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Canyonlands HMA Gather Plan

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Chapter 1. Introduction

This Environmental Assessment (EA) has been prepared to disclose and analyze environmental effects of the Bureau of Land Management (BLM) Richfield Field Office's (RFO) proposed action which consists of achieving and maintaining a herd population within the Appropriate Management Level (AML) by gathering and removing excess wild burros from the Canyonlands Herd Management Area (HMA) and conducting fertility control management over a 10-year period from the date of the initial gather operation. Maps of the HMA are contained in Appendix 2. The Proposed Action would achieve management objectives through gather and removal of excess burros within and near the Canyonlands HMA, implementation of population control measures and maintenance gathers.

This Environmental Assessment (EA) is a site-specific analysis of potential impacts that could result with the implementation of the proposed action or alternatives to the proposed action. 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; if so, BLM will prepare an Environmental Impact Statement (EIS). If the proposed action would not have significant effects, BLM will prepare a "Finding of No Significant Impact" (FONSI). A FONSI documents the reasons why implementation of the selected alternative would not result in "significant" environmental impacts (effects) beyond those already addressed in the RFO Resource Management Plan (RMP)/Final EIS (BLM. 2008). Following a FONSI, a Decision Record (DR) may be signed approving the selected alternative, whether the proposed action or another alternative.

1.1. Background

Since the passage of the Wild Free-Roaming Horses and Burros Act of 1971 (WFRHBA), Public Law 92-195, the BLM has refined its understanding of how to manage wild horse and burro population levels. By law, the BLM is required to control any overpopulation, including by removing excess animals once a determination has been made that excess animals are present, and removal is necessary. The WFRHBA requires the BLM to achieve and maintain a Thriving Natural Ecological Balance (TNEB) on public land to protect the range from the deterioration associated with overpopulation of wild horses and burros. To achieve program goals, the BLM must, among other things, identify the AML for individual herds. The AML upper limit shall be established as the maximum number of wild horse and burros which results in a TNEB and avoids a deterioration of the range. This number should be below the number that would cause rangeland damage (refer to *Animal Protection Institute of America v. Nevada BLM*, 118 IBLA 63, 75, (1991)). The AML is the number of wild horses and burros that can be sustained within a designated HMA which achieves and maintains a TNEB in keeping with the BLM's multiple-use mandate. Program goals have also included the application of contraceptive treatments to reduce total population growth rates in the short-term and increase the time between gathers. Other management efforts include conducting accurate population inventories and collecting genetic data to support genetic diversity assessments. Since the passage of the WFRHBA, management knowledge regarding burro population levels has increased. For example, wild horses are capable of increasing numbers 15-20% annually (NAS, 2013), resulting in the doubling of wild horse populations about every 3-4 years. Wild burro population growth rates may also be high; Ransom et al. (2016) summarized available studies and found an average annual herd growth rate of 19% for feral donkeys, but the BLM typically uses somewhat lower rates of increase for wild burro herd size projections, of 10 – 15% per year.

At the national level, annual gather and removals are based on national priorities (such as risks to public safety, wild horse health, and resource protection) and budget for gather operations. The national program also needs to consider the off-range costs and budget constraints, such as from costs of the agency's adoption efforts and of long-term care of excess un-adopted wild horses and burros in off-range pastures.

The use of fertility control methods such as immunocontraceptive vaccines, intrauterine devices (IUDs), sex ratio manipulation, and – in some cases – having a non-reproducing segment in the population, can help reduce total wild horse and burro population growth rates in the short term, increase gather intervals (the time span between gathers), and decrease the number of excess horses and burros that must be removed from the range. Other management efforts that help inform management decisions include monitoring rangeland conditions, conducting accurate population inventories, and collecting samples for genetic monitoring. Decreasing the numbers of excess wild horses and burros on the range and implementing fertility control measures is consistent with findings and recommendations from the National Academy of Sciences (NAS 2013). BLM's management of wild burros must also be consistent with Standards and Guidelines for Rangeland Health (43 CFR 4180).

The Canyonlands HMA is located in eastern Wayne County, Utah, approximately 25 miles east of Hanksville, Utah in the Horseshoe Canyon Area. The Canyonlands HMA is approximately 89,392 acres, including several parcels owned by Utah School and Institutional Trust Lands Administration. It is located adjacent to Glen Canyon National Recreation Area (GCNRA) on the east and the Horseshoe Canyon unit of Canyonlands National Park (CNP) on the west. The HMA overlaps portions of the French Spring/Happy Canyon Wilderness Study Area (WSA), Horseshoe Canyon South WSA, Horseshoe Canyon North WSA, and Dirty Devil WSA. Vegetation in the area is a mix of desert grasses and desert shrub, although areas with deeper soils support sagebrush and juniper.

1.2. Purpose and Need

The BLM's purpose for agency action is to implement actions that would achieve and maintain the wild burro population within established AML over a period of 10 years and help the BLM in achieving and maintaining a TNEB on these public lands. The BLM's need for agency action is to prevent undue or unnecessary degradation of the public lands associated with excess wild burros, allow for recovery of degraded range resources, and to restore a TNEB and multiple-use relationship on public lands, consistent with the provisions of section 1333(b) of the WFRHBA.

1.3. Land Use Plan Conformance

Land use decisions for the project area are contained in the Richfield Field Office Record of Decision and Approved Resource Management Plan (RMP), approved in 2008 (BLM 2008).

Specifically, the proposed action and alternative 2 conform to the following RMP goals and decisions:

The Approved RMP manages Canyonlands Herd Management Area (HMA) with an AML of 60-100 wild burros. BLM will allocate 600 Animal Unit Months (AUM) for wild burros. The BLM will provide active management to this burro herd. When the herd reaches approximately 100 head BLM will gather the burros to maintain the 60 head range. This number range (60-100 head) will keep a genetically viable herd unit and ensure a natural ecological balance between burro populations and wildlife, vegetation resources, water and other resource values.

WHB-1. Manage wild burro populations for appropriate age and sex ratios, genetic viability, and adoptability, as well as maintaining AML on the established HMA. Allow wild burro research, as long as other wild horse and burro program goals are met. Wild burro herd research data that may be collected include, but are not limited to, data to determine population size and characteristics, assess herd health, determine herd history and genetic profile (blood and hair sampling, Instruction Memorandum IM # 2002-095 Gather Policy and Selective Removal Criteria for Wild Horses Program Area: Wild Horse and Burro Program), and conduct immuno-contraceptive research and monitor results as appropriate. Other data that could be useful in population management would include general characteristics such as age ratios, sex ratios, and color, as well as health characteristics such as pregnancy rates, parasite loading, and the general physical condition of the burros. In addition, genetic sampling would determine the genetic health of the herd.

WHB-2. BLM will coordinate with the NPS to address burro trespass issues.

WHB-3. Allocate 600 AUMs for wild burros to meet an AML upper limit of 100.

WHB-4. Maintain the AML of the Canyonlands HMA at levels to maintain genetic viability.

WHB-5. Allow introductions of wild burros from other herd areas to maintain genetic viability, given the burros being introduced have characteristics similar to the burros in the Canyonlands HMA.

1.4. Relationship to Statutes, Regulations, and Other Plans

The action alternatives are consistent with all applicable BLM policies and regulations implementing the WFRHBA at Title 43 Code of Federal Regulations (CFR) 4700.

The action alternatives are also consistent with the WFRHBA, which mandates, among other things, that the Bureau *"prevent the range from deterioration associated with overpopulation," and "remove excess horses in order to preserve and maintain a TNEB and multiple use relationships in that area."*

Additionally, 43 CFR 4700.0-6 (a) states that *"Wild horses and burros shall be managed as self-sustaining populations of healthy animals in balance with other uses and the productive capacity of their habitat."*

1.5. Decision to Be Made

The authorized officer will determine whether to implement actions to achieve management objectives of maintaining the wild burro population within the established AML to achieve and maintain a TNEB. The authorized officer's decision is limited to the need to remove excess wild burros and to implement fertility control to achieve and maintain population size within the AML. Any decision would not adjust AML or livestock use, including forage allocations, as these were set through previous Richfield Field Office RMP decisions.

1.6. Scoping and Identification of Issues

Identification of issues for this assessment was accomplished by considering the resources that could be affected by implementation of the action alternatives and the anticipated and foreseeable results of the no-action alternative through involvement with the public and input from the BLM Interdisciplinary Team (Appendix 1). Additional public involvement is described in Chapter 5 - Consultation and Coordination.

Resources which are not present or are not affected by the Proposed Action or alternatives, are included as part of the Interdisciplinary Team NEPA Checklist (Appendix 1). Issues which need detailed analysis to make a reasoned choice between alternatives or determine levels of significance are summarized below and are analyzed in Chapter 3.

Issue 1. How would removal of wild burros affect livestock grazing?

Issue 2. How would removal of wild burros affect rangeland health/vegetation?

Issue 3. How would gathering wild burros affect wetland and riparian resources?

Issue 4. How would the gathering of burros affect wildlife?

Issue 5. How would the gathering of wild burros affect Mexican spotted owl (MSO) habitat and nesting areas?

Issue 6. How would the gathering and removal of excess wild burros affect individual wild burros and the overall population of the HMA?

Chapter 2. Proposed Action and Alternatives

2.1. Introduction

Based on identified issues, three alternatives are considered in detail:

- Alternative 1: Proposed Action – Gather and Remove Excess Wild Burros from the Canyonlands HMA and Population Growth Suppression using Fertility Control Vaccines and IUDs
- Alternative 2: Gather and Removal of Excess Wild Burro without Population Growth Suppression
- Alternative 3: No Action – No Gather, Removal, or Population Growth Suppression

Alternatives considered but not analyzed in detail (see Appendix 3) include:

- Population growth suppression without removals.
- Remove or reduce livestock within the HMA.
- Gather wild burros to the AML upper limit.
- Population growth suppression treatment only including using bait/water trapping to remotely dart Jennies with PZP liquid only (no removal).
- Bait or water trap only.
- Control wild burro numbers by natural means.
- Gather and release excess wild burros every two years and apply PZP-22 to burros for release.
- Make individualized excess wild burro determinations prior to removal.
- Use of gelding as non-reproductive population to reduce population growth rate.
- Allow the public to capture and remove wild burros.
- Use alternative capture techniques instead of helicopters to capture excess wild burros.

2.2. Description of Alternatives Considered in Detail

2.2.1. Proposed Action – Gather and Remove Excess Wild Burros from the Canyonlands HMA and Population Growth Suppression using Fertility Control Vaccines and IUDs

Under the Proposed Action, BLM would gather and remove excess wild burros within and around the HMA to low AML as expeditiously as feasible through one or more gathers, manage population growth using PZP or GonaCon-Equine and IUDs and possibly equip burros with GPS tracking units (either collar or tag) for monitoring purposes.

The number of burros removed would be based on the latest population inventory from within and around the HMA and would achieve and/or maintain low AML. BLM would also collect information on herd characteristics, collect genetic samples for monitoring genetic diversity levels in terms of observed heterozygosity, determine herd health, provide for public safety, and establish a TNEB with the other resources within the Project Area. Information gained from these management actions and subsequent monitoring of results could be used to inform future management of wild burros.

2.2.1.1 Gather

The BLM would conduct gathers over a 10-year period to remove excess wild burros until the project area wild burro population is at the low AML of 60 individuals (see Table 2.1). The 10-year period would begin with the first gather on the HMA after the decision record for this EA is signed. BLM would strive to reach low AML as quickly as possible, but it is expected that gather efficiencies and holding space available during the initial gather would not allow for the attainment of low AML during the initial gather. Based on the BLM's experience with past gathers conducted in the project area, only 50-60% of the population can typically be gathered in a single gather operation due to vast area, terrain, limited access, and behavior of the target animals. Consequently, follow-up gathers to remove any additional excess wild burro would be necessary to achieve low AML and to gather a sufficient number of wild burros to implement the population growth suppression component of the Proposed Action. Gather efforts would prioritize public health and safety issues in the area that are being caused by the burros (burros on heavily traveled roads and aggressive burros). Once low AML is reached, additional gathers would be needed to implement population growth suppression, if authorized, to keep the population within AML. If the wild burro population exceeds AML, follow-up gather(s) with removals to keep the population within AML would be conducted during the 10-year period in order to allow the range to recover and achieve a TNEB.

Regular population inventories would be conducted at a minimum of every 4 years to calculate the estimated population size. That estimate would be used to determine the number of excess burro to be captured, removed, and/or treated with population growth suppression during each gather. A population inventory was conducted in the project area in March 2022, which was used to estimate the population size and proposed capture, removal, and treated numbers for the initial gather (see Table 2.1). This process would be followed over the 10-year period to achieve and maintain the wild burro population within AML. Other administrative factors (budget, adoptions, holding space, etc.) and individual gather success could also impact the numbers gathered, removed, or treated over the 10-year period. Gathers would be scheduled by the BLM National Wild Horse and Burro Program Office, as outlined in BLM Instruction Memorandum (IM) 2022-044.[1]

Authorized wild burro capture techniques would be used to capture excess wild burros from the project area. These techniques include helicopter drive trapping, water and bait trapping, and roping. One or a combination of capture techniques may be used. The selected technique(s) would depend on herd health and the season. Temporary holding corrals and traps will not occur within

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[1] This document is available at: https://www.blm.gov/policy/im2022-044

Wilderness Study Areas (WSA) and Natural Areas. All techniques would be consistent with the comprehensive animal welfare program (Appendix 4) outlined in BLM Permanent IM 2021-002.[2]

2.2.1.2 Collected Data

During gather operations, BLM will record data including sex and age distribution, reproduction, survival, condition class information (using the Henneke rating system), color, size, and other information, along with the disposition of that animal (removed or released). Consistent with BLM IM 2009-062 and the WHB Management Handbook H-4700-1[3], hair follicle samples will be acquired every gather to determine whether the herd is maintaining acceptable genetic diversity (*e.g.*, with high enough levels of observed heterozygosity to indicate the herd is avoiding health risks from inbreeding depression). Periodic introduction of a small number of jacks or jennies from a different HMA, with desired characteristics similar to the wild burros within the HMA, could be made to augment genetic diversity in the project area, as measured by observed heterozygosity, if the results of genetic monitoring indicate that that is prudent.

The population inventory conducted in March 2022 used the Simultaneous Double Observer Method (Griffin et al. 2020). Burros were identified as individuals or as a band by their color, leg markings, face markings, and area/time recorded. Yearlings were distinguished from adults, when possible, but for administrative purposes, yearlings are considered adults (BLM 2010, H-4700-1). Only 6 foals were seen during that inventory, but burro foals can be born throughout the year (Ransom et al. 2016). For large groups, photos were used to ensure that any observed burros were only counted once in the totals. The planned flight paths were loaded into a Global Positioning System (GPS) and followed. The actual fight paths were recorded by GPS. The NAS report noted that raw counts of burros seen can be as much as 20%-30% lower than estimated population sizes of wild burros that account for unseen animals (NAS, 2013), so the observation data are analyzed to produce estimates of the number present, including those not seen. Crabb (2022) analyzed the March 2022 survey data, leading to estimated herd sizes at the time of survey of 109 adult burros (115 total at that time). However, Crabb went on to point out that recent research by Hennig et al. (2022) showed that even the double-observer analysis-based estimates of burro herd size underestimate true herd size by 25% or more. Therefore, the BLM added 25% to the number of adults estimated in Crabb (2022), to conclude that the actual number of adults in March 2022 was 136. By fall 2022, based on an assumed growth rate of 11% (which is a conservative value), the total number of wild burros in the HMA is expected to be 151.

Removal numbers listed in Table 2.1 were based on the estimated herd sizes as of July 2022.

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[2] This document is available at https://www.blm.gov/policy/pim-2021-002.

[3] These documents are available at https://www.blm.gov/policy/im-2009-062 and https://www.blm.gov/sites/blm.gov/files/uploads/Media_Library_BLM_Policy_H-4700-1.pdf.

Table 2.1. Estimated 2022 Population Size, Capture, and Removal Numbers

HMA	AML	2022 Estimated Population Post-foaling 2022 (7/14/2022)*	Fall/Winter 2022 Removal Numbers to Lower AML	Fall/Winter 2022 Removal Numbers to Upper AML
Canyonlands	**60-100**	151	91	51

*These values are based on the estimated March 2022 wild burro herd size (109 adults; Crabb 2022), plus 25% (136 adults in March 2022) to account for true abundance of burro herds being larger than double-observer statistical analyses (Hennig et al. 2022, cited in Crabb 2022). The post-foaling herd size estimate of 151 total burros by late summer 2022 also reflects a conservative 11% annual growth rate applied to the 136 adults present in March 2022. Gather, removal, and fertility treatment numbers will be adjusted over the 10-year period to reflect excess wild burros and numbers treated to achieve or maintain the population within AML.

