, and genetic effects, those impacts are generally minor and transient, do not prevent overall maintenance of a self-sustaining population, and do not generally outweigh the potential benefits of using contraceptive treatments in situations where it is a management goal to reduce population growth rates (Garrott and Oli 2013).

Peer-reviewed scientific literature details the expected impacts of spay and neuter methods on wild horses and burros. No finding of excess animals is required for BLM to pursue sterilization in wild horses or wild burros, but NEPA analysis has been required. The Verification Report details some of the many NEPA analyses related to projects with fertility control, but this review focuses on peer-reviewed scientific literature. The summary that follows first examines effects of spay use in females, then neuter use in males. This review does not examine effects of fertility control vaccines. Cited studies are generally limited to those involving horses and burros, except where including studies on other species helps in making inferences about physiological or behavioral questions not yet addressed in horses or burros specifically. While most studies reviewed here refer to horses, burros are extremely similar in terms of physiology, such that expected effects are comparable, except where differences between the species are noted.

[14] In this appendix the terms gelding, castration, and neutering are consistent with how they are represented in the literature cited. This language is different than language used within the body of the EA and appendices; where all castration and gelding procedures are noted as neutering and gelding; which are used to describe stallions who have been neutered. In this appendix, gelding is used to describe the neutering procedure as well as individuals who have undergone a neutering procedure. Castration is used to describe a specific male neutering procedure.

On the whole, the identified impacts at the herd level are generally transient. The principle impact to individuals treated is sterility, which is the intended outcome. Sterilization that affects individual horses and burros does not prevent BLM from ensuring that there will be self-sustaining populations of wild horses and burros in single herd management areas (HMAs), in complexes of HMAs, and at regional scales of multiple HMAs and complexes. Under the WFRHBA of 1971, BLM is charged with maintaining self-reproducing populations of wild horses and burros. The National Academies of Sciences (2013) encouraged BLM to manage wild horses and burros at the spatial scale of "metapopulations" – that is, across multiple HMAs and complexes in a region. In fact, many HMAs have historical and ongoing genetic and demographic connections with other HMAs, and BLM routinely moves animals from one to another to improve local herd traits and maintain high genetic diversity.

Discussions about herds that are 'non-reproducing' in whole or in part are in the context of this 'metapopulation' structure, where self-sustaining herds are not necessarily at the scale of single HMAs. So long as the definition of what constitutes a self-sustaining herd includes the larger set of HMAs that have past or ongoing demographic and genetic connections – as is recommended by the NAS 2013 report – it is clear that single HMAs can be managed as non-reproducing in whole or in part while still allowing for a self-sustaining population of wild horses or burros at the broader spatial scale. Wild horses are not an endangered species (USFWS 2015), nor are they rare. Nearly 67,000 adult wild horses and nearly 15,000 adult wild burros roam BLM lands as of March 1, 2018, and those numbers do not include at least 10,000 WH&B on US Forest Service lands, and at least 50,000 feral horses on tribal lands in the Western United States.

All fertility control methods affect the behavior and physiology of treated animals (NAS 2013), and are associated with potential risks and benefits, including effects of handling, frequency of handling, physiological effects, behavioral effects, and reduced population growth rates (Hampton *et al*. 2015). Contraception methods alone do not remove excess horses from an HMA's population, so one or more gathers are usually needed in order to bring the herd down to a level close to AML. Horses are long-lived, potentially reaching 20 years of age or more in the wild. Except in cases where extremely high fractions of mares are rendered infertile over long time periods of (i.e, 10 or more years), spaying and neutering are not very effective at reducing population growth rates to the point where births equal deaths in a herd. However, even modest levels of fertility control activities can reduce the frequency of horse gather activities, and costs to taxpayers. Population growth suppression becomes less expensive if fertility control is long-lasting (Hobbs *et al*. 2000), such as with spaying and neutering. Because spaying and neutering animals requires capturing and handling, the risks and costs associated with capture and handling of horses may be comparable to those of gathering for removal, but with expectedly lower adoption and long-term holding costs.

<u>Effects of Handling and Marking</u>

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

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

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

Intensive observational studies are not typically part of management goals (with the exception of projects such as the Conger & Frisco HMA gather plan and research study, UT-W020-2015-0017-EA) but if the goal is to detect complications from spaying and neutering on the range, then casual observation may help BLM determine if they are occurring. Observations of the long term outcomes of spaying and neutering may be recorded during routine resource monitoring work. Such observations could include but not be limited to band size, social interactions with other geldings and harem bands, distribution within their habitat, forage utilization and activities around key water sources. Periodic population inventories and future gather statistics could provide additional anecdotal information about how logistically effective it is to manage a portion of the herd as non-breeding animals.

<u>Neutering Males</u>

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

Including a portion of neutered males in a herd can lead to a reduced population-level per-capita growth rate so long as the neutered males take some of the places that would otherwise be occupied by fertile females. By having a skewed sex ratio with fewer females than males (fertile stallions plus neutered males), the result will be that there will be a lower number of breeding females in the population. Including neutered males in herd management is not new for BLM and federal land management. Geldings have been released on BLM lands as a part of herd management in the Barren Valley complex in Oregon (BLM 2011), the Challis HMA in Idaho (BLM 2012), and the Conger HMA in Utah (BLM 2016b). Vasectomized males and geldings were also included in US Fish and Wildlife Service management plans for the Sheldon National Wildlife Refuge that relied on sterilization and removals (Collins and Kasbohm 2016). Taking into consideration the literature available at the time, the National Academies of Sciences concluded in their 2013 report that a form of vasectomy was one of the three most promising methods for WH&B fertility control (NAS 2013).