2.2.1.3 Population Growth Suppression

BLM would begin implementing the population growth suppression component of the Proposed Action as a part of the initial gather or follow-up gathers. BLM would use PZP vaccine ZonaStat-H, PZP-22, (which consists of an initial PZP vaccine fluid injection followed by PZP pellet injection), GonaCon-Equine™ vaccine and / or flexible IUDs. The primary purpose of population growth suppression would be to slow the herd's growth rate to help maintain the population within AML once achieved. BLM may apply ZonaStat-H, PZP-22, GonaCon-Equine or IUDs prior to achieving AML if gather success, holding capacity limitations, population growth rates, other national gather priorities, or other circumstances prevent the BLM from achieving AML during the initial gather operations. The procedures to be followed for implementing fertility control are detailed in Standard Operating Procedures (SOP) and Scientific Literature Review for Population Growth Suppression Methods (Appendix 5).

Burros (donkeys) are a distinct species from horses, however they are both of the family equidae. While there are notable differences between the species in their anatomy, diet, behaviors and metabolism (Burden and Thiemann 2015), the essential endocrine controls of the hypothalamic-pituitary-gonadal axis and the function of the zona pellucida in fertility are the same. While most studies reviewed are based on results from horses, burros are similar enough in their reproductive physiology and immunology (i.e., Turini et al. 2021) that expected effects of immunocontraception are comparable.

PZP proteins are the antigens in PZP contraceptive vaccines. The PZP-22 treatment is one form of PZP vaccine that can lead to longer-lasting effects than the PZP ZonaStat-H liquid PZP alone, if animals are treated with a booster dose (Rutberg, et al., 2017). Jennies initially treated with any form of PZP vaccine will be subsequently treated only with forms of PZP vaccine. Each released jenny treated with PZP would receive the most current formulation of a single dose of ZonaStat-H, PZP-22 or a similar PZP population growth suppression treatment while in a temporary holding facility. The general understanding of PZP-22 vaccines is that when injected, PZP (antigen) causes the treated animal's immune system to produce antibodies; these antibodies bind to the zona pellucida proteins on the surface of oocytes (unfertilized eggs) and effectively block sperm binding and fertilization (ZooMontana, 2000). More recent information also indicates that some treated animals may have impaired ovarian function after treatment with PZP vaccines (Joonè et al., 2017; Nolan et al., 2018). PZP vaccine can be relatively inexpensive, meets BLM requirements for safety to treated animals and the environment, and can easily be administered in the field (NAS, 2013). In addition, PZP contraception research in horses showed that it appears to be completely reversible if fewer than approximately 4-5 doses are given to the same animal (Kirkpatrick and Turner, 2002; Nuñez, et al., 2017); the BLM assumes that physiological effects of immunization in burros is comparable to those documented in horses. Permanent sterility for horses treated consecutively in each of 5-7 years was observed by Nuñez, et al. (2010, 2017). Repeated treatment with PZP led to long-term infertility in Przewalski's horses receiving as few as one PZP booster dose (Feh, 2012). However, even if some number of jennies become sterile due to PZP treatment, that potential result would be consistent with the contraceptive purpose that motivates BLM's potential use of the vaccine.

GonaCon-Equine would be administered by hand injection. Jennies being treated for the first time would be held for approximately thirty days after the first treatment to administer a booster shot to increase efficacy and treatment longevity. Jennies initially treated with GonaCon-Equine vaccine would be subsequently treated only with forms of the GonaCon-Equine vaccine. The immune-contraceptive GonaCon-Equine vaccine meets most of the criteria that the National Research Council of the National Academy of Sciences (NAS, 2013) used to identify the most promising fertility control methods, in terms of delivery method, availability, efficacy, and side effects. GonaCon-Equine is approved for use by authorized federal, state, tribal, public and private personnel, for application to wild and feral equids in the United States (EPA, 2013, 2015). Its use is appropriate for free ranging wild burro herds. Taking into consideration available literature on the subject, the NAS concluded in their 2013 report that GonaCon-B (which is produced under the trade name GonaCon-Equine for use in feral horses and burros) was one of the most preferable available methods for contraception in wild horses and burros (NAS, 2013).

In 2013, the NAS suggested that additional studies be done on the contraceptive efficacy and behavioral effects of GonaCon-Equine, and such suggested studies have been published since that time. GonaCon-Equine has been used on feral horses in Theodore Roosevelt National Park (Baker et al. 2018), on a small number of wild horses in the Water Canyon area within the Antelope Complex (see DOI-BLM-NV-L020-2015-0014-EA) and was given to over 150 wild mares in fiscal year 2020. As with other contraceptives applied to wild horses and burros, the long-term goal of GonaCon-Equine use is to reduce or eliminate the need for gathers and removals (NAS, 2013). GonaCon-Equine vaccine is an EPA approved vaccine (EPA, 2009, 2013, 2015) that is relatively inexpensive, meets BLM requirements for safety to mares and the environment, and is produced in a USDA-APHIS laboratory. Its categorization by the EPA 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. GonaCon-Equine is produced as a pharmaceutical-grade vaccine, including aseptic manufacturing technique to deliver a sterile vaccine product (Miller et al., 2013). If stored at 4° C, the shelf life is 6 months (Miller et al., 2013).

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

Non-pregnant, released jennies could be treated with a flexible IUD as the population growth suppression instead of GonaCon-Equine vaccine or PZP vaccine. As with GonaCon-Equine and PZP, the long-term goal of using flexible IUDs would be to reduce or eliminate the need for gathers and removals (NAS, 2013). Jennies treated with IUDs would not receive GonaCon-Equine or PZP treatment at the same time. An IUD size that is appropriate for burros would be used. IUDs could be placed in non-pregnant jennies selected to be released back into the HMA. Generally, the jennies selected for release would be 5 years and older. Animals to be treated would be sent to a short-term holding facility where the jennies would be checked by a veterinarian using ultrasound to confirm pregnancy status. Pregnant jennies would not receive an IUD. The IUD prevents pregnancy by its physical presence in the jenny's uterus as long as the IUD stays in place (NAS, 2013). For example, in trials of one type of flexible IUD, approximately 75% of mares living and breeding with fertile stallions retained the Y-Shaped Silicone IUD for Feral Horses over two breeding seasons (see Appendix 5). None of the mares that kept their IUDs became pregnant during an experimental trial. After IUD removal, the majority of mares returned to fertility.

The BLM would return to the HMA as needed over the ten-year period to remove excess burros and to re-apply vaccines and IUDs and initiate new treatments to maintain contraceptive effectiveness in controlling population growth rates. Vaccines and IUDs can safely be reapplied as necessary to control the population growth rate. Once the herd size in the project area is at AML and population growth seems to be stabilized, BLM will determine the required frequency of new jennies treatments and jennies re-treatments with vaccines and IUDs, to maintain the number of burros within AML. Reference in this text to any specific commercial product, process, or service, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement, recommendation, or favoring by the U.S. Department of the Interior.

2.2.1.4 Identification and Tracking

Under this alternative, every jenny that is handled and returned to the range would be identifiable by a uniquely numbered radio-frequency identification (RFID) chip, placed in the nuchal ligament, in keeping with standard equine veterinary practice. Individual identification is consistent with BLM policy for fertility control application (BLM H-4700-1, 2010), and allows for vaccine applicators to have access to the complete treatment history of any given jenny. Additional guidelines for visibly marking fertility vaccine-treated animals are noted in the SOPs for fertility control use. Also, BLM would fit some wild jennies with GPS and very high frequency (VHF) radio collars and tags with the intent to collect high spatial and temporal resolution information for recording free-roaming burro movement, locations, and for other monitoring purposes including but not limited to effectiveness of population inventories, demographic rates assessment, habitat use, and interactions with other resources. Not every treated jenny would be fitted with a tracking device. Procedures for attaching the collars are described in Appendix 6, Affixing Radio Collars.

Only female burros would be fitted with GPS collars, while males or females could have a GPS radio transmitter tag braided into their tails (Schoenecker, et al., 2020) if a suitable braiding method is developed for burros. If tags are braided into the tails, they would be held in place with a non-toxic, low temperature curing epoxy resin. Collars would only be placed on burros that are 3 years old or older and in Henneke body condition score 4 or greater. Animals that are "thin" (Henneke score of $\leq$3), deformed, or who have any apparent neck problems would not be fitted with a collar. As tail tags are small (<200g) and are not worn around the neck, they are considered of low burden to the animal and, therefore, could potentially be worn by animals in lower body condition. All radio collars would have a remote manual release mechanism in case of emergency and a timed-release mechanism which would be programmed to release at the end of the monitoring period. No collars would remain on wild burros indefinitely. If both of the collar drop-off mechanisms fail at the end of the monitoring period, those individual burros would be captured, and the collars manually removed. Radio tagged burros would not need to be observed as often but would be observed regularly (6-10 times per year).

2.2.1.5 Design Features to Minimize Impacts

- When actively trapping wild burros, traps would be checked daily. Burros would be either removed or fed and watered for up to several days prior to transportation to a holding facility.

- Whenever possible, capture sites would be placed in previously disturbed areas. Generally, these activity sites would be small (less than one half acre) in size and temporary. No new roads would be constructed.

- Cultural clearance would be conducted if trap sites are located in area not previously disturbed.

- No trap sites, temporary holding or motorized use would occur within the WSAs and Natural Areas (Appendix 2 - Maps).

- Helicopter gathers would not be conducted between March 1 – August 31 to coincide with the MSO seasonal buffer on lands within the MSO critical habitat and PAC sites (Appendix 2 - Maps). The critical habitat and MSO PAC sites (Appendix 2 - Map 3) would have a 0.5-mile buffer from trap sites.

- Any burro trap sites and temporary holding locations on BLM lands will require a wildlife clearance between December 15th – August 31st, with appropriate buffers added to any found nest and/or burro sites.

- Helicopter gather operations would not occur from April 15th-June 30, which overlaps with the most critical stress periods for desert bighorn, mule deer, and pronghorn lambing/fawning seasons. Water/bait traps of a small size (less than 30 burros) could be conducted.

- Water/bait trap gathers of a large size (more than 30 burros) would not be conducted between March 1 – June 30 (with the exception of emergency gathers). While water/bait trap gathers of a smaller size would be conducted year-round based on site conditions and location of burros. Water/bait trapping may be selected as the primary method to maintain the population within AML and other special circumstances as appropriate.

- The helicopter would avoid eagles and other raptors and would not be flown repeatedly over any identified active raptor nests.

- All capture and handling activities would be conducted in accordance with the most current BLM policies and procedures (which is currently the CAWP IM 2021-002).

- During capture operations, safety precautions would be taken to protect all personnel, animals, and property involved in the process from injury or damage (Appendix 4).

- Only authorized personnel would be allowed on site during the removal operation (see Appendix 7 - Observation Protocol and Ground Rules).

- Private landowners or the proper administering agency(s) would be contacted, and authorization obtained prior to setting up traps on any lands which are not administered by BLM.

- Recreation staff would be consulted if trap sites are proposed to be located directly adjacent to WSA or Natural Areas. Wherever possible, traps would be constructed in such a manner as to not block vehicular access on designated roads.

- Access to roads may be temporarily restricted during gather operations to provide for public safety. Once the burros or helicopter have cleared the main road, it should be opened as soon as possible.

- If possible, traps would be constructed so that no riparian vegetation is contained within them. Impacts to riparian vegetation and/or running water located within a trap (and available to burros) would be mitigated by removing burros daily from the trap. No vehicles would be operated on riparian vegetation or on saturated soils associated with riparian/wetland areas.

- When possible, gathers would be scheduled to minimize impacts with big game hunting seasons.

- Small amounts of carefully managed veterinary medicines and treatments may be used to treat sick or injured animals at the capture sites.

- Weed-free hay would be used in trap sites and temporary holding facilities located on BLM-administered lands.

- Females 3 years and older being returned to the HMA may be collared with GPS location-recording devices that have a VHF radio beacon (‘radio collars’). No males would be collared.

If collars are too tight, the release function would be deployed remotely, or collar would be removed after capture. If neck abrasions or sores caused by a collar are observed and have not healed within 4 weeks of when they are observed, the collar's remote release would be activated, or the burro would be captured as soon as possible to remove the collar.

- Male and Female burros being released after gather operations may have GPS/VHF radio transmitter tags braided into their tails if a suitable braiding method is developed for burros.

- No hazardous material would be used, produced, transported, or stored in conjunction with this action.

- Gather operations would be conducted in accordance with the Comprehensive Animal Welfare Program (CAWP) as adjusted or amended through the National and State wild horse and burro program direction. The current CAWP is attached in Appendix 4.

- When gather objectives require gather efficiencies of 50-80% or more of the animals to be captured from multiple gather sites (traps) within the HMA, the helicopter drive method and helicopter assisted roping from horseback would be the primary gather methods used. Post-gather, every effort would be made to return released animals (if any) to the same general area from which they were gathered.

- Given a summer or early fall gather window, bait and/or water trapping may be used provided the gather operations timeframe is consistent with current animal and resource conditions. Bait and/or water trapping may also be selected as the primary method to maintain the population within AML and other special circumstances as appropriate.

- An Animal and Plant Inspection Service (APHIS) or other licensed veterinarian may be on-site during gathers, as needed, to examine animals and make recommendations to BLM for care and treatment of wild burros. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy (Permanent IM-2021-007) by the BLM authorized officer or other delegated official.

- Data including sex and age distribution, reproduction, survival, condition class information (using the Henneke rating system), color, size, and other information may also be recorded, along with the disposition of that animal (removed or released). Hair and/or blood samples would be acquired every gather in accordance with BLM IM 2009-062, to determine whether BLM's management is maintaining acceptable genetic diversity (avoiding inbreeding depression).

- Any horses or burros gathered and determined, with consultation between BLM and Utah State brand inspectors, to be domestic animals will be turned over to the local brand inspector in accordance with state law. This is in accordance with the Cooperative Agreement between The Department of Agriculture, State of Utah and the Utah State Office, BLM, approved January 2001.

- Excess animals would be transported to a BLM facility where they would be cared for in accordance with the WFRHBA, most current regulations and policies (i.e., prepared (freeze-marked, vaccinated, microchipped, and de-wormed) for adoption, sale, or long-term holding).

2.2.1.6 Temporary Holding Facilities During Gathers

Wild burros gathered would be transported from the trap sites to a temporary holding corral near the HMA or off-range facilities within 10 hours of the trap site, in goose-neck trailers or straight-deck semi-tractor trailers. At the temporary holding corral, the wild burros may be aged and sorted into different pens based on sex. The burros would be provided an ample supply of good quality hay and water. Jennies and their un-weaned foals would be kept in pens together. All burros identified for retention in the HMA would be penned separately from those animals identified for removal as excess. All jennies identified for release would be treated with fertility control vaccine or flexible IUDs.

At the temporary holding facility, a veterinarian, when present, would provide recommendations to the BLM regarding care, treatment, and, if necessary, euthanasia of the recently captured wild burros. 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 in keeping with BLM policy (Permanent IM 2021-007) using methods acceptable to the American Veterinary Medical Association.

2.2.1.7 Transport, Off Range, Holding, and Adoption Preparation

Wild burros removed from the range as excess would be transported to the receiving short-term holding facility in a goose-neck stock trailer or straight-deck semi-tractor trailers. Trucks and trailers used to haul the wild burros would be inspected prior to use to ensure wild burros could be safely transported. Wild burros would be segregated by age and sex when possible and loaded into separate compartments. Jennies and their un-weaned foals may be shipped together depending on age and size of foals. Foals would be reunited with their mares/jennies at the temporary holding facility within four hours of capture unless the Lead COR/COR/PI authorizes a longer time or foals are old enough to be weaned during the gather. Transportation of recently captured wild burros would be limited to a maximum of 10 hours.