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

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

<u>Direct Effects of Neutering</u>

No animals which appear to be distressed, injured, or in poor health or condition would be selected for gelding. Stallions would not typically be neutered within 72 hours of capture. The surgery would be performed by a veterinarian using general anesthesia and appropriate surgical techniques. The final determination of which specific animals would be gelded would be based on the professional opinion of the attending veterinarian in consultation with the Authorized Officer (i.e., refer to the SOPs for neutering in the Antelope / Triple B gather EA, DOI-BLM-NV-E030-2017-010-EA).

Though neutering is a common surgical procedure, especially gelding, some level of minor complications after surgery may be expected (Getman 2009), and it is not always possible to predict when postoperative complications would occur. Fortunately, the most common complications are almost always self-limiting, resolving with time and exercise. Individual impacts to the stallions during and following the gelding process should be minimal and would mostly involve localized swelling and bleeding. Complications may include, but are not limited to: minor bleeding, swelling, inflammation, edema, infection, peritonitis, hydrocele, penile damage, excessive hemorrhage, and eventration (Schumacher 1996, Searle *et al*. 1999, Getman 2009). A small amount of bleeding is normal and generally subsides quickly, within 2-4 hours following the procedure. Some degree of swelling is normal, including swelling of the prepuce and scrotum, usually peaking between 3-6 days after surgery (Searle *et al*. 1999). Swelling should be minimized through the daily movements (exercise) of the horse during travel to and from foraging and watering areas. Most cases of minor swelling should be back to normal within 5-7 days, more serious cases of moderate to severe swelling are also self-limiting and are expected to resolve with exercise after one to 2 weeks. Older horses are reported to be at greater risk of post-operative edema, but daily exercise can prevent premature closure of the incision, and prevent fluid buildup (Getman 2009). In some cases, a hydrocele (accumulation of sterile fluid) may develop over months or years (Searle *et al*. 1999). Serious complications (eventration, anesthetic reaction, injuries during handling, etc.) that result in euthanasia or mortality during and following surgery are rare (e.g., eventration rate of 0.2% to 2.6% noted in Getman 2009, but eventration rate of 4.8% noted in Shoemaker *et al*. 2004) and vary according to the population of horses being treated (Getman 2009). Normally one would expect serious complications in less than 5% of horses operated under general anesthesia, but in some populations these rates have been as high as 12% (Shoemaker 2004). Serious complications are generally noted within 3 or 4 hours of surgery but may occur any time within the first week following surgery (Searle *et al*. 1999). If they occur, they would be treated with surgical intervention when possible, or with euthanasia when there is a poor prognosis for recovery. Vasectomized stallions may remain fertile for up to 6 weeks after surgery, so it is optimal if that treatment occurs well in advance of the season of mare fertility starting in the spring (NAS 2013). The NAS report (2013) suggested that chemical vasectomy, which has been developed for dogs and cats, may be appropriate for wild horses and burros.

For intact stallions, testosterone levels appear to vary as a function of age, season, and harem size (Khalil *et al* 1998). It is expected that testosterone levels will decline over time after castration. Testosterone levels should not change due to vasectomy. Vasectomized stallions should retain their previous levels of libido. Domestic geldings had a significant prolactin response to sexual stimulation, but lacked the cortisol response present in stallions (Colborn *et al*. 1991). Although libido and the ability to ejaculate tends to be gradually lost after castration (Thompson *et al*. 1980), some geldings continue to mount mares and intromit (Rios and Houpt 1995, Schumacher 2006).

Indirect Effects of Neutering

Other than the short-term outcomes of surgery, neutering is not expected to reduce males' survival rates. Castration is actually thought to increase survival as males are released from the cost of reproduction (Jewell 1997). In Soay sheep castrates survived longer than rams in the same cohort (Jewell 1997), and Misaki horse geldings lived longer than intact males (Kaseda *et al*. 1997, Khalil and Murakami 1999). Moreover, it is unlikely that a reduced testosterone level will compromise gelding survival in the wild, considering that wild mares survive with low levels of testosterone. Consistent with geldings not expending as much energy toward in attempts to obtain or defend a harem, it is expected that wild geldings may have a better body condition that wild, fertile stallions. In contrast, vasectomized males may continue to defend or compete for harems in the way that fertile males do, so they are not expected to experience an increase in health or body condition due to surgery.

Depending on whether an HMA is non-reproducing in whole or in part, reproductive stallions may or may not still be a component of the population's age and sex structure. The question of whether or not a given neutered male would or would not attempt to maintain a harem is not germane to population-level management. It is worth noting, though, that the BLM is not required to manage populations of wild horses in a manner that ensures that any given individual maintains its social standing within any given harem or band. Neutering a subset of stallions would not prevent other fertile stallions and mares from continuing with the typical range of social behaviors for sexually active adults. For fertility control strategies where gelding is intended to reduce growth rates by virtue of sterile males defending harems, the NAS (2013) suggested that the effectiveness of gelding on overall reproductive rates may depend on the pre-castration social roles of those animals. Having a post-gather herd with some neutered males and a lower fraction of fertile mares necessarily reduces the absolute number of foals born per year, compared to a herd that includes more fertile mares. An additional benefit is that geldings that would otherwise be permanently removed from the range (for adoption, sale or other disposition) may be released back onto the range where they can engage in free-roaming behaviors.

Behavioral Effects of Neutering

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

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

Vasectomized males continue to attempt to defend or gain breeding access to females. It is generally expected that vasectomized WH&B will continue to behave like fertile males, given that the only physiological change in their condition is a lack of sperm in their ejaculate. If a vasectomized stallion retains a harem, the females in the harem will continue to cycle until they are fertilized by another stallion, or until the end of the breeding season. As a result, the vasectomized stallion may be involved in more aggressive behaviors to other males through the entire breeding season (Asa 1999), which may divert time from foraging and cause him to be in poorer body condition going into winter. Ultimately, this may lead to the stallion losing control of a given harem. A feral horse herd with high numbers of vasectomized stallions retained typical harem social structure (Collins and Kasbohm 2016). Again it is worth noting that the BLM is not required to manage populations of wild horses in a manner that ensures that any given individual maintains its social standing within any given harem or band.