Upon arrival, recently captured wild burros would be off-loaded and placed in holding pens where they would be fed good quality hay and water. Most wild burros begin to eat and drink immediately and adjust rapidly to their new situation. At the short-term holding facility, a veterinarian would provide recommendations to the BLM regarding care, treatment, and if necessary, euthanasia of the recently captured wild burros. 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) that was not diagnosed previously at the temporary holding corrals at the gather site would be humanely euthanized in keeping with BLM policy (Permanent IM 2021-007) using methods acceptable to the American Veterinary Medical Association (AVMA). Wild burros in very thin condition (Henneke score of <3) or animals with injuries are sorted and placed in sick pens, fed separately, and/or treated for their injuries. Recently captured wild burros, generally jennies, in very thin condition (Henneke score of <3) may have difficulty transitioning to feed. Based on the BLM's experience, 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. At short-term corral facilities, a minimum of 700 square feet would be provided per animal.

After recently captured wild burros have transitioned to their new environment, they would be prepared for adoption or sale. Preparation involves freeze-marking the animals with a unique identification number, vaccination against common diseases, castration, and de-worming.

2.2.1.8 Public Participation

- Prior to conducting a gather, a communications plan or similar document summarizing the procedures to follow when media or interested public request information or viewing opportunities during the gather would be prepared.

- The public must adhere to guidance from the agency representative, and viewing must be prearranged.

2.2.1.9 Safety

- Safety of BLM employees, contractors, members of the public, and the wild burros would be given primary consideration.

- A briefing between all parties involved in the gather would be conducted each morning.

- All BLM personnel, contractors and volunteers would wear protective clothing suitable for work of this nature. BLM would alert observers of the requirement to dress properly for the weather conditions and season. BLM would assure that members of the public are in safe observation areas. Observation protocols and ground rules would be developed for the public and enforced to keep both public and BLM personal in a safe environment.

- The handling of hazardous, or potentially hazardous materials such as liquid nitrogen and vaccination needles would be accomplished in a safe and conscientious manner by BLM personnel or the contract veterinarian.

2.2.1.10 Responsibility and Lines of Communication

- The local Wild Horse and Burro Specialist / Project Manager from the Color Country District Office (CCDO) would have the direct responsibility to ensure that the procedures in IM 2013-060, Wild Horse and Burro Gather: Management by Incident Command System are followed.

- The Gather Research Coordinator (GRC) from the CCDO would have the direct responsibility to ensure compliance with all monitoring data collection and sampling. The GRC would also ensure appropriate communication with Field Office Manager, HQ-260 National Research Coordinator, College of Veterinary Medicine at Texas A&M University, and APHIS.

- BLM personnel would take an active role to ensure the appropriate lines of communication are established between the Field Office, State Office, Axtell Wild Horse Corrals, Delta Wild Horse Corrals, Southerland Wild Horse Corral, or other Wild Horse Facility.

- While understanding that public and employee health and safety is the top priority, all employees involved in the gathering operations would keep the best interests of the animals at the forefront at all times.

2.2.2. Alternative 2 – Gather and Removal of Excess Wild Burro without Population Growth Suppression

This alternative would be the same as the Proposed Action; however, no population growth suppression treatments would be applied as identified in Section 2.2.1.3.

2.2.3. Alternative 3 – No Action – No Gather, Removal, or Population Growth Suppression

No wild burro gathers, removals, or use of any population growth suppression would be undertaken to address the wild burro's overpopulation and associated range degradation at this time. The No Action Alternative does not comply with the WFRHBA, regulations, or the Richfield RMP and does not meet the purpose and need for action in this EA. It is included as a basis for comparison with the Proposed Action.

2.3. Alternatives Considered but Eliminated from Further Analysis

Alternatives considered but eliminated from detailed analysis are included in Appendix 3, which has discussion and rationale about why each alternative was not carried forward.

Chapter 3. Affected Environment and Environmental Impacts

3.1. Introduction

Chapter 3 contains the effects analysis related to the issues. Section 3.2 presents an overview of reasonably foreseeable environmental trends and planned actions considered in the effects analysis. The Interdisciplinary Team NEPA Checklist (Appendix 1) indicates which resources of concern are either not present in the project area or would not be impacted to a degree that requires detailed analysis. Issues which are necessary to make a reasoned choice between alternatives or determine levels of significance are described in Section 3.3. A scientific literature review is also included in Appendix 5 - SOPs for Population Growth Suppression Methods and Scientific Literature Review.

3.2. Cumulative Effects

The Canyonlands HMA is mainly being utilized by livestock, wildlife, and wild burros. All of these uses are expected to continue. The area has also been impacted by ongoing drought. Various types of recreation use occur in the area. The primary recreational uses include canyoneering and extensive backpacking trips into remote canyons of the Dirty Devil and Horseshoe Canyon drainages. Other popular recreational uses included driving for pleasure, sightseeing, and hunting. It is reasonable to expect that all these uses will continue to increase in the future due to growing popularity of the area, in addition to the surrounding areas being overpopulated with visitors. The HMA is also in close proximity of the Glen Canyon National Recreation Area and Canyonlands National Park units. Dispersed recreation has increased over the past decade. It is expected under all alternatives that these trends in land use, within the area, will continue. No other reasonably foreseeable future actions are known in the HMA.

3.3. Issues

For all issues, the impact analysis area is considered to be in the Robbers Roost grazing allotment (or portions of grazing allotments) that overlap with the Canyonlands HMA. Burros may also be gathered outside of the HMA where burros have strayed in search of forage, water, and space.

3.3.1. General Setting

The average amount of precipitation that is expected for the HMA and Robbers Roost allotment is 8 to 12 inches. According to rain gauge data collected by the Henry Mountain Field Station, the area has had below average precipitation 7 out of the last 14 years. 2015 was the only year that received above average precipitation, and it received 130% of normal. Currently, the area is experiencing Exceptional Drought (see Appendix 8).

Available water within the HMA is the limiting factor regarding the wild burro population. Water is limited to isolated springs and man-made developments that supply water to permitted livestock, wildlife, and wild burros.

3.3.2. *Issue 1. How would removal of wild burros affect livestock grazing?*

Affected Environment

Approximately 3600 Cattle Animal Unit Months (AUMs) and 240 Domestic Horse AUMs are permitted on the Robbers Roost Allotment that is in and adjacent to the HMA (Table 3.1).

Livestock forage allocations based on existing grazing preference (authorized AUMs) were included in the Richfield RMP. The livestock grazing permit was renewed in 2006 within the Canyonlands HMA. For the past several years, actual livestock use within the Robbers Roost allotment has been substantially reduced during the years of drought. As livestock grazing permits are evaluated, additional adjustments to the total livestock grazing may be made through the permit renewal process based on current utilization levels, actual grazing use, vegetative trend and precipitation monitoring data.

Table 3.1. Allotment, Season of Use, Numbers, Kind of Livestock and AUM's in the HMA.

Allotment	Livestock Number	Livestock Kind	Grazing Begin	Period End	%Public Land	AUMs
Robbers Roost	20	Horse	3/1	2/28	100	240
Robbers Roost	300	Cattle	3/1	2/28	100	3600
					TOTAL AUMs	**3840**

Vegetation in these areas continues to be impacted by wild burros, exacerbated by drought conditions. During years of drought, the reduction in the amount of available forage and the utilization of forage by wild burros has caused the Robbers Roost livestock permittee to reduce livestock numbers. Reasons for reductions in use vary within the area, but often include recognition that either there is not sufficient forage for both the present numbers of wild burros and the preference level of livestock grazing or the economics of the range livestock industry are down. Although voluntary reductions in cattle AUMs have been taken by the permittee, burro numbers have remained at or above the upper AML levels throughout most of the drought years.

There are limited amounts of water developments throughout the HMA. These developments range from springs dug out with a pick and shovel to developed springs or wells with pipelines and troughs. Most of the developments have been installed for livestock grazing but provide additional water sources and benefits for wildlife and wild burros. These developments require maintenance from the grazing permittee on the allotment. When permittees do not turn any livestock out on an allotment or area due to drought or other reasons, these developments may not be maintained and can fall into disrepair. This has resulted in reduced water sources for all animals when water is most needed.

Wild burros have dug out holes where there is a seep of water, allowing them to get a drink. However, over time this can compact the soil and can seal off the seep. Burros by nature will paw at a potential water source (Lundgren et al. 2021), which can cause damage to some water troughs. Wild burros have also been known to dig up and break pipelines near air vents, because they can smell the water at that location, adding to the maintenance cost of a pipeline and troughs.

Environmental Impacts

Proposed Action – Gather and Remove Excess Wild Burros from the Canyonlands HMA and Population Growth Suppression using Fertility Control Vaccines and IUDs

Livestock located near gather activities may be temporarily disturbed or displaced by helicopter use and increased vehicle traffic during the gather operations. This displacement would be temporary, and the livestock would move back into the area once gather operations move to another area. Past experience has shown that gather operations have no direct impact on livestock. Direct impacts to livestock grazing from removal of excess wild burros would be reduced competition for water and forage, resulting in an increase in forage availability and quality.

Annual authorized livestock use may be adjusted due to a number of factors, including rangeland health or drought. Managing wild burros at the AML through gather and removal with or without fertility control would help with long-term sustainability of authorized livestock use within the HMA at the current permitted levels. Managing wild burros within AML would reduce the likelihood of adjustments to livestock permits due to overuse of resources by excess wild burros. This action would have no direct impact on current livestock permits in terms of active AUMs, season of use and/or terms and conditions. Any adjustments to livestock permits would be made through the grazing permit renewal process.

Alternative 2 – Gather and Removal of Excess Wild Burro without Population Growth Suppression

Impacts of the gather and removal without population growth suppression would be similar to the Proposed Action. However, wild burro populations would be expected to increase at a faster rate (up to 15% annually) and exceed the high end of the AML sooner than the Proposed Action, which may result in increasing competition between livestock and wild burros.

Alternative 3 – No Action – No Gather, Removal, or Population Growth Suppression

Wild burro populations would continue to increase above the AML established in the RMP, consuming more than allocated for them. Because wild burros compete directly with livestock for resources, there is the potential for authorized livestock to be reduced in line with forage availability, which could impact permittees and result in long-term changes in grazing management. As wild burro numbers increase above the AML, the less available forage there is for livestock grazing. Reduced forage production could result in reduced permitted livestock use within the HMA.

3.3.3. *Issue 2. How would removal of wild burros affect rangeland health/vegetation?*

<u>**Affected Environment**</u>

To achieve desired conditions on the public lands, the BLM uses rangeland health standards and guidelines. Standards describe specific conditions needed for public land health, such as the presence of streambank vegetation and adequate canopy and ground cover. Guidelines are the management techniques designed to achieve or maintain healthy public lands, as defined by the standards. The rangeland health assessment was completed on the Robbers Roost grazing allotment within the gather area prior to the 2006 permit renewal. Nested frequencies, utilization, rangeland health assessments, actual use, precipitation, etc., were utilized to determine whether BLM Utah's Standards and Guidelines for Rangeland Health were being achieved. The Allotment was determined to be functioning at risk due to livestock use in Riparian Areas. Rangeland Health standards were not being met due to the impacts of livestock grazing on wetland/riparian areas.

Monitoring data demonstrates that some areas within allotments show utilization levels from moderate-heavy due to use by both livestock and excess wild burros.

Continued grazing pressure from burros in concentrated areas, especially during persistent years of drought conditions, impairs the potential for future forage production. Livestock grazing is regimented into frequency, intensity, and timing of grazing according to permit renewals, in order to promote forage reproduction and vigor of key species. In contrast, wild burros, especially at levels above AML, continue to graze key species during critical growing periods and without rest, resulting in above-ground production loss. In addition, grazing more than 50 percent of a plant's foliage reduces its root mass and ability to obtain nutrients and water from the soil (Herbel, 1982; Williams, et al., 1968).

Vegetation production and vigor has been reduced by the past and present droughts. Drought is defined as prolonged dry weather, generally when precipitation is less than 75% of the average annual amount (Society for Range Management, 1974). Precipitation is the most important single factor determining the type and productivity of vegetation in an area. Forage production increases rapidly as precipitation increases up to about 20 inches per year (Holechek, 1989). Slight reduction from normal precipitation can cause severe reductions in plant yield in areas with less than 12 inches of precipitation (Klages, 1942). During the periods from 2004-2021 average annual precipitation never exceeded 7 inches within the HMA.

The HMA supports multiple vegetation types including grasslands and black sagebrush sites (see Table 3.2). The dominant vegetation type in the grasslands is Indian ricegrass, galleta, sand dropseed, and needle and thread.

Utilization studies that have been completed, along with RFO staff observations, suggest that as wild burro populations increase, there is a decrease of forage species. The grasses in the key foraging areas were grazed by wild burros, livestock, and wildlife during the critical spring season and utilized moderately-to-heavy.

Environmental Impacts

This analysis assumes that livestock use would continue at levels established by grazing permit renewal decisions, big game population numbers would continue as established by herd management plans and state law, and removal of wild burros would be conducted as proposed in the action alternatives to within the AML levels specified for the HMA.

Proposed Action – Gather and Remove Excess Wild Burros from the Canyonlands HMA and Population Growth Suppression using Fertility Control Vaccines and IUDs

Under the Proposed Action, competition for forage and water between wild burros, wildlife, and livestock would be directly reduced because there would be fewer burros within the HMA. This would also improve rangeland health and keep use levels within management plan objectives.

A reduced demand for forage would help improve the vigor of vegetation and allow for seedling establishment and increased ground cover, thereby helping to establish and maintain a TNEB. If precipitation remains near or above long-term average levels, this reduced demand for forage would facilitate recovery from the extended drought and result in improved vegetative trend of key forage species. Long-term rangeland health would improve within the allotments as key forage and riparian areas would receive less use, especially during time of drought when wild burros are hardest on these areas.

Reducing excess wild burro population to within AML would contribute to maintaining sufficient vegetation and litter within the HMA to protect soil from erosion, meet plant physiological requirements, facilitate plant reproduction, and reduce potential for spread of noxious weeds.

Based on the BLM's experience, helicopter gather operations would result in short-term (1 to 10 days) direct impacts to vegetation including disturbance of native vegetation immediately in and around temporary trap sites and holding and handling facilities. Bait trapping would result in longer duration (5-365 days) direct impacts to vegetation, but these impacts would still be considered short-term. There would be direct impacts to the vegetation immediately in and around temporary trap sites and holding, sorting, and animal handling facilities. Impacts would be created by vehicle traffic and hoof action of penned burros and could be locally severe in the immediate vicinity of the corrals or holding facilities. Keeping the sites approximately one-half acre in size would minimize the disturbance area. Since most trap sites and holding facilities are re-used during recurring wild burro gather operations, any impacts would remain site-specific and isolated in nature. In addition, most trap sites or holding facilities are selected to enable easy access by transportation vehicles and logistical support equipment and would, therefore, generally be near or on roads, pullouts, water haul sites, or other previously disturbed flat spots. These common practices would minimize impacts.

The use of population growth suppression on wild burro gathers would not impact rangeland resources and vegetation directly but would have indirect impacts if wild burro populations were reduced or maintained within AML for longer periods of time. Maintaining populations within AML would extend the beneficial impacts described in this section.

Alternative 2 – Gather and Removal of Excess Wild Burro without Population Growth Suppression

Under this alternative, impacts on rangeland health associated with gather and removal activities would be the same as those that would occur under the Proposed Action. However, without the use of population growth suppression, the AML would be more difficult to maintain as the growth rate would be higher than it would be with the Proposed Action. This would require more frequent gathers in the HMA to maintain AML. Increased frequency of gathers would result in greater short-term disturbance of vegetation and soils in and around temporary trap sites and holding and handling facilities.

Additionally, without slowing reproduction, a steady increase in the number of wild burros through natural foaling rates would result in heavier utilization and downward trend in key forage species. Removal of excess wild burros would be beneficial to vegetative resources, but plant communities would not receive as much opportunity to recover as under the Proposed Action.

Alternative 3 – No Action – No Gather, Removal, or Population Growth Suppression

Under the No Action Alternative, wild burros within and adjacent to the HMA would continue to increase in population beyond the capacity of the habitat to provide water and forage. Moderate to heavy use of vegetation resources by wild burros would continue resulting in further degradation of plant communities, increased soil erosion, and greater susceptibility to invasive species. Downward trends in key perennial species would be expected in conjunction with reductions in ecological condition and soil stability. The vegetative functional/structural groups (i.e., grass, shrubs, trees, etc.) would be changed as grasses are over utilized during critical growing seasons. Vegetation would also experience reduced production, which would result in reduced forage availability to wildlife, livestock, and wild burros. Eventually, rangeland health would be reduced below a threshold from which it would be difficult to recover. Considerable progress towards the Standards and Guidelines for Rangeland Health would not occur.