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

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

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

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

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

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

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

<u>Spaying</u>

Spaying mares by removing a mares ovaries, via colpotomy, has been an established veterinary technique since 1903 (Loesch and Rodgerson 2003, NAS 2013). Spaying via colpotomy has the advantage of not leaving any external wound that could become infected. For this reason, it has been identified as a good choice for sterilization of feral or wild mares (Rowland *et al*. 2018). The procedure has a relatively low complication rate, although post-surgical mortality and morbidity are possible, as with any surgery. Herd-level birth rate is expected to decline in direct proportion to the fraction of spayed mares in the herd because spayed mares cannot become pregnant. Spaying mares has already been shown to be an effective part of feral horse management that reduced herd growth rates on federal lands (Collins and Kasbohm 2016).

Current Methods of Spaying

This literature review of spay impacts focuses on 2 methods: flank laparoscopy, and colpotomy. The anticipated effects of the spay treatment are both physical and behavioral. Physical effects would be due to post-surgical healing and the possibility for complications.

Colpotomy is a surgical technique in which there is no external incision, reducing susceptibility to infection. For this reason, ovariectomy via colpotomy has been identified as a good choice for feral or wild horses (Rowland *et al*. 2018). Ovariectomy via colpotomy is a relatively short surgery, with a relatively quick expected recovery time. In 1903, Williams first described a vaginal approach, or colpotomy, using an ecraseur to ovariectomize mares (Loesch and Rodgerson 2003). The ovariectomy via colpotomy procedure has been conducted for over 100 years, normally on open (non-pregnant), domestic mares. It is expected that the surgeon should be able to access ovaries with ease in mares that are in the early- or mid-stage of pregnancy. The anticipated risks associated with the pregnancy are described below. When wild horses are gathered or trapped for fertility control treatment there would likely be mares in various stages of gestation. Removal of the ovaries is permanent and 100 percent effective, however the procedure is not without risk. The proposed alternative would allow for researchers to quantify the outcomes of using ovariectomy via colpotomy for mares that are in various gestational stages. The proposed alternative would also allow researchers to record in detail and test for any behavioral effects on the range.

Flank laparoscopy (Lee and Hendrickson 2008) is commonly used in domestic horses for application in mares due to its minimal invasiveness and full observation of the operative field. Ovariectomy via flank laparoscopy was seen as the lowest risk method considered by a panel of expert reviewers convened by USGS (Bowen 2015). In a review of unilateral and bilateral laparoscopic ovariectomy on 157 mares, Röcken *et al*. (2011) found that 10.8% of mares had minor post-surgical complications, and recorded no mortality. Mortality due to this type of surgery, or post-surgical complications, is not expected, but is a possibility. In two studies, ovariectomy by laparoscopy or endoscope-assisted colpotomy did not cause mares to lose weight, and there was no need for rescue analgesia following surgery (Pader *et al*. 2011, Bertin *et al*. 2013). This surgical approach entails three small incisions on the animal's flank, through which three cannulae (tubes) allow entry of narrow devices to enter the body cavity: these are the insufflator, endoscope, and surgical instrument. The surgical procedure involves the use of narrow instruments introduced into the abdomen via cannulas for the purpose of transecting the ovarian pedicle, but the insufflation should allow the veterinarian to navigate inside the abdomen without damaging other internal organs. The insufflator blows air into the cavity to increase the operating space between organs, and the endoscope provides a video feed to visualize the operation of the surgical instrument. This procedure can require a relatively long duration of surgery, but tends to lead to the lowest post-operative rates of complications. Flank laparoscopy may leave three small (<5 cm) visible scars on one side of the horse's flank, but even in performance horses these scars are considered minimal. 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. Monitoring for up to two weeks at the facility where surgeries take place will allow for veterinary inspection of wound healing. The ovaries may be dropped into the abdomen, but this is not expected to cause any health problem; it is usually done in ovariectomies in cattle (e.g., the Willis Dropped Ovary Technique) and Shoemaker *et al*.

(2014) found no problems with revascularization or necrosis in a study of young horses using this method.

Effects of Spaying on Pregnancy and Foal

The average mare gestation period ranges from 335 to 340 days (Evans *et al*. 1977, p. 373). There are few peer reviewed studies documenting the effects of ovariectomy on the success of pregnancy in a mare. A National Research Council of the National Academies of Sciences (NAS) committee that reviewed research proposals in 2015 explained, “The mare’s ovaries and their production of progesterone are required during the first 70 days of pregnancy to maintain the pregnancy” (NAS 2015). In female mammals, less progesterone is produced when ovaries are removed, but production does not cease (Webley and Johnson 1982). In 1977, Evans *et al*. stated that by 200 days, the secretion of progesterone by the corpora lutea is insignificant because removal of the ovaries does not result in abortion (p. 376). “If this procedure were performed in the first 120 days of pregnancy, the fetus would be resorbed or aborted by the mother. If performed after 120 days, the pregnancy should be maintained. The effect of ovary removal on a pregnancy at 90–120 days of gestation is unpredictable because it is during this stage of gestation that the transition from corpus luteum to placental support typically occurs” (NAS 2015). In 1979, Holtan *et al*. evaluated the effects of bilateral ovariectomy at selected times between 25 and 210 days of gestation on 50 mature pony mares. Their results show that abortion (resorption) of the conceptus (fetus) occurred in all 14 mares ovariectomized before day 50 of gestation, that pregnancy was maintained in 11 of 20 mares after ovariectomy between days 50 and 70, and that pregnancy was not interrupted in any of 12 mares ovariectomized on days 140 to 210. Those results are similar to the suggestions of the NAS committee (2015).

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

Direct Effects of Spaying

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

During the Sheldon NWR ovariectomy study, mares generally walked out of the chute and started to eat; some would raise their tail and act as if they were defecating; however, in most mares one could not notice signs of discomfort (Bowen 2015). In their discussion of ovariectomy via colpotomy, McKinnon and Vasey (2007) considered the procedure safe and efficacious in many instances, able to be performed expediently by personnel experienced with examination of the female reproductive tract, and associated with a complication rate that is similar to or less than male castration. Nevertheless, all surgery is associated with some risk. Loesch *et al*. (2003) lists that following potential risks with colpotomy: pain and discomfort; injuries to the cervix, bladder, or a segment of bowel; delayed vaginal healing; eventration of the bowel; incisional site hematoma; intraabdominal adhesions to the vagina; and chronic lumbar or bilateral hind limb pain. Most horses, however, tolerate ovariectomy via colpotomy with very few complications, including feral horses (Collins and Kasbohm 2016). Evisceration is also a possibility, but these complications are considered rare (Prado and Schumacher, 2017). Mortality due to surgery or post-surgical complications is not anticipated, but it is a possibility and therefore every effort would be made to mitigate risks.

In September 2015, the BLM solicited the USGS to convene a panel of veterinary experts to assess the relative merits and drawbacks of several surgical ovariectomy techniques that are commonly used in domestic horses for potential application in wild horses. A table summarizing the various methods was sent to the BLM (Bowen 2015) and provides a concise comparison of several methods. Of these, ovariectomy via colpotomy was found to be relatively safe when practiced by an experienced surgeon and was associated with the shortest duration of potential complications after the operation. The panel discussed the potential for evisceration through the vaginal incision with this procedure. In marked contrast to a suggestion by the NAS report (2013), this panel of veterinarians 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" (Bowen 2015).

Most spay surgeries on mares have low morbidity 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 surgical protocols that would be used, 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, as is compatible with accepted animal husbandry practices. In a study of the effects of bilateral ovariectomy via colpotomy on 23 mares, Hooper and others (1993) reported that postoperative problems were minimal (1 in 23, or 4%). Hooper *et al*. (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 *et al*. (2011) noted a morbidity of 10.8% 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% complication rate where one mare of 39 showed signs of moderate colic after laparoscopic ovariectomy (Devick 2018 personal communication).

Behavioral Effects of Spaying

No fertility control method exists that does not affect physiology or behavior of a mare (NAS 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*. 2014). The health and behavioral effects of spaying wild horse mares that live with other fertile and infertile wild horses has not been well documented, but the literature review below can be used to make reasonable inferences about their likely behaviors.

Horses are anovulatory (do not ovulate/express estrous behavior) during the short days of late fall and early winter, beginning to ovulate as days lengthen and then cycling roughly every 21 days during the warmer months, with about 5 days of estrus (Asa *et al*. 1979, Crowell-Davis 2007). Estrus in mares is shown by increased frequency of proceptive behaviors: approaching and following the stallion, urinating, presenting the rear end, clitoral winking, and raising the tail towards the stallion (Asa *et al*. 1979, Crowell-Davis 2007). In most mammal species other than primates estrus behavior is not shown during the anovulatory period, and reproductive behavior is considered extinguished following spaying (Hart and Eckstein 1997). However mares may continue to demonstrate estrus behavior during the anovulatory period (Asa *et al*. 1980). Similarly, ovariectomized mares may also continue to exhibit estrous behavior (Scott and Kunze 1977, Kamm and Hendrickson 2007, Crabtree 2016), with one study finding that 30% of mares showed estrus signs at least once after surgery (Roessner *et al* 2015) and only 60 percent of ovariectomized mares cease estrous behavior following surgery (Loesch and Rodgerson 2003). Mares continue to show reproductive behavior following ovariectomy due to non-endocrine support of estrus behavior, specifically steroids from the adrenal cortex. Continuation of this behavior during the non-breeding season has the function of maintaining social cohesion within a horse group (Asa *et al*. 1980, Asa *et al*. 1984, NAS 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 levels in ovariectomized mares were similar to intact mares during the anestrous season, and during the breeding season were similar to levels in intact mares at mid-estrus (Garcia and Ginther 1976).

The likely effects of spaying on mares' social interactions and group membership can be inferred from available literature, even though wild horses have rarely been spayed and released back into the wild, resulting in few studies that have investigated their behavior in free-roaming populations. Wild horses and burros are instinctually herd-bound and this behavior is expected to continue. However, no study has documented the rate at which spayed mares will continue to remain with the stallion and band from which the mare was most recently attached. Overall the BLM anticipates that some spayed mares may continue to exhibit estrus behavior which 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 (NAS 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 on to 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 NAS (2013), the ideal fertility control method would not eliminate sexual behavior or change social structure substantially.

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

BLM expects that wild horse harem 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.

'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 spayed 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.

Indirect Effects of Spaying

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 a HMA (BLM H-4700-1, 2010) and there are no permanent physical barriers being proposed. However, the study would document the movement patterns of both herd segments to determine any difference in use areas and distances travelled.

In domestic animals, spaying is often associated with weight gain and associated increase in body fat (Fettman *et al* 1997, Becket *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 & 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 that 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). In wild horses the quality and quantity of forage is unlikely to be sufficient to promote over-eating and obesity.

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

The likely effects of spaying on mares' home range and habitat use can also be surmised from available literature. Bands of horses tend to have distinct home ranges, varying in size depending on the habitat and varying by season, but always including a water source, forage, and places where horses can shelter from inclement weather or insects (King and Gurnell 2005). It is unlikely that spayed mares will change their spatial ecology, but being emancipated from constraints of lactation may mean they can spend more time away from water sources and increase their home range size. Lactating mares need to drink every day, but during the winter when snow can fulfill water needs or when not lactating, horses can traverse a wider area (Feist & McCullough 1976, Salter 1979). During multiple aerial surveys in years following the mare ovariectomy study at the Sheldon NWR, it was documented that all treated individuals appeared to maintain group associations, no groups consisted only of treated females, and none of the solitary animals observed were treated females (Collins and Kasbohm 2016). Since treated females maintained group associations, this indicates that their movement patterns and distances may be unchanged.