3.3.4. *Issue 3. How would gathering wild burros affect wetland and riparian resources?*

Affected Environment

Damage to wetland and riparian areas often increases during drought years when excess wild burros may trample and dig in these areas in search of water. Drought conditions have resulted in many of the springs being unavailable as water sources for wildlife, livestock, and wild burros. High populations of wild burro impact riparian areas with increased trailing, vegetative use, and trampling. Heavy use by wild horses has been documented at Wagon and Twin springs (also used by burros), through BLM RFO Proper Functioning Conditioning (PFC) assessments, as a contributing factor in riparian areas at adjacent gathering areas. Burro digging may expose subsurface water in sandy or gravelly streambeds where water is accessible within 1.5 m; Lundgren et al. 2021 suggested that this makes the ecosystem engineers that cause ecological benefits, but

Rubin et al. (2021) and Bleich et al. (2021) pointed out that ecological benefits from wild burro presence must be weighed against ecological damage they can cause, especially at high densities. Of the springs not achieving PFC (13 of 23 springs below PFC), most of the springs that had "non-functional" or "functional-at-risk" ratings (10 of 23 springs) were attributed to heavy cattle grazing and trampling of riparian area. With pressure from livestock and wild burros using these springs, riparian areas within the HMA and adjacent gathering areas can be over utilized with detrimental effects to spring resources.

Table 3.3. Summary of Riparian Condition Ratings

HMA and adjacent gathering areas	Proper Functioning Condition	Functional-At Risk Stable	Functional-At Risk Trending Up	Functional-At risk Trending Down	Non-functional
Canyonlands HMA	1.7 acres	0.1 acres	--	--	2.95 acres
Adjacent gathering areas	2.55 acres	3.25 acres	--	1.5 acres	0.6 acres

Environmental Impacts

Proposed Action – Gather and Remove Excess Wild Burros from the Canyonlands HMA and Population Growth Suppression using Fertility Control Vaccines and IUDs

When possible, trap sites would not be constructed in riparian areas and temporary holding facilities would not be constructed in riparian areas. The Proposed Action may have short term impacts to riparian areas in the event that trap sites are constructed within riparian areas. Traps would be monitored and burros, livestock, and/or wildlife would be removed immediately upon capture. Long term impacts of the Proposed Action would reduce the impacts to riparian wetland zones and improve water quality due to the decreased utilization by wild burros in these sensitive areas, which would allow for the possibility of riparian wetland areas to improve through natural processes. Implementing the Proposed Action would decrease competition for water sources and alleviate pressures exerted on riparian habitat due to wild burros congregating around these sensitive areas. The functionality of riparian resources would improve towards PFC, for those riparian areas below PFC and retain PFC for those riparian areas which are functioning properly, with the removal of excess wild burros and implementation of fertility control.

Alternative 2 – Gather and Removal of Excess Wild Burro without Population Growth Suppression

Under Alternative 2, impacts on riparian areas associated with gather and removal activities would be the same as those that would occur under the Proposed Action. However, in the absence of population growth suppression, wild burro populations would be expected to increase at a faster rate (up to 15% annually) and exceed the high end of the AML sooner, increasing the utilization of riparian vegetation and browse and trampling faster than under the Proposed Action.

Alternative 3 – No Action – No Gather, Removal, or Population Growth Suppression

Direct impacts would result from continued and increased utilization on riparian vegetation as wild burro populations continue to increase. Riparian areas currently rated at PFC, would experience downward trends caused by utilization of riparian vegetation and browse, and trampling by populations of wild burros in excess of AML. Riparian areas rated below PFC (Functional at Risk and Nonfunction) would likely not improve, and downward trends would continue as livestock utilization rates remain unchanged and wild burro numbers continue to increase, resulting in increased utilization of spring resources.

3.3.5. *Issue 4. How would the gathering of burros affect wildlife?*

<u>Affected Environment</u>

There are four threatened and endangered (T&E) wildlife species in the project area. The Southwestern willow flycatcher (*Empidonax traillii extimus*) and Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) have been observed in the Dirty Devil and Green River corridors, but the Canyonlands HMA and adjacent areas where burros will be gathered does not have suitable riparian habitat for either species. California condors (*Gymnogyps californianus*) have been observed in the HMA, but no California condors are known to nest north of Zion National Park (ZNP). The primary T&E wildlife species of concern is Mexican spotted owl (*Strix occidentalis lucida)* and is discussed in detail in Issue 5. With design features, no T&E wildlife species would be affected by the gather activities. While several special status wildlife species are known to occur in the project area, burrowing owl (*Athene) cunicularia),* golden eagle (*Aquila chrysaetos*) and kit fox (*Vulpes macrotis*) would be the primary special status wildlife species affected (refer to Section 2.2.1.5. for Design Features concerning wildlife monitoring), if found. Refer to Wildlife Staff Report for more details.

Big game species that occur in the HMA and surrounding area include desert bighorn (*Ovis canadensis nelsoni*), mule deer (*Odocoileus heminous*), and pronghorn (*Antilocapra americana*). All three species are year-long residents. This area has crucial habitat for desert bighorn with 2,604 acres within the HMA (3% of HMA) including areas to the north and south of the HMA, with seasonal lambing restrictions between April 15th-June 15th. The area also has crucial habitat for pronghorn with 25,998 acres within the HMA (33% of HMA) including areas to the west and north of the HMA, with seasonal fawning restrictions between May 15th-June 15th. Burro gathering is likely to occur in the area to the west of the HMA which has seasonal pronghorn fawning restrictions. Mule deer occur in the area but do not have any crucial habitat in the project area. Competition between wildlife and wild burros increases dramatically when fewer resources such as forage and/or water are available. Cougars are known to kill burros (Lundgren et al. 2022), but the herd size trends in Canyonlands HMA indicate that if there is any predation on burros there, it is at a low enough level that it does not prevent the herd from growing at a relatively high rate.

A variety of migratory birds inhabit the HMA and surrounding area during the spring, summer, and fall months (refer to Section 2.2.1.5. for Design Features concerning wildlife monitoring), including the black-throated sparrow (*Amphispiza bilineata*), canyon wren (*Catherpes* mexicanus), common nighthawk (*Chordeiles minor*), common poorwill (*Phalaeaenoptilus nuttallii*), common raven (*Corvus corax*), Cooper's hawk (*Accipiter cooperii*), great horned owl (*Bubo virginianus*), horned lark (*Eremophila alpestris*), long-eared owl (*Asio otus*), mourning dove (*Zenaida macroura*), northern flicker (*Colaptes auratus*), pinyon jay (*Gymnorhinus cyanocephalus*), prairie falcon (*Falco mexicanus*), red-tailed hawk (*Buteo jamaicensis*), rock wren (*Salpinctes obsoletus*), sagebrush sparrow (*Artemisiospiza nevadensis*), Say's phoebe (*Sayornis saya*), and Western screech owl (*Megascops kennicottii*).

No fish species occur within the HMA or surrounding burro gathering area. The closest areas with fish habitat are the Dirty Devil and Green River corridors.

Environmental Impacts

Proposed Action – Gather and Remove Excess Wild Burros from the Canyonlands HMA and Population Growth Suppression using Fertility Control Vaccines and IUDs

Activities such as using helicopters and roping can have short-term effects on wildlife due to human noise and activity and potential surface disturbances. Direct impacts from bait and water trapping would vary by wildlife species. The intensity of these impacts would vary by individual and would be indicated by behaviors ranging from nervous agitation to physical distress. Temporary disturbance or displacement would occur to wildlife during set up of traps or if they were unable to escape when burros were captured in a trap. Since traps are monitored, it is very unlikely wildlife would become trapped. Refer to Section 2.2.1.5. for design features which will be used to mitigate disturbances associated with helicopter and bait trapping.

Big game habitat would be indirectly affected by the improvements in resource health from the removal of excess burros and population growth suppression. Implementing the Proposed Action would reduce utilization on key forage species, improving the quantity and quality of forage available to wildlife and decreasing competition for water sources. Impacts to big game from drive trapping gather operations should be minimized because gather operations would not occur from March 1-August 31, which overlaps with the most critical stress periods for desert bighorn, mule deer, and pronghorn lambing/fawning seasons.

Short-term impacts to migratory birds could include the occasional destruction of nests and eggs due to trampling by burros, or associated nest abandonment of birds intolerant to disturbances. Refer to Section 2.2.1.5 for design features will be used to mitigate disturbances to migratory birds, if trapping occurs during March 1 – July 31.

Alternative 2 – Gather and Removal of Excess Wild Burro without Population Growth Suppression

Under Alternative 2, impacts to wildlife associated with gather and removal activities would be the same as those that would occur under the Proposed Action. However, in the absence of population growth suppression, wild burro populations would be expected to increase at a faster rate (up to 15% annually) and exceed the high end of the AML sooner, increasing the frequency of gathers. Heavy and severe use of desirable vegetation and water resources by wild burros would increase faster than under the Proposed Action.

Alternative 3 – No Action – No Gather, Removal, or Population Growth Suppression

Under the No Action Alternative, important wildlife upland habitats would continue to be impacted to a greater degree as the wild burro population increases. Downward trends in key perennial vegetation species would be expected in conjunction with reductions in ecological condition. As this occurs, vegetation would also experience reduced production levels resulting in reduced forage available to wildlife. Wild burros would increasingly compete with wildlife for resources. Desert shrub obligates dependent on suitable desert shrub ecosystems for nesting and breeding would continue to be depleted. Competition between desert bighorn, mule deer, pronghorn and wild burros for forage and water resources during the spring and summer months would continue. However, the potential impacts from disruption due to increased human activity, trampling of nests at trap sites, and helicopter use would not occur.

3.3.6. *Issue 5. How would the gathering of wild burros affect MSO habitat and nesting areas?*

<u>Affected Environment</u>

Mexican spotted owl (MSO) has 41,965 acres of designated critical habitat within the HMA (53% of HMA) and surrounding areas (69 FR 53182). The primary constituent elements for critical habitat in canyon habitats are cooler and often more humid conditions than the surrounding area; clumps or stringers of trees and/or canyon walls containing crevices, ledges, or caves; high percentage of ground litter and woody debris; and/or riparian or woody vegetation. These primary constituent elements provide physical and biological feature that support nesting, roosting, and foraging. All projects occurring within MSO designated critical habitat or where MSO are known to occur require United States Fish & Wildlife Service (USFWS) Section 7 Consultation before they can proceed.

In addition to designated critical habitat the RFO has designated five Protected Activity Centers (PAC) at Burro Seep Canyon, French Spring Canyon, Larry Canyon, Sam's Mesa Box Canyon, and Twin Corral Box Canyon, in the HMA area. PACs have a spatial buffer of 0.5 miles, for BLM sanctioned activities, such as Special Recreation Permits (SRP) and ground disturbance projects between March 1 – August 31, which is the time when MSO breed, brood, and fledge their young.

Wherever found, regardless of designated critical habitat or PAC's, MSO occupied nest sites have a 0.5-mile spatial buffer preventing ground disturbance between March 1 – August 31.

<u>Environmental Impacts</u>

Proposed Action – Gather and Remove Excess Wild Burros from the Canyonlands HMA and Population Growth Suppression using Fertility Control Vaccines and IUDs

Under the Proposed Action, Design Features (Section 2.2.1.5) will be in place to prevent helicopter trapping during the seasonal buffer between March 1 – August 31, preventing the disturbance of occupied nest sites. Bait and water trapping near riparian resources, is the one primary constituent element in MSO designated critical habitat which may be affected by the burro gather, by temporarily displacing prey species, which MSO forage upon. Impacts from bait and water trapping on MSO habitat will be short term and will not occur within 0.5 miles of an occupied nest or PAC site between March 1 – August 31.

Long term, the Proposed Action would reduce utilization of forage species, resulting in greater seed production, which MSO prey species forage on, ultimately benefiting MSO. Less utilization of water resources, by burros, will also benefit both MSO and their prey.

Alternative 2 – Gather and Removal of Excess Wild Burro without Population Growth Suppression

Under Alternative 2, impacts to MSO associated with gather and removal activities would be the same as those that would occur under the Proposed Action. However, in the absence of population growth suppression, wild burro populations would be expected to increase at a faster rate (up to 15% annually) and exceed the high end of the AML sooner, increasing the frequency of gathers. Heavy and severe use of desirable vegetation, which is a seed source for MSO prey species, and water resources by wild burros would increase faster than under the Proposed Action.

Alternative 3 – No Action – No Gather, Removal, or Population Growth Suppression

Under the No Action Alternative, important MSO designated critical habitat would continue to be impacted to a greater degree as the wild burro population increases. Downward trends in key perennial vegetation species would be expected in conjunction with reductions in ecological condition. As this occurs, vegetation would also experience reduced production levels resulting in reduced seed production available to MSO prey species. Riparian resources would continue to be negatively impacted as burro populations increase. However, the potential impacts from disruption due to increased human activity, trampling of MSO prey nests/burrows at trap sites, and helicopter use would not occur.

3.3.7. *Issue 6. How would the gathering and removal of excess wild burros affect individual wild burros and the overall population of the HMA?*

Affected Environment

The only known gather and removal on the Canyonlands HMA occurred in 1988. Burro gathers have proven to be difficult, due to the remoteness, rugged terrain and burro movement. Other burro gathers (Sinbad HMA) in the San Rafael Swell area have proven to be difficult due to these same factors. As the population increases, it becomes harder to gather the number of burros needed to reduce the population to within AML.

Since the completion of the RMP in 2008 the AML has been 60-100 burros. The current estimated population of the Canyonlands HMA (Table 2.1) was developed after completion of an aerial population inventory flight in March of 2022, and subsequent analysis of the data to estimate the number of animals that were present in the surveyed area, but not seen by any observer (Crabb, 2022). The statistical analysis for 2022 survey of burro abundance in Canyonlands led to an expected population of 151 head by fall 2022 (see Table 2.1 and Population Inventory, Appendix 9). Of the burros present in the March 2022 survey area, 39% were estimated to be outside the HMA boundaries.

Because burros have a cecal digestive system, can eat a wide variety of low-quality forage, and can cover longer distances than can domestic ruminants, wild burros may remain in good health under forage conditions that would be fatal to domestic ruminants; their physiological adaptations allow them to survive in environments with less available water than many other mammals (Douglas and Hurst 1993). This has allowed burros in the HMA to remain healthy during drought conditions as they have been able to move up to 15 miles between water and forage sources. However, if drought conditions continue, the BLM expects that there would be an increase in burros lost to starvation and dehydration, as has occurred in the past.

Upland vegetation in proximity to reliable water sources is used more heavily by wild burro, wildlife, and livestock, while vegetation in areas farther from water is used slightly or not at all. There are many areas within the HMA that have adequate forage but are not usable for most of the year due to lack of water and/or seasonal conditions. During drought conditions, as has occurred during 1999-2004 and the last few years, several water sources dry up, concentrating wild burros on the remaining water sources and limiting the number of burros that the HMA can support. The increased concentration of wild burros at and near these sites reduces vegetation and causes soil compaction.

Currently, there is no genetic information on the Canyonlands wild burro herd. However, they should not be considered to be a truly isolated herd; rather this herd should be seen as part of a larger metapopulation of connected subpopulations of wild burros (NAS 2013). Samples collected as a result of the first gather will inform BLM's understanding about the herd's current levels of genetic diversity, and the relative similarity of this herd to other sampled herds. At the time of the only gather on this HMA in the late 1980's the collecting of blood or hair samples for genetic analysis was being done on only a few HMAs. Most HMAs now have at least baseline data for genetics.

Based on the BLM's data, forage utilization levels by wild burros on rangelands within the HMA increase as the population increases. The potential for reduction of key forage species also increases as the amount of sustainable forage is depleted through higher levels of use. When grazer density is high relative to available forage resources, overgrazing by any species can lead to long-term reductions in plant productivity, including decreased root biomass (Herbel, 1982; Williams, et al., 1968) and potential reduction of stored carbon in soil horizons. Drought events over the past fifteen years have shown the effects of limited resources range condition (i.e., Dinan et al. 2021). Areas inside and outside the HMA are experiencing increased use on forage species and resources by wild burros as they expanded outside the HMA in search of forage and water.

Environmental Impacts

Proposed Action – Gather and Remove Excess Wild Burros from the Canyonlands HMA and Population Growth Suppression using Fertility Control Vaccines and IUDs

Removal of excess wild burros would improve herd health for animals on the range. Decreased competition for forage and water resources would reduce stress and promote healthier animals. Damage to the range from excess wild burros would be reduced and vegetation resources would start recovering. Wild burro populations above AML compete for forage, water, and cover allocated to wildlife and livestock. The removal of excess animals coupled with anticipated reduced reproduction (population growth rate) as a result of population growth suppression should, therefore, result in improved health and condition of jennies and foals as the actual population comes into line with the population level that can be sustained with available forage and water resources and would allow for healthy range conditions (and healthy animals) over the longer-term. Reduced population growth rates with the use of fertility control vaccines or IUDs would be expected to extend the time interval between gathers and reduce disturbance to individual animals as well as any possible temporary effects on herd social structure resulting from gathers, over the foreseeable future.

Based on the BLM's experience with past gather operations, impacts to individual animals may occur as a result of handling stress associated with the gathering, processing, and transportation of animals. The intensity of these impacts varies by individual animal and is indicated by behaviors ranging from nervous agitation to physical distress. Acute mortality to individual animals from these impacts is infrequent but averaged less than 0.2% of wild burros gathered by bait trapping, and less than 0.5% for wild horse helicopter gathers (Scasta, 2019). Other impacts to individual wild burros include separation of members of individual bands of wild burros and removal of animals from the population. Indirect impacts can occur after the initial stress event and may include increased social displacement or increased conflict between jacks. The BLM's experience is that these impacts may occur intermittently during wild burro gather operations. Traumatic injuries may occur, and typically involve bruises from biting and/or kicking, which do not break the skin.

Gather success in other HMAs has been 60-70% using the helicopter drive trap method. It is anticipated that gather success would be similar in this HMA. Because it would likely take several successive gather operations over the ten-year period to bring the wild burro population of the HMA to low end of AML, bands of burros would continue to leave the boundaries of the HMA into areas not designated for their use in search of forage and water. The stated objectives for wild burro herd management area, to "prevent the range from deterioration associated with overpopulation" and "preserve and maintain a thriving natural ecological balance and multiple use relationship in that area" would not be met with just the first gather operation but would be met as proposed over time.

Until the population in the HMA is brought within AML, individuals in the herd could still be subject to increased stress and possible death as a result of continued competition for water and forage. Although lessened, the areas experiencing heavy and severe utilization levels by wild burros would remain near current levels and impacts to rangeland resources (concentrated trailing, riparian trampling, increased bare ground, etc.) throughout the HMA would be expected to continue until its wild burro population can be reduced to within the AML.

The BLM's experience with previous gathers in Utah is that the more an area is gathered, the more likely it is for horses and burros to learn to evade the helicopter by taking cover in forested areas, rugged terrain and canyons. Wild horses and burros would also move out of the area when they hear a helicopter, thereby further reducing the overall gather efficiency. Frequent gathers would increase this source of stress to wild horses and burros, as individuals and as entire herds.

PZP Vaccine

Selected released jennies would receive a single dose of PZP and/or PZP-22 contraceptive vaccine or similar vaccine/fertility control. A more thorough review of the potential effects of PZP vaccines is in Appendix 5. When injected, PZP (antigen) causes the treated animals' immune system to produce antibodies; these antibodies bind to the zona pellucida proteins on the surface of unfertilized eggs and effectively block sperm binding and fertilization (ZooMontana, 2000). Some jennies could be expected to have impaired ovarian function after treatment with PZP vaccines (Joonè et al., 2017; Nolan et al., 2018). PZP is relatively inexpensive, meets BLM requirements for safety to treated animals and the environment, and can easily be administered in the field. In addition, PZP contraception appears to be reversible for animals that are treated only a few times. One-time application at the capture site would not affect normal development of a fetus should the jennies already be pregnant when vaccinated, hormone health of the jennies, or behavioral responses to stallions (Kirkpatrick et al., 1995). The vaccine has also proven to have no apparent effect on pregnancies in progress, the health of offspring, or the non-reproductive behaviors of treated animals (Turner et. al., 1997). Results from a burro PZP treatment project at Black Mountain HMA (Arizona) have not yet been published but are consistent with published studies on PZP effects in horses (Kahler and Boyles-Griffin 2022).

Based on the BLM's experience, mares and jennies receiving the vaccine would experience slightly increased stress levels associated with handling while being vaccinated and freeze marked. Serious injection site reactions associated with fertility control treatments are relatively rare in treated mares and jennies. It is expected that any direct impacts associated with fertility control, such as swelling or local reactions at the injection site, would be minor in nature and of short duration. Most mares or jennies recover quickly once released back to an HMA, and none are expected to have long term impacts from the fertility control injections, other than the contraceptive effects that are the purpose of treatment.

Ransom et al. (2010) found no differences in how PZP-treated and control mares allocated their time between feeding, resting, travel, maintenance, and 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. Turner and Kirkpatrick (2002) 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.

In two studies involving a total of four wild horse populations, both Nunez 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., 2002). Ransom et al. (2010) found that control mares were herded by stallions more frequently than PZP-treated mares, and Nunez et al. (2009) found that PZP-treated mares exhibited higher infidelity to their band stallion during the non-breeding season than control mares. Madosky et al. (2010) found this infidelity was also evident during the breeding season in the same population that Nuñez et al. (2009) studied, resulting in PZP-treated mares changing bands more frequently than control mares. Long-term implications of these changes in social behavior are currently unknown. One expected long-term, indirect effect on wild horses and burros 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, and their better health is expected to be reflected in 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 mares' milk. This is particularly to be expected if there is an improvement in rangeland forage quality at the same time, due to reduced wild horse population size. Past application of fertility control has shown that mares' overall health and body condition 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, maintained higher body condition, and had larger healthy foals than untreated mares.

Following resumption of fertility, the proportion of jennies that conceive and foal could be increased due to their increased body condition, a phenomenon that could be called a 'rebound effect.' Elevated fertility rates have been observed after horse and burro gathers and removals (Kirkpatrick and Turner, 1991). More research is needed to document and quantify these hypothesized effects; however, it is believed that repeated contraceptive treatment may minimize the hypothesized rebound effect after a gather.

Because successful fertility control would reduce foaling rates and population growth rates, another indirect effect would be to reduce the number of wild burros 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 burros. Also, reducing the numbers of wild burros that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild burros, and thereby could eliminate the need to send additional excess burros from this area to off-range pastures or for other statutorily mandated disposition. A high level of physical health and future reproductive success of fertile jennies within the herd would most likely 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 would also allow for continued and increased improvement to range conditions within the project area, which would have long-term benefits to wild burro habitat quality including, potentially, resilience to ecological disturbances such as drought (i.e., Dinan et al. 2021) and climate change. 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 burros and wildlife throughout the HMA. With rangeland conditions more closely approaching a TNEB, and with a less concentrated distribution of wild burros across the HMA, there should also be less trailing and concentrated use of water sources, which would have many benefits to the wild burros still on the range. Lower population density would be expected to lead to reduced competition among wild burros using the water sources, and less fighting among burros accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild burros. Wild burros would also have to travel less distance back and forth between water and desirable foraging areas. Should PZP booster treatment and repeated fertility control treatment continue into the future, the chronic cycle of overpopulation and large gathers and removals would no longer occur; instead, a consistent cycle of balance and stability would ensue, resulting in continued improvement of overall habitat conditions and animal health. While it is conceivable that widespread and continued treatment with PZP could reduce the birth rates of the population to such a point that birth is consistently below mortality, that outcome is not likely unless a very high proportion of the jennies present are treated in almost every year.

GonaCon-Equine Vaccine

Most of the impacts to animals treated under this alternative would be similar to those for animals treated with PZP, though there are some physiological differences in the mechanism of vaccine action. GonaCon-Equine is a vaccine that causes a jennies to develop antibodies against gonadotropin releasing hormone (GnRH; NAS, 2013). A more thorough review of the potential effects of GonaCon-Equine vaccine is in Appendix 5. Selected released jennies would receive GonaCon-Equine before release back on to the HMA to control the population growth rate. After the first dose that a jenny receives, following doses would be considered a booster. GonaCon-Equine can safely be reapplied as necessary to control the population growth rate. Even with one booster treatment of GonaCon-Equine, it is expected that most, if not all, jennies would return to fertility at some point (based on Baker et al., 2018), although the average duration of effect after a booster dose has not yet been fully quantified. It is unknown what would be the expected rate for the return to fertility in jennies boosted more than once with GonaCon-Equine. It is possible that some jennies treated multiple times with GonaCon-Equine vaccine may remain infertile until they die on the range; that result would be consistent with the contraceptive intention of the vaccine.

Based on the BLM's experience, jennies receiving the vaccine would experience slightly increased stress levels associated with handling while being vaccinated and freeze marked. Serious injection site reactions associated with fertility control treatments are rare in treated jennies. Any direct impacts associated with fertility control, such as swelling or local reactions at the injection site, would be expected to be minor in nature and of short duration. Most jennies would be expected to recover quickly once released back to an HMA, and none are expected to have long term impacts from the fertility control injections.

GonaCon and other anti-GnRH vaccines can be injected while a female is pregnant with no apparent effect on pregnancies in progress, foaling success, or the health of offspring (Miller et al., 2000; Powers et al., 2011; Baker et al., 2013) – in such a case, a successfully contracepted jenny will be expected to give birth during the following foaling season, but to be infertile during the same year's breeding season. Thus, a jenny injected in November 2022 would not show the contraceptive effect (i.e., no new foal) until spring 2024.

Intrauterine Devices (IUDs)

As with other methods of population growth suppression, use of flexible IUDs and other fertility control measures are expected to help reduce population growth rates, extend the time interval between gathers, and reduce the total number of excess animals that will need to be removed from the range. A more thorough review of the potential effects of IUDs is in Appendix 5. The 2013 NAS report considered IUDs, and a recent study by Holyoak et al. (2021) indicates that a flexible, inert, Y-shaped, medical-grade silicone IUD design prevented pregnancies in all the domestic mares that retained the device, even when exposed to fertile stallions.

IUDs are considered a temporary fertility control method that does not generally cause future sterility (Daels and Hughes, 1995). IUDs have historically been used in livestock management, including in domestic horses. Insertion of an IUD can be a very rapid procedure, but it does require the mare or jenny to be temporarily restrained, such as in a squeeze chute. IUDs in mares and jennies may cause physiological effects including discomfort, infection, perforation of the uterus if the IUD is hard and angular, endometritis, uterine edema (Killian et al., 2008), and pyometra (Klabnik-Bradford et al., 2013), but the BLM would not use hard, inflexible IUDs. The effects of IUD use on genetic diversity in a given herd should be comparable to those of other temporary fertility control methods; use should reduce the fraction of mares breeding at any one time but does not necessarily preclude treated mares and jennies from breeding in the future, as they survive and regain fertility.

The exact mechanism by which IUDs prevent pregnancy is uncertain, but may be related to persistent, low-grade uterine inflammation (Daels and Hughes, 1995; Gradil et al., 2021; Hoopes et al., 2021). Turner et al. (2015) suggested that the presence of an IUD in the uterus may, like a pregnancy, prevent the treated animal from coming back into estrus. However, some domestic mares did exhibit repeated estrus cycles during the time when they had IUDs (Killian et al., 2008; Gradil et al., 2019; Lyman et al., 2021; Hoopes et al., 2021). The main cause for an IUD to not be effective at contraception is its failure to stay in the uterus (Daels and Hughes, 1995; NAS, 2013). As a result, one of the major challenges to using IUDs to control fertility in mares and jennies on the range is preventing the IUD from being dislodged or otherwise ejected over the course of daily activities, which could include, at times, frequent breeding.

At this time, it is thought that any IUD inserted into a pregnant mare or jenny may cause the pregnancy to terminate, which may also cause the IUD to be expelled. For that reason, IUDs would only be inserted in non-pregnant (open) animals. Wild mares and jennies that would be screened for pregnancy status for potentially receiving IUDs would be transported to a prep facility with a padded hydraulic squeeze chute, checked for pregnancy by a veterinarian prior to insertion of an IUD which would be appropriately sized for burros. This can be accomplished by transrectal palpation and/or ultrasound performed by a veterinarian. Pregnant mares and jennies would not receive an IUD. Only a veterinarian would apply IUDs in any BLM management action. The animals would be transported back to the range after an observation period of 1 week or more, with exact time period determined by the attending veterinarian.

The U.S. Geological Survey (USGS) / Oklahoma State University (OSU) researchers tested a Y-shaped IUD to determine retention rates and assess effects on uterine health; retention rates were greater than 75% for an 18-month period, and mares returned to good uterine health and reproductive capacity after removal of the IUDs (Holyoak et al., 2021). These Y-shaped silicone IUDs are considered a pesticide device by the EPA, in that they work to mitigate fertility in treated animals by physical means (EPA, 2020).

Water/Bait Trapping

Bait and water trapping would be used in some small areas of the HMA to remove a small number of wild burros or to conduct fertility treatments. This method is slightly less stressful to the burros, but after frequent gathers, wild burros would become more difficult to trap using this method. Burros would begin to avoid water sources or areas where the traps are set. During past water trap operations, some wild burros near death have been observed avoiding going into a water trap. Water trap operations had to be stopped and panels removed to allow these burros to drink before dying.

Bait or water trapping generally requires a long window of time for success. Although the trap would be set in a high probability area for capturing excess wild burros residing within the area and at the most effective time periods, time is required for the burros to acclimate to the trap and/or decide to access the water/bait.

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

When actively trapping wild burros, the trap would be checked daily. Burros would either be 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 trap sites.

Based on the BLM's experience with past gather operations, 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 burros 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 burros at a given location, which can also relieve the resource pressure caused by too many burros. As the proposed bait and/or water trapping in this area is a lower stress approach to gathering of wild burros, such trapping can continue into the foaling season without harming the jennies or foals. Conversely, the BLM has observed that at times water trapping can be stressful to wild burros due to their reluctance approaching new, human structures or intrusions. In these situations, wild burros may avoid watering or may travel greater distances in search of other watering sources or panels may have to be removed to let the burro drink.

Transport, Short-Term Holding, and Adoption Preparation

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

Recently captured wild burros, generally jennies, 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, potential impacts to wild burros are similar to those that can occur during transport. Injury or mortality during the preparation process is low but can occur. 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.

Radio Collaring and Tagging

Based on numerous studies that have used modern radio collars with manual (emergency) remote releases as well as timed-releases as a back up, and GPS transmitter tags to study the ecology of wild ungulates and equids in particular, the current design of these devices has almost no effect on the animals wearing them. The impact of GPS transmitters weighing 30g braided into the tail of a wild horse is negligible and considered "no impact." All collars on BLM-managed wild burros would have a scheduled drop-off date that happens before the end of the battery life, and a remotely-triggerable drop-off function that can be activated any time, via ultra-high frequency (UHF) radio signal. The impact of radio collars and tags is very minimal. For example, from March 2015 into 2020 researchers at the USGS conducted a preliminary study on captive wild horses and burro jennies to determine proper fit and wear of radio collars (Schoenecker et al., 2020). The condition of wild horses and burros wearing radio collars was compared to non-collared controls and documented with photographs. In addition, both collared individuals and controls were observed for 80 minutes each week for 14 weeks to quantify any impact of the collar on their behavior and health. At the end of the study period (2020) the collars were removed and neck assessments were conducted. Analyses indicate that mares had almost no impact in terms of rubbing or wear from radio collars and behavior of collared and uncollared mares and burros did not differ (Schoenecker et al., 2020). There was also no impact of radio tags on behavior or wear. In more recent studies that included free-roaming radio-collared burros, the authors did not report any injuries to collared burros (Gedir et al. 2021, Hennig et al. 2022).

There are some possible effects from the use of collars on horses or burros. On males, on rare occasions, a collar over an ear has been observed, so no males would be collared. Also, collars may be fitted too tightly, or a horse or burro may grow, tightening the collar. If these situations are observed, the remote-release function would be activated remotely. If remote release failed, the collar would be removed after capturing the animal through approved methods part of the Proposed Action. Serious neck abrasions or sores have not been reported in the wild where BLM-managed wild horses have been collared recently (e.g., Collins et al., 2014; Schoenecker et al., 2020; Schoenecker et al. 2022). If neck abrasions or sores caused by a collar are observed and have not healed within 4 weeks of when it is sighted, the collar's remote release would be deployed, or the burro would be captured as soon as possible to remove the collar.