Spaying wild horses does not change their status as wild horses under the WFRHBA (as amended). In terms of whether spayed mares would continue to exhibit the free-roaming behavior that defines wild horses, BLM does expect that spayed mares would continue to roam unhindered in the Warm Springs HMA where this action would take place. Wild horse movements may be motivated by a number of biological impulses, including the search for forage, water, and social companionship that is not of a sexual nature. As such, a spayed animal would still be expected to have a number of internal reasons for moving across a landscape and, therefore, exhibiting 'free-roaming' behavior. Despite marginal uncertainty about subtle aspects of potential changes in habitat preference, there is no expectation that spaying wild horses will cause them to lose their free-roaming nature.

In this sense, a spayed wild mare would be just as much 'wild' as defined by the WFRHBA as any fertile wild mare, even if her patterns of movement differ slightly. Congress specified that sterilization is an acceptable management action (16 USC §1333.b.1). Sterilization is not one of the clearly defined events that cause an animal to lose its status as a wild free-roaming horse (16 USC §1333.2.C.d). Any opinions based on a semantic and subjective definition of what constitutes a 'wild' horse are not legally binding for BLM, which must adhere to the legal definition of what constitutes a wild free-roaming horse , based on the WFRHBA (as amended). BLM is not obliged to base management decisions on personal opinions, which do not meet the BLM's principle and practice to "Use the best available scientific knowledge relevant to the problem or decision being addressed, relying on peer reviewed literature when it exists" (Kitchell *et al*. 2015).

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.

<u>Effects of Spaying on Bone Histology</u>

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 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 ratesin 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, 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, Colorado State University Emeritus, written comm., 2015). Dr. Turner indicated that an estrogen deficiency (no ovaries) could potentially affect a horse’s bone metabolism, just as it does in sheep and human females when they lead a sedentary lifestyle, but indicated that the constant weight bearing exercise, coupled with high exposure to sunlight ensuring high vitamin D levels, are expected to prevent bone density loss (Simon Turner, Colorado State University 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, Colorado State University 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.

<u>Genetic Effects of Spaying and Neutering</u>

It is true that spayed females and neutered males are unable to contribute to the genetic diversity of the herd. BLM is not obligated to ensure that any given individual in a herd has the chance to sire a foal and pass on genetic material. Management practices in the BLM Wild Horse and Burro Handbook (2010) include measures to increase population genetic diversity in reproducing herds where monitoring reveals a cause for concern about low levels of observed heterozygosity. These measures include increasing the sex ratio to a greater percentage of fertile males than fertile females (and thereby increasing the number of males siring foals), and bringing new animals into a herd from elsewhere.

In herds that are managed to be non-reproducing, it is not a concern to maintain genetic diversity because the management goal would be that animals in such a herd would not breed.

In reproducing herds where large numbers of wild horses have recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses, spaying and neutering 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 NAS 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. It is worth noting that, although maintenance of genetic diversity at the scale of the overall population of wild horses is an intuitive management goal, there are no existing laws or policies that require BLM to maintain genetic diversity at the scale of the individual herd management area or complex. Also, there is no Bureau-wide policy that requires BLM to allow each female in a herd to reproduce before she is treated with contraceptives. Introducing 1-2 mares every generation (about every 10 years) is a standard management technique that can alleviated potential inbreeding concerns (BLM 2010). The NAS report (2013) recommended that managed herds of wild horses would be better viewed as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements.

In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM. 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.

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 (NAS 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with admixtures from domestic breeds. As a result, in most HMAs, applying fertility control to a subset of mares is not expected to cause irreparable loss of genetic diversity. Improved longevity and an aging population are expected results of contraceptive treatment that can provide for lengthening generation time; this result would be expected to slow the rate of genetic diversity loss (Hailer *et al*. 2006). Based on a population model, Gross (2000) found that a strategy to preferentially treat young animals with a contraceptive led to more genetic diversity being retained than either a strategy that preferentially treats older animals, or a strategy with periodic gathers and removals.

Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity, in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Although those results are specific to mares, some inferences about potential effects of stallion sterilization may also be made from their results. Roelle and Oyler-McCance (2015) showed that the risk of the loss of genetic heterozygosity is extremely low except in cases where all of the following conditions are met: starting levels of genetic diversity are low, initial population size is 100 or less, the intrinsic population growth rate is low (5% per year), and very large fractions of the population are permanently sterilized. Given that 94 of 102 wild horse herds sampled for genetic diversity did not meet a threshold for concern (NAS 2013), the starting level of genetic diversity in most wild horse herds is relatively high.

In a breeding herd where more than 85% of males in a population are sterile, there could be genetic consequences of reduced heterozygosity and increased inbreeding coefficients, as it would potentially allow a very small group of males to dominate the breeding (e.g., Saltz *et al*. 2000). Such genetic consequences could be mitigated by natural movements or human-facilitated translocations (BLM 2010). Garrott and Siniff's (1992) model predicts that gelding 50-80% of mature males in the population would result in reduced, but not halted, mare fertility rates. However, neutering males tends to have short-lived effects, because within a few years after any male sterilization treatment, a number of fertile male colts would become sexually mature stallions who could contribute genetically to the herd.

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Appendix K, Standard Operating Procedures for Spaying

Pre-surgery Animal Selection, Handling and Care

1. Mare selected for spaying will be greater than 3 years of age and less than 20 years of age.

2. All mares selected for spaying will have a Henneke body condition score of 3 or greater. No animals which appear distressed, injured or in failing health or condition will be selected for spaying.

3. Mares will not be spayed within 36 hours of capture.

4. Mares selected for the treatment would be shipped to a BLM facility for the surgery.

5. Mares selected for surgery will be held in pens separate from the general population at the facility.

6. At no time will recently anesthetized animals be returned to the general population before they are fully recovered from anesthesia.