No effects are expected from the tail tags; however, it is possible that they may form an irritation to individuals should vegetation get tangled in the tail. In this case it is expected that the tag would ultimately rip out of the hair (leaving no injury) as the burro rubs it. Similarly, the BLM's observation has been that tail tags eventually fall off the animal as the tail hair grows out, typically within a year. At this time, tail tags have been attached by braiding horse tail hair. Burro tail hair is more sparse than horse tail hair, but tags may still be attached to burro tails if a similarly safe and effective method is available.

The use of collar and tag technology could be beneficial to understanding how free-roaming burros move across the HMA and use increasingly scarce resources. Lack of this information has contributed to the management complexity of this species. Applying this technology to the monitoring of free-roaming burros could provide the opportunity to better understand burro resource use, habitat preference, home range, and movement patterns. Such radio collars could be incorporated into investigations of social structure and herd or band dynamics as well as behavioral modifications associated with reproductive management, including contraceptive use and sterilization however, there are no such sterilization studies proposed to take place in this HMA at this time. Therefore, any planned application of GPS technology to record animal locations is being considered in this decision as part of BLM's potential wild burro monitoring.

Wild Burros Remaining or Released Following a Gather

The wild burros that are not captured may be temporarily disturbed and may move into another area during the gather operations. Apart from changes to herd demographics (primarily in the form of a lower population size after some animals are removed), the BLM's experience with gathers over the past 40+ years is that direct population-wide impacts have been temporary in nature with most if not all impacts disappearing within hours to several days of when wild burros are released back into the HMA. No observable effects associated with these impacts would be expected within one month of the gather operations or release, except for a heightened awareness of human presence.

As a result of lower density of wild burros across the HMA following the removal of excess burros competition for resources would be reduced, allowing wild burros to utilize preferred, quality habitat. Confrontations between jacks would also become less frequent, as would fighting among wild burro bands at water sources. Achieving the AML and improving the overall health and fitness of wild burros could also increase foaling and foaling survival rates over the current conditions.

The primary effects to the wild burro population that would be directly related to this proposed gather would be to herd population dynamics, age structure or sex ratio, and subsequently the growth rates and population size over time. The remaining wild burros not captured would maintain their social structure and herd demographics (age and sex ratios). Impacts to the rangeland as a result of the current overpopulation of wild burros would be reduced under the Proposed Action. Fighting among jacks would decrease since they would protect their position at water sources less frequently; 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.

Indirect individual impacts are those impacts which occur to individual wild burro after the initial stress event, and may include spontaneous abortions in jennies, and increased social displacement and conflict in jacks. These impacts, like direct individual impacts, are known to occur intermittently during wild burro gather operations. An example of an indirect individual impact would be the brief skirmish which occurs among older jacks following sorting and release into the jack pen, which lasts less than two minutes and ends when one jack retreats. The BLM's experience with past gathers indicates that traumatic injuries usually do not result from these conflicts. These injuries typically involve a bite and/or kicking with bruises which do not break the skin. Like direct individual impacts, the frequency of occurrence of these impacts among a population varies with the individual.

Spontaneous abortion events among pregnant mares and jennies following capture are also rare, though poor body condition can increase the incidence of such spontaneous abortions. Given the expected timing of gathers contemplated in this action, spontaneous abortion is not considered to be an issue for the proposed gather.

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

- The jenny rejecting the foal. This occurs most often with young mothers or very young foals.
- The foal and mother becoming separated during sorting and cannot be matched.
- The jenny dying or being humanely euthanized during the gather.
- A foal being ill, weak, or needing immediate special care that requires removal from the mother.
- The mother not producing enough milk to support the foal.

Occasionally, foals are gathered that were already orphans 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 the agency's experience is that they rarely die or have to be euthanized. Nearly all foals that would be gathered would be over four months of age and some would be ready for weaning from their mothers. In private industry, domestic horses are normally weaned between four and six months of age.

Gathering the wild horses and burros during the fall/winter reduces risk of heat stress, although this can occur during any gather, especially in older or weaker animals. Adherence to the CAWP and gather SOPs as well and techniques used by the gather crew or contractor help minimize the risks of heat stress. Heat stress does not occur often, but if it does, death can result.

Alternative 2 – Gather and Removal of Excess Wild Burro without Population Growth Suppression

Under Alternative 2, impacts on wild burros associated with gather and removal activities would be the same as those that would occur under the Proposed Action. However, in the absence of population growth suppression, wild burro populations would be expected to increase at a faster rate (up to 15% annually) and exceed the high end of the AML sooner, increasing the frequency of gathers.

Alternative 3 – No Action – No Gather, Removal, or Population Growth Suppression

The No Action Alternative would not meet the purpose and need and would not conform with the WFRHBA, Federal regulations, and BLM policy. The current population would likely continue to increase at a rate of 15% annually (NAS, 2013). The BLM realizes that some members of the public advocate "letting nature take its course." However, allowing burros to die of dehydration and starvation would be inhumane treatment and clearly indicates that an overpopulation of burro exists in the HMA. The No Action Alternative would not allow for data collection of genetic information of the wild burros in the HMA.

The No Action Alternative would allow wild burro populations to increase beyond the carrying capacity of the rangeland resources within the HMA. The general health of the wild burro population in the HMA would be reduced as burro numbers increased. Large die-offs may occur if the population increases to a point where available forage and water are depleted. This would be especially true during drought or other events such as wildfire.

Short-term herd dynamics would not be impacted under the No Action. Burros would continue to be free-roaming and follow natural patterns. However, if populations increased beyond the carrying capacity, herd dynamics could be impacted because of declines in individual burro health. Near normal populations exhibit a 1:1 sex ratio. If water and forage resources become severely depleted, relative to burro population size, then population sex structure shifts favoring males could occur, as males are better adapted to compete for resources during changing environmental conditions.

Collection of hair follicle samples for genetic diversity monitoring would not be logistically feasible under the No Action alternative; the BLM would most likely not gain baseline information about the genetic diversity status of this herd unless it uses much more expensive and laborious efforts (such as fecal DNA based monitoring).

Chapter 4. Monitoring

Under all alternatives, including the No Action Alternative, monitoring would be required to determine if the program goals are being met. BLM personnel would collect and maintain the data during gather and removal operations as outlined in the Proposed Action and Alternative 2. Population inventory via aerial survey would be conducted every three to four years in the HMA as required by the WFRHBA and BLM policy. Additionally, vegetation monitoring studies (rangeland health, trend, and utilization) would be ongoing and continue to be conducted to document livestock, wildlife, and wild burro use. During gather operations under the Proposed Action and Alternative 2, an APHIS or other licensed veterinarian will be on-site, if needed, to examine animals and make recommendations to BLM for care and treatment of the wild burros.

For the Proposed Action and Alternative 2, supplemental monitoring would take place, based on available funding and personnel, using GPS/VHF radio collars or radio tags to locate individuals and to monitor and record population dynamics, group size responses to change in animal density, management interventions, seasonal weather, and climate. Birth rates and population increase would be monitored after population growth suppression as funding and priorities allow. Samples for genetic monitoring will be collected during gathers under the Proposed Action and Alternative 2, but not the No Action alternative. Periodic introduction of jacks or jennies from a different HMA, with desired characteristics similar to the wild burros within the HMA, could be made to augment genetic diversity in the HMA, as measured by observed heterozygosity, if the results of genetic monitoring indicate that that is prudent.

Chapter 5. Consultation and Coordination

The BLM conducted a virtual public hearing regarding the use of helicopters and motorized vehicles to capture wild horses and burros on April 26, 2022. During the hearing, the public was given the opportunity to comment with new information and to voice any concerns or opinions regarding the use of these methods to capture wild horses (or burros). As required by 43 CFR 4740.1(b). Primary issues discussed include the following.

(1) How helicopters are used during gathers and their effects on wild burros.

(2) Appropriate management levels in HMAs and how they are established and monitored.

(3) Legal ability of BLM using motorized vehicles.

5.1. Persons, Groups, and Agencies Consulted

Name	Purpose & Authorities for Consultation or Coordination	Findings & Conclusions
State Historic Preservation Office (SHPO)	Consultation for undertakings, as required by the National Historic Preservation Act (NHPA) (16 USC 470)	The proposed action is exempt from SHPO consultation as stated in the 2020 Cultural Resource Fieldwork Guidelines and Standards BLM Supplement H-8110-Utah. Temporary animal traps and corrals, in use for one week or less, are included in the list of undertakings exempt from SHPO consultation. This project will be included in annual reporting sent to SHPO per existing protocol.
The Hopi Tribe of Arizona, the Kaibab Band of Paiute Indians of the Kaibab Indian Reservation, the Moapa Band of Paiute Indians of the Moapa River Indian Reservation, the Navajo Nation, the Paiute Indian Tribe of Utah, the Pueblo of Jemez, the San Juan	Consultation as required by the American Indian Religious Freedom Act of 1978 (42 USC 1531) and NHPA (16 USC 1531)	In response to letters dated June 9, 2022, the Paiute Indian Tribe of Utah responded to convey that they have no objections pertaining to the project and are not aware of cultural resource sites, practices, or locations of importance in the tribe's traditional religions or culture within the project area. No further consultation was requested by the Paiute Indian Tribe of Utah for this project. No other responses to the letters were received.

Name	Purpose & Authorities for Consultation or Coordination	Findings & Conclusions
Southern Paiute Tribe of Arizona, the Southern Ute Indian Tribe of the Southern Ute Reservation, the Ute Indian Tribe of the Uintah & Ouray Reservation, the Ute Mountain Ute Tribe, the White Mesa Ute, and the Zuni Tribe of the Zuni Reservation		
United States Fish and Wildlife Service	Consultation as required by Endangered Species Act of 1973, Section 7 (16 U.S.C. 1536).	The Proposed Action would have limited impacts on MSO or their nesting, roosting, or foraging habitat. Therefore, the wild burro gather on the Canyonlands HMA and surrounding areas *may affect, but is not likely to adversely affect* MSO or their critical habitat. Additionally, no other T&E species will be affected by the Proposed Action. Concurrence was issued 8-30-2022, USFWS Project Code 22-0072501.
National Parks Service	Discussion of burros leaving the HMA and entering NPS lands.	Spring of 2021 BLM met with NPS to discuss options for removing burros that leave the HMA and enter NPS land. No traps or holding facilities will be setup on NPS lands during gathers. Helicopters could access NPS airspace during a gather. At the request of NPS, the BLM could assist in moving burros from NPS lands back to the HMA.

5.2. List of Preparers

The list of BLM preparers is included in Interdisciplinary Team NEPA Checklist.

5.3. Public Involvement and Scoping

Notification of the Proposed Action was posted on the BLM's ePlanning website on May 27th, 2022 (https://eplanning.blm.gov/eplanning-ui/project/2019899/510). The BLM will offer a 30-day public comment period on the EA beginning November 1, 2022. The EA will be provided on the project's ePlanning website and announced through a news release, letters, and emails.

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Appendix 1

INTERDISCIPLINARY TEAM CHECKLIST

Project Title: Canyonlands Burro Gather Plan

NEPA Log Number: DOI-BLM-UT-C020-2022-0017-EA

File/Serial Number:

Project Leader: Chad Hunter, Jeff Reese

DETERMINATION OF STAFF: ***(Choose one of the following abbreviated options for the left column)***

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
NC = (DNAs only) actions and impacts not changed from those disclosed in the existing NEPA documents cited in Section D of the DNA form. The Rationale column may include NI and NP discussions.

Determi-nation	Resource	Rationale for Determination	Signature	Date
RESOURCES AND ISSUES CONSIDERED (INCLUDES SUPPLEMENTAL AUTHORITIES APPENDIX 1 H-1790-1)				
NI	Air Quality	Air quality in the project area currently meets National Ambient Air Quality Standards (NAAQS). Hydrocarbons would be released into the atmosphere by internal combustion engines used during the gather but will be short in duration. It is possible that dust will be produced because of the nature of the action but this will also be short in duration. Overall, emissions would be small compared to traffic on local and regional roads and highways. Regardless of the proposed action, the area will likely continue to meet all air quality regulations and standards.	Brandon Jolley	2/3/2022
NP	Areas of Critical Environmental Concern	I have reviewed the Richfield RMP and there are no ACEC's near the project area.	Brandon Jolley	2/3/2022
NI	BLM Natural Areas	The action alternatives occur within two Natural Areas. Horseshoe Canyon South and Labyrinth Canyon. The BLM is required to protect, preserve, and maintain the wilderness characteristics of these two areas. It is expected that there will be no negative impacts to the natural areas. Gather operations (holding corrals, fertility control treatments, etc.) must take place outside the natural area boundaries.	Austin Hiskey	2/10/2022
NP	Cultural Resources	The proposed action is exempt from SHPO consultation as stated in the 2020 Cultural Resource Fieldwork Guidelines and Standards BLM Supplement H-8110-Utah. Animal traps and corrals in use for one week or less are included in the list of undertakings exempt from SHPO consultation.	Jacqueline Monsell	1/31/2022
NI	Environmental Justice	Title VI of the Civil Rights Act and Executive Order 12898 ("Environmental Justice") requires federal agencies to identify and address "disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations." In accordance with CEQ Environmental Justice Guidelines, minority populations should be identified and effects to them analyzed, if either of the following	Brandon Jolley	2/3/2022

Determi-nation	Resource	Rationale for Determination	Signature	Date
		two conditions apply: (1) of those likely to be affected by the Proposed Action, 50 percent or more would be part of the minority population, and (2) within the project area, the minority population percentage is greater than the minority population percentage outside the project area or in the general population. Neither of these conditions applies to the project area for this effort. Therefore, implementation and potential environmental consequences of the action considered would not disproportionately affect any specific group of people (including any racial, ethnic, or socioeconomic group).		
NP	Farmlands (Prime or Unique)	There are no prime or unique farmlands within the HMA according to Soil Survey of the Henry Mountains Area, Utah(631).	Brant Hallows	1/27/2022
NI	Floodplains	Floodplains are present, but the proposed action and alternatives would not affect floodplain function.	Mark Dean	2/7/2022
NI	Fire/Fuels Management	No impact to fire/fuels management	Robert Bate	1/27/2022
NI	Geology / Mineral Resources/Energy Production	The proposed action would have no impact on geologic, mineral resources, or energy production resources	Sam Marolt	1-31-2022
NI	Greenhouse Gas Emissions	While some slight increases in GHG production is expected from the use of equipment during the gather, no significant increases are expected in the long term.	Brandon Jolley	2/3/2022
NI	Invasive Species/Noxious Weeds (EO 13112)	There are currently no known populations of noxious weeds in the HMA and it is not likely that any would be introduced as long as any feed used at or near the traps and holding facilities is certified to be weed free.	Brant Hallows	1/27/2022
NI	Lands/Access	If approved and carried out, assuming appropriate site-specific mitigation, it is anticipated that this burro gather project would generally not negatively impact any land use authorizations within the proposed area; nor would they permanently affect access to public land. All actions would be subject to valid prior existing rights. Authorization holders and adjacent landowners would need to be contacted and coordinated with if they were to be affected by gather efforts. Existing roads and trails should be used for vehicle travel; designated routes should be used where possible. During wet road conditions, any deep ruts remaining on the roads from the proposed action should be repaired at the discretion of the Authorized Officer. Generated trash/debris should be removed from public land and discarded at an authorized facility.	Michael Utley	2/3/2022
NI	Lands with Wilderness Characteristics	There are no Lands with Wilderness Characteristics polygons within the Canyonland HMA; however, LWC may occur outside the HMA boundary. LWC is managed for multiple use and can accommodate gathering operations. Prior to gathering operations, recreation staff will need to be consulted with to identify specific areas where gathering operations can occur.	Austin Hiskey	2/10/2022
PI	Livestock Grazing	The removal of excess burros would be beneficial to livestock. Livestock compete with wild burros for available forage and water resources. Livestock may be temporarily displaced or disturbed during the proposed gather.	Jeff Reese	1/31/2022