7. Prior to surgery, animals in holding pens may be held off feed for a period of time (typically 24-36 hours) at the recommendation and direction of the attending veterinarian. They will have free access to water.

8. The final determination of which specific animals will be spayed will be based on the professional opinion of the attending veterinarian in consultation with the Authorized Officer.

Ovariectomy via Colpotomy Procedure

1. While in the squeeze chute, mares that would have rectal palpation and/or transrectal ultrasound performed to determine if the mare is pregnant and to stage the pregnancy if indicated.

2. The patient would be restrained in a fully-padded chute which allows for access to the horse's neck for injections and to the tail and perineal area to allow for performance of the surgery. Each mare would be intravenously administered a mixture of detomidine hydrochloride (10-20 ug/kg; 5-10 mg), butorphanol tartrate (0.02-0.04 mg/kg; 5-15 mg), and Xylazine hydrochloride (0.2-0.5 mg/kg; 100-300 mg) to sedate and provide analgesia (to minimize discomfort) for surgery (exact dosages may be adjusted as determined by the veterinarian). If further sedation is required the mare would 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.

3. Following sedation, a rectal examination would be performed to evacuate the rectum and double check pregnancy status and gestational stage. The tail would be wrapped and tied straight up. A padded bumper would be placed above the rump of the mare to keep her from jumping up. While the surgical field may not be entirely sterile, all reasonable steps would be taken to ensure that it is disinfected. The perineal region would be cleansed, and the vagina would be aseptically prepared for surgery using povidone iodine solution prior to insertion of the surgeon's sterile gloved arm into the vaginal vault. The surgical procedure would involve making an incision,

approximately 1-3 centimeters long, in the anterior-dorsallateral vagina. Both ovaries are accessed through this one incision. The incision would be enlarged with blunt dissection to perforate the peritoneum and allow the surgeon's hand to enter the abdomen. This method separates rather than transects the muscle fibers so the incision decreases in length when the tissues contract after the tranquilization wanes post-surgery. The ovary and associated mesovarium are isolated by direct manual palpation and local anesthesia (5 ml 5% bupivacaine and 5 ml 2% lidocaine) is injected into each ovarian pedicle. This combination was selected to provide rapid onset (lidocaine) and extended duration (bupivacaine) of effect, reducing pain associated with removal of the ovaries. The surgeon would add epinephrine to the lidocaine/bupivacaine anesthesia of the ovarian pedicle to constrict blood vessels. This may reduce the risk of hemorrhage at the surgical site, and by reducing blood flow at the site of injection the local anesthesia should stay longer at the surgical site. The rate would be 1 ml/ 100ml of the anesthetic mixture (epinephrine for injection 1: 1000). The ovarian pedicle would be transected with a chain ecraseur.

2. Instruments would be cleaned and soaked in Chlorhexidine between procedures, then rinsed with sterile saline. Duration of surgery for each individual would be recorded, but is expected to take approximately 15 minutes. The veterinarian would conduct no more than 25 surgeries per day to avoid surgeon fatigue.

3. Horse that have received the surgery would be turned out into a smaller pen for recovery from sedation. 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 larger pens.

4. The specific drug combination used will be at the discretion of the attending veterinarian.

Appendix L, Standard Operating Procedures for Gathers

The following standard operating procedures (SOPs) for gathering and handling wild horses apply whether a contractor or BLM personnel conducts a gather. The primary concern is the safety of all animals gathered, of all BLM personnel and contractors involved, and of any members of the public viewing the gather.

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

Pre-Gather Evaluation

1. Prior to any gathering operation, the BLM would provide for a pre-gather evaluation of existing conditions in the gather area(s). The evaluation would include animal conditions, prevailing temperatures, drought conditions, soil conditions, road conditions, and a topographic map with special designation boundaries, the location of fences, other physical barriers, and acceptable gather locations in relation to animal distribution.
2. All of the involved BLM personnel and/or contractors would be apprised of all conditions and would be given instructions regarding the gather and handling of animals to ensure their health and welfare is protected.

Gather Methods That May Be Used

The primary gather methods used in the performance of gather operations include:

1. Helicopter Drive Gathering. This gather method involves utilizing a helicopter to herd wild horses into a temporary gather site. If this gather method is selected, the following applies:
    a. For helicopter gathers conducted by BLM personnel, gather operations would be conducted in conformance with the Wild Horse Aviation Management Handbook (January 2009).
    b. The BLM would assure that an Animal and Plant Health Inspection Service (APHIS) veterinarian or contracted licensed veterinarian is on-site during the gather to examine animals and make recommendations to BLM for care and treatment of wild horses.
    c. A minimum of two saddle-horses shall be immediately available at the gather site to accomplish roping if necessary. Roping shall be done as determined by the BLM. Under no circumstances shall animals be tied down for more than one half hour.
    d. Foals shall not be left behind, and orphaned.
    e. The rate of movement and distance the animals travel shall consider terrain, physical barriers, access limitations, weather, extreme temperature (high and low), condition of the animals, urgency of the operation (animals facing drought, starvation, fire rehabilitation, etc.) and other factors.
2. Helicopter Assisted Roping. This gather method involves utilizing a helicopter to herd wild horses to ropers. If this gather method is selected, the following applies:

   a. For helicopter gathers conducted by BLM personnel, gather operations would be conducted in conformance with the Wild Horse Aviation Management Handbook (January 2009).
   b. The BLM would assure that an Animal and Plant Health Inspection Service (APHIS) veterinarian or contracted licensed veterinarian is on-site during the gather to examine animals and make recommendations to BLM for care and treatment of wild horses.
   c. Under no circumstances shall animals be tied down for more than one half hour.
   d. Foals shall not be left behind, or orphaned.
   e. The rate of movement and distance the animals travel shall consider terrain, physical barriers, access limitations, weather, extreme temperature (high and low), condition of the animals, urgency of the operation (animals facing drought, starvation, fire rehabilitation, etc.) and other factors.