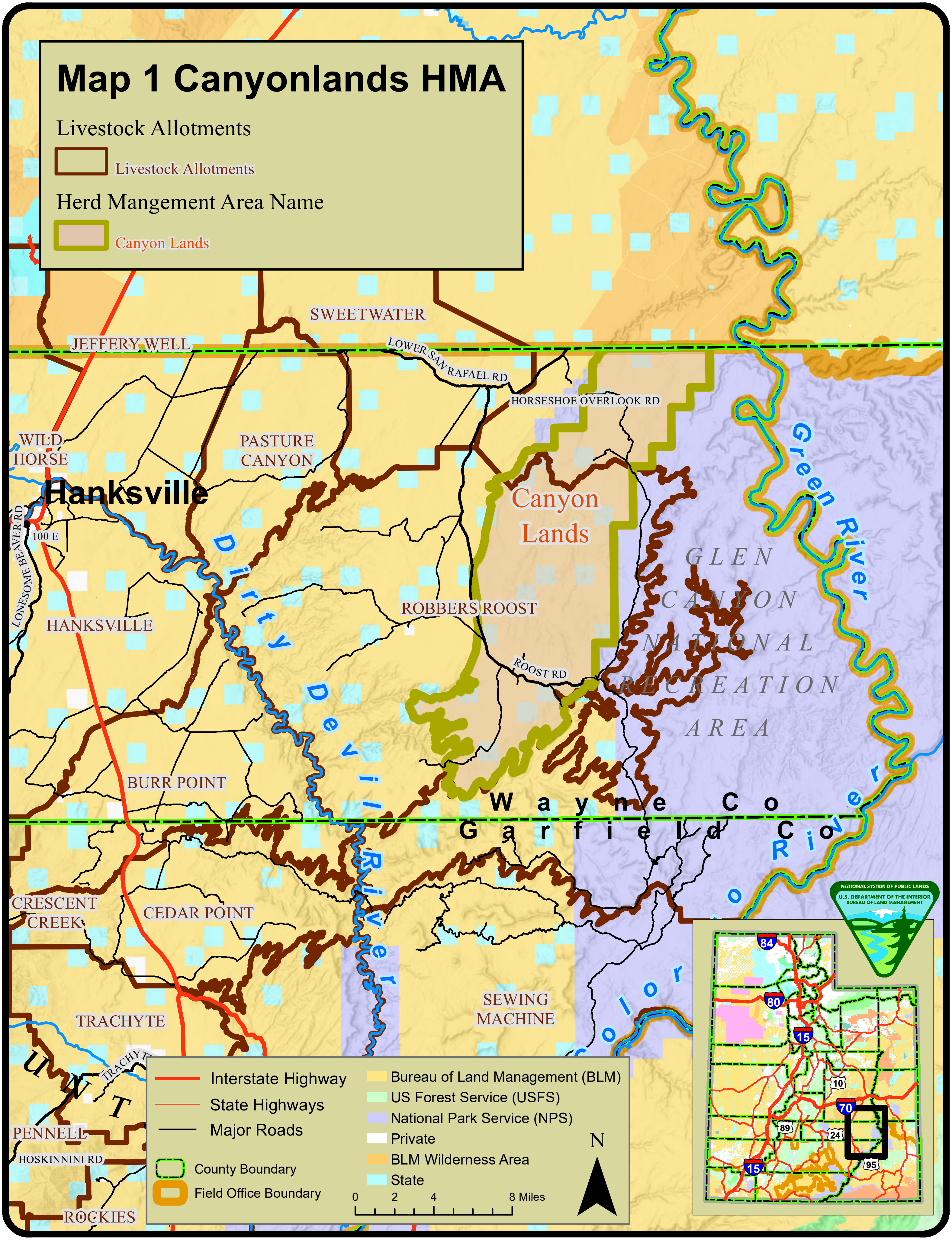
Determi-nation	Resource	Rationale for Determination	Signature	Date
PI	Migratory Birds and Raptors	Any burro trailing/herding routes and temporary staging and corral locations on undisturbed BLM lands will require a wildlife clearance while migratory birds are active, between March 1st-July 31st. Any observed migratory bird nests found during this time will be flagged with a 100 ft buffer. Raptors are also in the project area, such as burrowing owls and golden eagles; and the Raptor BMP's within the RFO RMP will be followed for any raptor nests occurring within the project or surrounding areas. Mexican spotted owl are in the project area, while California condor, Southwestern willow flycatchers, and yellow-billed cuckoo have been known to occur in the area. These species will be discussed in the "Threatened, Endangered, or Candidate Animal Species" section. Other migratory birds occur in the project area, see wildlife staff report.	Joe Chigbrow	2/8/2022
NP	National Historic Trails	There are no National Historic Trails within the vicinity of the action alternatives.	Austin Hiskey	2/10/2022
NP	Native American Religious Concerns	In response to letters dated June 9, 2022, the Paiute Indian Tribe of Utah responded to convey that they have no objections pertaining to the project and are not aware of cultural resource sites, practices, or locations of importance in the tribe's traditional religions or culture within the project area. No further consultation was requested by the Paiute Indian Tribe of Utah for this project. No other responses to the letters were received.	Jacqueline Monsell	7/21/2022
NI	Paleontology	The proposed action is located in PFYC (Potential Fossil Yield Classification) 2- low and 3 – moderate. The proposed action should not affect paleontological resources. However, if any paleontological resources are exposed during the proposed action, work must stop at that location and a qualified BLM representative must evaluate the find.	Sam Marolt	1-31-2022
PI	Rangeland Health Standards	The removal of wild Burros would be expected to be beneficial to Rangeland Health.	Jeff Reese	1/31/2022
NI	Recreation	The action alternatives will allow for recreational opportunities to continue, even when gathering operations commence. The primary recreation activity that occurs within the HMA is canyoneering in the canyon and motorized touring along the motorized routes. These activities will be unrestricted and allowed to occur without interruption. Some recreationists may be negatively impacted by the sight and sounds of the helicopter as it flies over the canyons. This impact is expected to be short term. For those who are displaced by the gathering operations, there are several areas nearby where unconfined recreation will still abound. Once the gathering operations have concluded, the recreational management action of a high probability of experiencing solitude, closeness to nature, self-reliance, challenge, and risk in an unmodified and natural appearing environment will return.	Austin Hiskey	2/10/2022
PI	Utah Sensitive Animal Species and Species of Concern	Any burro trailing/herding routes and temporary staging and corral locations on undisturbed BLM lands will require a wildlife clearance. Other than the raptors discussed in the section "Migratory Birds and Raptors", kit fox is the species most likely to be affected within the project area. If active kit fox burrows are found between December 15 and April 14, their breeding season, then a 0.25 mile buffer around the active burrow is implemented. If active burrows are found	Joe Chigbrow	2/8/2022

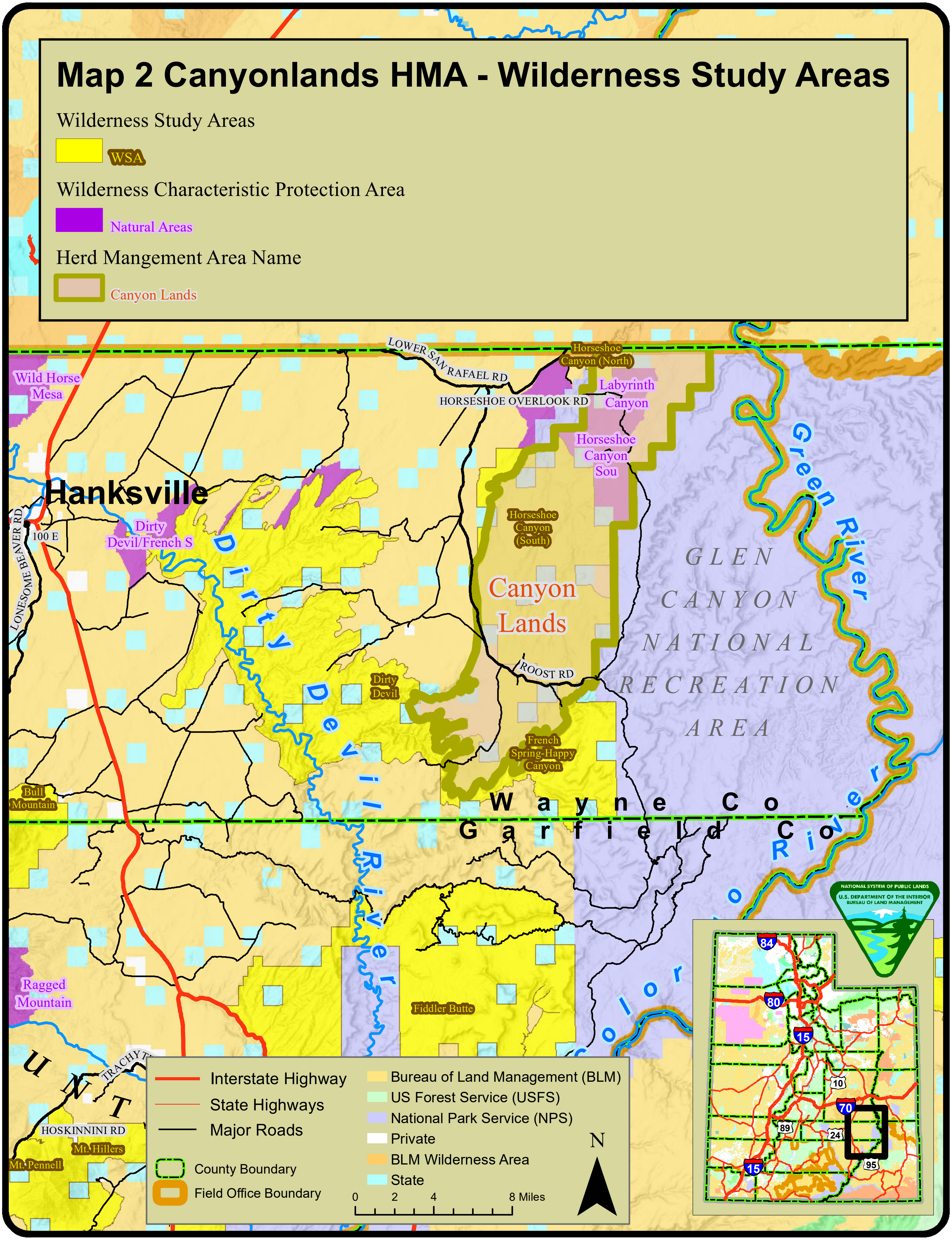
Determi-nation	Resource	Rationale for Determination	Signature	Date
		between April 15 and December 14, a 50 meter buffer should be sufficient. Other SS occur in the project area, see wildlife staff report.		
NP	Sage Grouse	No sage grouse occur in the Henry Mountains Field Station area.	Joe Chigbrow	2/8/2022
NI	Socio-Economics	This project is not expected to have any impacts to the Socio-Economics of the local or regional area.	Brandon Jolley	2/3/2022
NI	Soils	Soil disturbance from hoof action will be the most notable result from the proposed action. Hoof action will be most concentrated in holding areas. Soil Surveys of Glen Canyon National Recreation Area (UT689) and Henry Mountains Area, Utah, Parts of Garfield, Kane, and Wayne Counties (UT631) show the large majority of soils to be moderately resistant to compaction. Because the concentration of hoof action in holding areas will be very short-term in soils that are already moderately resistant to compaction and occur over such small areas, there is no potential for any measurable impacts to soils as a result of the proposed action.	Brant Hallows	1/31/2022
NP	Threatened, Endangered, Candidate or Special Status Plant Species	According to the U.S. Fish and Wildlife's Information for Planning and Consultation site (IPaC) Three species have the potential to be present within the project area: Jones' Cycladenia, Navajo sedge and Ute ladies tresses. The perennial fluvial systems that support Ute ladies tresses are not present, nor are the hanging gardens that support Navajo sedge. Further, Navajo sedge is only known in Utah from San Juan County. Jones' Cycladenia is typically found on steep to very steep raw badlands slopes which are lacking in the project area. The closest known Cycladenia population is approximately 20 air miles away. Cycladenia is very easy to identify, so it is very unlikely that is occurs in the project area. If any of these listed species were to occur, the removal of burros could only be a benefit.	Dustin Rooks	1/28/2022
PI	Threatened, Endangered, or Candidate Animal Species	The Proposed Action would have limited impacts on MSO or their nesting, roosting, or foraging habitat. Therefore, the wild burro gather on the Canyonlands HMA and surrounding areas *may affect, but is not likely to adversely affect* MSO or their critical habitat. Additionally, no other T&E species will be affected by the Proposed Action. Concurrence was issued 8-30-2022, USFWS Project Code 22-0072501.	Joe Chigbrow	10/6/2022
NI	Wastes (hazardous or solid)	There are no known waste issues currently associated with the proposed action. Use of mechanical equipment introduces a threat only if an unforeseen incident or malfunction occurs with the equipment. However, this threat is unlikely due to the probability and minimal quantities of product utilized. Should an unforeseen incident occur, reporting and mitigation is required.	Devin McLemore	2/4/2022
NI	Water Resources/Quality (drinking/surface/ground)	Water resources are present but the proposed action and alternatives would not result in impacts which require detailed analysis. The proposed action would result in some additional soil disturbance when compared to the no action alternative. This activity could result in increased soil erosion and sedimentation downstream, but there are no sensitive receptors nearby or other resource issues of concern.	Mark Dean	2/7/2022

Determi-nation	Resource	Rationale for Determination	Signature	Date
NI	Water Rights	Water Rights are present in the HMA but the proposed action does not include any activities which would affect water rights.	Mark Dean	2/7/2022
PI	Wetlands/Riparian Zones	This project will have short term impacts on riparian areas impacted by burro gathering operations because of trailing/herding burros along riparian corridors. Traps, when possible, would be constructed so that no riparian vegetation is contained within them. If traps do contain riparian vegetation and/or running water, the trap will be monitored so that burros will be removed immediately upon capture. Reduction of burros may improve riparian corridors, especially in areas where burros concentrate, eroding stream banks and heavily grazing riparian vegetation.	Joe Chigbrow	5/31/2022
NI	Wilderness/WSA	Horseshoe Canyon North & South, French Springs-Happy Canyon, and a portion of the Dirty Devil WSA all are located within the action alternatives. These areas are to be managed in a manner that does not impair their suitability for designations as wilderness. Gathering operations like corrals, and fertility treatment areas will not occur within the WSA boundaries. The activities associated with action alternatives should be in conformance with BLM handbook 6330 The use of helicopters will not negatively impact the WSA. Baiting and roping of burros would have negative short-term impacts upon the WSA's. If possible, these activities should not occur in WSAs as it could create an unnatural congregation of burros and would not meet the non-impairment standard. Removal of burros will be beneficial to the WSA's and prevent further impairment. .	Austin Hiskey	2/10/2022
PI	Wildlife and Fish Excluding Designated/Special Status Species	No fish would be impacted by burro gathering operations. This area has crucial habitat for desert bighorn with 2,604 acres within the HMA (3% of HMA) including areas to the north and south of the HMA, with seasonal lambing restrictions between April 15th-June 15th. The area also has crucial habitat for pronghorn with 25,998 acres within the HMA (33% of HMA) including areas to the west and north of the HMA, with seasonal fawning restrictions between May 15th-June 15th. Mule deer occur in the area but do not have any crucial habitat in the project area. This project will have short term impacts on wildlife using this habitat from noise and human disturbance, if burro gathering does not occur within those desert bighorn and pronghorn crucial habitats during fawning and lambing seasonal restrictions.	Joe Chigbrow	2/8/2022
NI	Woodland / Forestry	No impact to Woodland/Forestry	Robert Bate	1/27/2022
PI	Vegetation Excluding Designated/Special Status Species	The proposed gather is not expected to disturb a significant amount of vegetation. There is some disturbance expected in and around trap sites and holding sites. Trap sites and holding sites should be placed in already disturbed areas if possible and small areas where new vegetation disturbance may take place should be reseeded at the conclusion of the gather if possible. The removal of excess wild burros would be beneficial to vegetation by ensuring that there is sufficient forage for wildlife, livestock and wild burros.	Jeff Reese	1/31/2022
NI	Visual Resources	The action alternatives do not include any long-term ground disturbing activities and no permanent structures. Any impacts to visual resources will be short term such as dust.	Austin Hiskey	2/10/2022

Determi-nation	Resource	Rationale for Determination	Signature	Date
		Once the gather has concluded, visual resources will return to their pre gather state.		
PI	Wild Horses and Burros	See EA for detail Analysis	Jeff Reese	1/31/2022