3. Bait/Water Trapping. This gather method involves utilizing bait (e.g., water or feed) to lure wild horses into a temporary gather site. If this gather method is selected, the following applies:
   a. The pre-gather evaluation would determine whether the proposed activities would necessitate the presence of a veterinarian during operations. If it is determined that a large number of animals may need to be euthanized or gather operations could be facilitated by a veterinarian, these services would be arranged before the gather would proceed.
   b. Finger gates shall not be constructed of materials such as "T" posts, sharpened willows, etc., that may be injurious to animals.
   c. All trigger and/or trip gate devices must be approved by the BLM prior to gather of animals.
   d. Gather sites shall be checked a minimum of once every 10 hours.

<u>Gather Sites, Holding Facilities, Etc.</u>

1. All gather sites and temporary holding facilities locations must be consistent with the NEPA analysis, Decision Record, and approved by the BLM prior to the construction.
2. All gather sites and temporary holding facilities not located on public land must have prior written approval of the landowner.
3. All gather sites and temporary holding facilities would be located to reduce the likelihood of injury and stress to the animals and to minimize potential damage to the natural resources of the area. These sites would be located on or near existing roads whenever possible.
4. All gather sites and temporary holding facilities would not be constructed on wetlands or riparian zones.
5. Prior to setting up a gather site or temporary holding facility, the BLM would conduct all necessary clearances (archaeological, wildlife, etc.). Once clearances have been obtained, the gather site or holding facility may be set up.

6. All gather sites, wings, and temporary holding facilities shall be constructed, maintained and operated to handle the animals in a safe and humane manner and be in accordance with the following:
    a. Gather sites and temporary holding facilities shall be constructed of portable panels, the top of which shall not be less than 72 inches high for horses and 60 inches high for burros, and the bottom rail of which shall not be more than 12 inches from ground level. All gather sites and temporary holding facilities shall be oval or round in design.
    b. All loading chute sides shall be a minimum of 6 feet high and shall be fully covered, plywood, metal without holes larger than 2”x4”.
    c. All runways shall be a minimum of 30 feet long and a minimum of 6 feet high for horses, and 5 feet high for burros, and shall be covered with plywood, burlap, plastic snow fence or like material a minimum of 1 foot to 5 feet above ground level for burros and 1 foot to 6 feet for horses. The location of any portable fly chute to restrain, age, or provide additional care for the animals shall be placed in the runway in a manner as instructed by the BLM.
    d. All crowding pens including the gates leading to the runways shall be covered with a material which prevents the animals from seeing out (plywood, burlap, plastic snow fence, etc.) and shall be covered a minimum of 1 foot to 5 feet above ground level for burros and 2 feet to 6 feet for horses.
    e. All pens and runways used for the movement and handling of animals shall be connected with hinged self-locking or sliding gates.
7. No modification of existing fences would be made without authorization from the BLM.
8. When dust conditions occur within or adjacent to the gather site or holding facility, the ground would be wet down with water.
9. Animals shall not be held in gather sites and/or temporary holding facilities on days when there is no work being conducted, unless prior approval has granted by the BLM.
10. Alternate pens within the holding facility shall be furnished to separate mares or jennies with small foals, sick and injured animals, estrays or other animals needing to be housed in a separate pen.
11. All sick or injured animals will be restrained, if treatment is necessary. The BLM would determine if animals must be humanely euthanized and provide for the destruction of such animals and appropriate disposition of the carcasses.
12. Alternate pens within the holding facility shall be furnished for animals that will be released back into the gather area, and to segregate animals transported from remote locations so they may be returned to their traditional ranges.
13. Animals shall be sorted as to age, number, size, temperament, sex, and condition when in the holding facility so as to minimize, to the extent possible, injury due to fighting and trampling. A portable chute may be necessary to restrain animals for the purpose of determining an animal’s age, sex, or other necessary procedures.

14. Animals held in the gather sites and/or temporary holding facilities shall be provided with a continuous supply of fresh clean water at a minimum rate of 10 gallons per animal per day. Animals held for 10 hours or more in the gather site or temporary holding facilities shall be provided good quality hay at the rate of not less than two pounds of hay per 100 pounds of estimated body weight per day. Certified weed free hay would be required.
15. Approriate security at all sites is required to prevent loss, injury, or death of gathered animals.
16. Animals to be released back into the HMA following gather operations may be held up to 21 days or as directed by the BLM. Animals that are to be released back into the gather area may need to be transported back to the original gather site.
17. No personnel working at gather sites may excavate, remove, damage, or otherwise alter or deface or attempt to excavate, remove, damage or otherwise alter or deface any archaeological resource.

Transporation of Animals

1. All motorized equipment employed in the transportation of gathered animals shall be in compliance with appropriate State and Federal laws and regulations applicable to the humane transportation of animals.
2. All motorized equipment, tractor-trailers, and stock trailers shall be in good repair, of adequate rated capacity, and operated so as to ensure that gathered animals are transported without undue risk or injury.
3. Only tractor-trailers or stock trailers with a covered top shall be allowed for transporting animals from gather site(s) to temporary holding facilities, and from temporary holding facilities to final destination(s). Sides or stock racks of all trailers used for transporting animals shall be a minimum height of 6 feet 6 inches from the floor. Single deck tractor-trailers 40 feet or longer shall have at least two (2) partition gates providing at least three (3) compartments within the trailer to separate animals. Tractor-trailers less than 40 feet shall have at least one partition gate providing at least two (2) compartments within the trailer to separate the animals. Compartments in all tractor-trailers shall be of equal size plus or minus 10 percent. Each partition shall be a minimum of 6 feet high and shall have a minimum 5 foot wide swinging gate. The use of double deck tractor-trailers is unacceptable and shall not be allowed.
4. All tractor-trailers used to transport animals to final destination(s) shall be equipped with at least one (1) door at the rear end of the trailer which is capable of sliding either horizontally or vertically. The rear door(s) of tractor-trailers and stock trailers must be capable of opening the full width of the trailer. Panels facing the inside of all trailers must be free of sharp edges or holes that could cause injury to the animals. The material facing the inside of all trailers must be strong enough so that the animals cannot push their hooves through the side.
5. Floors of tractor-trailers, stock trailers and loading chutes shall be covered and maintained with wood shavings to prevent the animals from slipping as much as possible during transport.

6. Animals to be loaded and transported in any trailer shall include limitations on numbers according to age, size, sex, temperament, and animal condition. The following minimum square feet per animal shall be allowed in all trailers:
   a. 11 square feet per adult horse (1.4 linear foot in an 8 foot wide trailer)
   b. 6 square feet per horse foal (0.75 linear feet in an 8 foot wide trailer)
7. The condition and size of the animals, weather conditions, distance to be transported, or other factors shall be considered when planning for the movement of gathered animals.
8. Appropriate brand and/or inspection services shall be provided or the gathered animals.
9. If dust conditions are such that the animals could be endangered during transportation, the transporation vehicles would adjust speed.
10. Animals shall be transported to their final destination from temporary holding facilities as quickly as possible after the gather.
    a. Animals shall be scheduled to arrive at the final destination between 7:00 a.m. and 4:00 p.m, unless prior approval has been granted by the BLM.
    b. No animals shall be scheduled to arrive at final destination on Sunday and Federal holidays, unless prior approval has granted by the BLM.
    c. Animals shall not be allowed to remain standing on trucks while not in transport for a combined period of greater than three (3) hours in any 24 hour period.

<u>Safety and Communications</u>

1. The BLM personnel and contractors shall have active communications, including through radio systems that have appropriate FCC licenses.
2. All accidents occurring during the performance of any task order shall be immediately reported to the BLM.
3. All helicopter use must be in compliance with Federal Aviation Regulations, Part 91. Pilots shall comply with Federal Aviation Certificates and applicable State regulations.
   a. Fueling operations shall not take place within 1,000 feet of animals.

<u>Animal Characteristics and Behavior</u>

1. Releases of wild horses would be near available water when possible. If the area is new to them, a short-term adjustment period may be required while the wild horses become familiar with the new area.

<u>Public Participation</u>

1. Opportunities for public viewing (i.e. media, interested public) of gather operations would be made available to the extent possible; however, the primary considerations would be to protect the health, safety and welfare of the animals being gathered and the personnel involved.
2. The public would be required to adhere to guidance from the on-site BLM representative. It is BLM policy that the public would not be allowed to come into direct contact with wild horses being held in BLM facilities. Only authorized BLM personnel or contractors

may enter the corrals or directly handle the animals. The general public may not enter the corrals or directly handle the animals at any time or for any reason during BLM operations.

Responsibility and Lines of Communication

1. The Field Manager would ensure appropriate lines of communication are established between the gather operations, Field Office, District Office, State Office, National Program Office, and BLM Holding Facility offices.
2. All publicity, formal public contact and inquiries would be handled through the Field Manager and/or District or State Public Affairs Officer.
3. All BLM personnel and contractors involved in the gathering operations would keep the best interests of the animals at the forefront at all times.

Appendix M, Acronyms/Abbreviations

AAEP	American Association of Equine Practitioners
AHPA	American Horse Protection Association
AIM	Assessment, Inventory and Monitoring
AML	Appropriate Management Level
APHIS	Animal and Plant Health Inspection Service
ARMPA	Approved Resource Management Plan Amendment, Utah Greater Sage-Grouse
AUM	Animal Unit Month
AVMA	American Veterinary Medical Association
BBC	Birds of Conservation Concern
BCR	Bird Conservation Region
BHCA	Bird Habitat Conservation Areas
BLM	Bureau of Land Management
CAWP	Comprehensive Animal Welfare Policy
CIA	Cumulative Impact Area
DPG	Dugway Proving Ground, West Desert Test Center
DPS	Distinct Population Segment
DR	Decision Record
EA	Environmental Assessment
EPS	Economic Profile System
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FIA	Freund's Incomplete Adjuvant
FLPMA	Federal Land Policy and Management Act
FMA	Freund's Modified Adjuvant
FONSI	Finding of No Significant Impact
FR	Federal Register
GAO	Government Accountability Office
GHMA	General Habitat Management Area
GIS	Geographic Information System
H	Handbook
HA	Herd Area
HAF	Habitat Assessment Framework
HMA	Herd Management Area
HSUS	Humane Society of the United States
IB	Information Bulletin
IDT	Interdisciplinary Team
IM	Instruction Memorandum
MBTA	Migratory Bird Treaty Act
MLRA	Major Land Resource Area
MOU	Memorandum of Understanding
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act
NRC	National Research Council
NRCS	Natural Resource Conservation Service
OIG	Office of Inspector General
ORC	Off-Range Corrals
PHMA	Priority Habitat Management Area
PLPCO	Public Land Policy Coordinating Office
PZP	*Porcine zona pellucida*
RFAS	Reasonably Foreseeable Action Scenario
RHA	Rangeland Health Assessment
RINS	Raptor Inventory Nest Survey
RMP	Resource Management Plan
RQ	Reportable Quantities
SITLA	School and Institutional Trust Lands Administration
SLFO	Salt Lake Field Office
SOP	Standard Operating Procedure
SSS	Special Status Species
TNEB	Thriving Natural Ecological Balance
UPIF	Utah Partners in Flight
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
UTSO	Utah State Office
WFRHBA	Wild Free-Roaming Horses and Burros Act
WMU	Wildlife Management Units
WO	Washington Office

Appendix N, References

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