Appendix 2


Map 1 Canyonlands HMA
Livestock Allotments
Livestock Allotments
Herd Mangement Area Name
Canyon Lands
SWEETWATER
JEFFERY WELL
LOWER SAN RAFAEL RD
HORSESHOE OVERLOOK RD
WILD HORSE
PASTURE CANYON
Hanksville
Canyon Lands
100 E
LONESOME BEAVER RD
Dirty Devil River
GLEN CANYON NATIONAL RECREATION AREA
Green River
ROBBERS ROOST
HANKSVILLE
ROOST RD
BURR POINT
Wayne Co
Garfield Co
CRESCENT CREEK
CEDAR POINT
Colorado River
SEWING MACHINE
TRACHYTE
PENNELL
HOSKINNINI RD
ROCKIES
Interstate Highway
State Highways
Major Roads
County Boundary
Field Office Boundary
Bureau of Land Management (BLM)
US Forest Service (USFS)
National Park Service (NPS)
Private
BLM Wilderness Area
State
0 2 4 8 Miles
N
NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
84
80
15
70
89
24
95
10


Map 2 Canyonlands HMA - Wilderness Study Areas
Wilderness Study Areas
WSA
Wilderness Characteristic Protection Area
Natural Areas
Herd Mangement Area Name
Canyon Lands
LOWER SAN RAFAEL RD
Horseshoe Canyon (North)
Wild Horse Mesa
Labyrinth Canyon
HORSESHOE OVERLOOK RD
Horseshoe Canyon Sou
Hanksville
Dirty Devil/French S
100 E
LONESOME BEAVER RD
Horseshoe Canyon (South)
Canyon Lands
GLEN CANYON NATIONAL RECREATION AREA
Green River
Dirty Devil River
ROOST RD
Dirty Devil
French Spring-Happy Canyon
Bull Mountain
Wayne Co
Garfield Co
Colorado River
Ragged Mountain
Fiddler Butte
TRACHY
HOSKINNINI RD
Mt. Hillers
Mt. Pennell
Interstate Highway
State Highways
Major Roads
County Boundary
Field Office Boundary
Bureau of Land Management (BLM)
US Forest Service (USFS)
National Park Service (NPS)
Private
BLM Wilderness Area
State
0 2 4 8 Miles
N
NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
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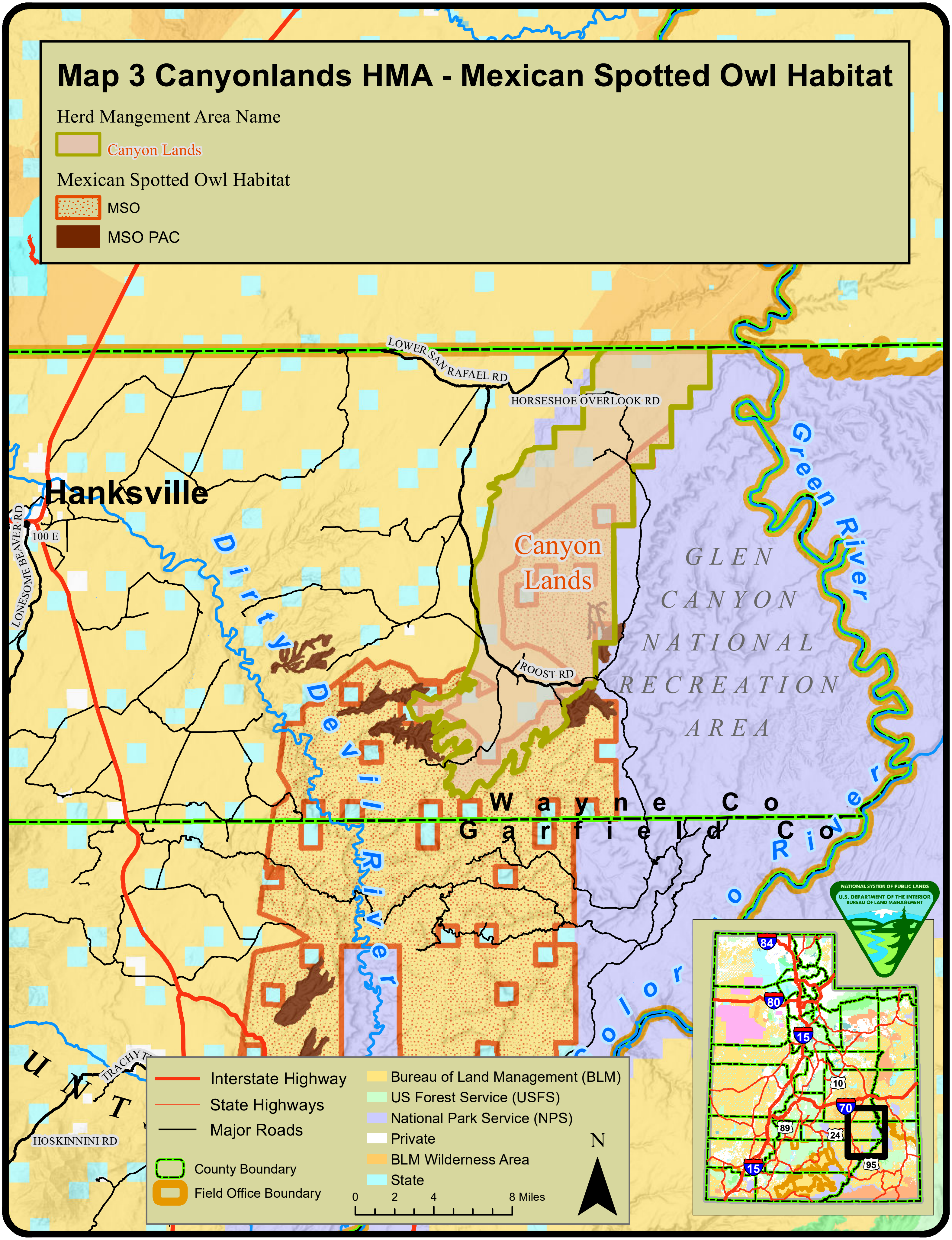
Map 3 Canyonlands HMA - Mexican Spotted Owl Habitat



Appendix 3. Alternatives Considered but Not Analyzed in Detail

Population Growth Suppression without Removals

This alternative would not meet the purpose and need to achieve population objectives. It would not allow for population regulation by removing wild burros to achieve and maintain AML on the Canyonlands HMA. Wild burro management under this alternative would involve gathering and inoculating jennies with PZP or other population growth suppression vaccines as outlined in Alternatives 1 and 2. Gather, data collection, and handling techniques would be followed in accordance with Alternatives 1 and 2. Jennies inoculated during the winter of 2022 and other years the vaccine was administered would foal normally in the spring following treatment. Reproduction would be limited the following year or years after treatment.

The current population within the Canyonlands HMA exceeds the AML as established in the Richfield Field Office Record of Decision and Approved Resource Management Plan (RMP), approved in 2008. Implementing population growth suppression without removing excess wild burros would not address the immediate need of achieving AML and a TNEB. Population modeling shows that using this alternative with the currently available immunocontraceptives would not control the population of wild burros and would not be in conformance with Richfield Field Office RMP. The WFRHBA mandates the BLM to prevent the range from deterioration associated with overpopulation and preserve and maintain a TNEB in consideration with multiple use relationships.

Removal or Reduction of Livestock within the HMA

This alternative is not in the scope of the decision to be made and would not meet the purpose and need. This alternative would involve no removal of wild burros and instead would address excess wild burro population numbers through the removal or reduction of livestock within the HMA. This alternative was not brought forward for detailed analysis because it is inconsistent with multiple use management, as required by FLPMA, the Richfield Field Office RMP and the WFRHBA, which directs the Secretary to immediately remove excess wild burros when BLM has determined that an overpopulation exists on a given area and that action is necessary to remove excess animals.

Livestock grazing can only be reduced on permits following the process outlined in the regulations found at 43 CFR Part 4100. Reductions and changes have already been made to livestock grazing within the allotment associated with the Canyonlands HMA under this authority. The elimination of livestock grazing in an area would require an amendment to the land use plans, which is outside of the scope of this analysis. Such changes to livestock grazing cannot be made through a wild burro gather decision.

Additionally, re-allocating livestock AUMs to wild burros would not achieve the purpose and need identified in Section 1.2 or a TNEB. Livestock can be confined to specific pastures, limited periods of use, and specific seasons-of-use to minimize impacts to vegetation during the critical growing season and to riparian zones during the summer months. Wild burros are present year-round and their impacts to rangeland resources cannot be controlled through establishment of a grazing system. Thus, impacts from wild burros can only be addressed by limiting their numbers to a level within AML that was established to avoid adverse impacts to rangeland resources and other multiple uses.

Gather Wild Burros to the AML Upper Limit

A post-gather population size at the upper level of the AML range (60 to 100) would result in the AML being exceeded the next year. This would be unacceptable for several reasons, including that it does not meet the purpose and need.

The AML represents "that 'optimum number' of wild horses (burros) which results in a thriving natural ecological balance and avoids a deterioration of the range" (Animal Protection Institute, 109 IBLA 119; 1989). The Interior Board of Land Appeals (IBLA) has also held that "Proper range management dictates removal of horses (burros) before the herd size causes damage to the rangeland. Thus, the optimum number of horses (burros) is somewhere below the number that would cause resource damage" (Animal Protection Institute, 118 IBLA 63, 75; 1991).

The upper level of the AML established within a HMA represents the maximum population at which a TNEB would be maintained. The lower level represents the number of animals to remain in a HMA following a wild burro gather, to allow for a periodic gather cycle, and to prevent the population from exceeding the established AML between gathers.

Additionally, gathering to the upper range of AML would result in the need to follow up with another gather within one year (with resulting stress on the wild burro population), and could result in overutilization of vegetation resources and damage to the rangeland if the BLM were unable to gather the excess burros in the HMA on an annual basis. This alternative would not achieve a TNEB and would not prevent further degradation of the rangeland associate with excess wild burros. For these reasons, this alternative did not receive further consideration in this document.

Raising the AML for Wild Burros

Raising the AML where there are known resource degradation issues associated with the current overpopulation of wild burros does not meet the purpose and need of restoring a TNEB or the need to meet rangeland health standards. This alternative would delay a gather until the AML can be reevaluated is inconsistent with the WFRHBA, which directs BLM to manage the range to prevent deterioration associated with excess wild burros and the Secretary to immediately remove excess wild burros and to manage for a TNEB and for multiple uses. There is no basis for modifying the AML at this time because available data shows that excess wild burros are present on the range, that excess burros need to be removed, and that there is insufficient water and forage within the HMA to support an increase in the wild burro AML. Given the resource degradation occurring with the current overpopulation of wild burros, it is necessary to bring the population back to AML first so the agency can collect additional data that would help inform whether the range could support additional burros above AML while still ensuring a TNEB. Given the absence of data that would support a modification to the AML, this gather decision is not an appropriate mechanism for adjusting AML.

Population Growth Suppression Treatment Only Including Using Bait/Water Trapping To Dart Jennies with PZP Remotely (No Removal)

The alternative is technically infeasible, would not meet the purpose and need, and would be contrary to the WFRHBA. Population modeling was completed to analyze the potential impacts associated with conducting gathers approximately every 3 years over the next 10-year period to treat captured jennies with population growth suppression. Under this alternative, no excess wild burros would be removed. The use of bait or water trapping would still not remove excess wild burros. While the average population growth rate would be reduced, AML would not be achieved, and the damage to the range associated with wild burro overpopulation would continue. The use of remote darting to administer PZP within the HMA where the burros are not accustomed to human activity has been shown to be very difficult. For example, in the Cedar Mountain HMA during a two-year study by Humane Society (unpublished) where administration of PZP by remote darting was to occur, not a single horse was successfully darted.

Bait or Water Trap Only

An alternative considered but eliminated from detailed analysis was use of bait and/or water trapping as the primary gathering method. The use of bait and water trapping, though effective in specific areas and circumstances, would not be timely, cost-effective, or technically feasible as the primary gather method for this HMA for the following reasons: (1) the project area is too large to effectively use this gather method; (2) road access for vehicles to potential trapping locations necessary to get equipment in/out as well as to safely transport gathered wild burros is very limited; (3) the presence of scattered water sources on both private, state and public lands inside and outside the HMA would make it almost impossible to restrict wild burro access to the extent necessary to effectively gather and remove the excess animals through bait and/or water trapping to achieve management goals; and (4) the large number of burros that would need to be captured within a year period using only this method requires logistical resource (panels, trucks, trailers, personal etc.) that are not available to the local or state BLM. However, as discussed in the EA, water or bait trapping may be used to achieve the desired goals of Alternatives 1 and 2 if gather efficiencies are too low using a helicopter, a helicopter gather cannot be scheduled, or to help maintain AML once achieved.

Controlling Wild Burro Numbers by Natural Means

This alternative is substantially similar to the No Action Alternative. This alternative was eliminated from further consideration because it is contrary to the WFRHBA, which requires the BLM to prevent the range from deterioration associated with an overpopulation of wild burros. It is also inconsistent with the Richfield Field Office RMP which direct the BLM to conduct gathers as necessary to achieve and maintain the AML. The alternative of using natural controls to achieve a desirable AML has not been shown to be feasible in the past as indicated by the population increases between gathers. Wild burros in the Canyonlands HMA are not substantially regulated by predators. In addition, wild burros are a long-lived species with documented foal survival rates exceeding 95 percent, and they are not a self-regulating species. The National Academies of Sciences report (2013) investigated the claim that wild horses (burros) can “self-regulate” their herds and concluded that horse (burro) populations are expected to behave much as other ungulates. As such, wild burros are not expected to self-regulate their herd sizes at levels that would maintain a TNEB. Rather, decreases in wild burro growth rates would only be expected to take place after available natural resources have become so limited by overgrazing and overuse of water that burro body condition is severely impaired. It is expected that foals and nursing mothers may be the first to suffer starvation and death by thirst. Populations would be expected to crash due to resource limitation, but only after extensive ecological damage had occurred. Allowing populations to be regulated by starvation, death by thirst, and ecological resource degradation would not be consistent with the WFRHBA. This alternative would result in a steady increase in numbers, which would continually exceed the carrying capacity of the range until severe and unusual conditions that occur periodically – such as blizzards or extreme drought – caused catastrophic mortality of wild burros (see Population Modeling).

Gather and Release Excess Wild Burros Every Two Years and Apply Two-Year PZP to Burros for Release.

This alternative would not meet the purpose and need and would be infeasible. Based on past gathers that the BLM has conducted in the San Rafael area, only 50-60% of the population can be gathered in a single gather operation due to excessive vast area, terrain, remoteness and behavior of the target animals. Another alternative considered was to gather a substantial portion of the existing population (90 percent) and implement population growth suppression treatment only, without removal of excess burros. This alternative would not result in attainment of AML for the HMA as excess burros would remain on the HMA. The wild burro population would continue to have an average population growth rate of 5 percent to 15 percent, which would add to the current wild burro overpopulation, albeit at a slower rate of growth than would likely occur under the No Action Alternative.

Use of Gelding as Non-reproductive Population to Reduce Population Growth Rate

This alternative would not meet the purpose and need. A non-reproductive population of geldings was excluded from further consideration at this time due to there being more effective ways to adequately reduce the female burro fertility rates within the HMA. Moreover, by itself, it is unlikely that sterilization (gelding) would allow the BLM to achieve a population within AML or other management objectives of reducing population growth rate since a single jack is capable of impregnating multiple jennies, and jacks other than the dominant jack may also breed with some jennies. Therefore, to be fully effective, use of sterilization to control population growth requires that either the entire male population be gathered and treated (which is not practical) or that some percentage of the female wild horses/burros in the population be gathered and treated. If the treatment is not of a permanent nature (e.g., application of the PZP-22 vaccine to jennies) the animals would need to be gathered and treated on a cyclical basis.

Allow Public to Capture and Remove Wild Burros
An alternative using members of the public to gather wild burros through a permitting process was suggested by the public. This alternative was eliminated from further consideration because it is contrary to the WFRHBA.

The WFRHBA placed all wild free-roaming horses and burros that occur on public lands under the jurisdiction of the Secretary of the Interior and Secretary of Agriculture for the purpose of management and protection in accordance with the provisions of that Act. It places penalties on members of the public that willfully remove or attempt to remove a wild free-roaming horse or burro from the public lands without authorization. The WFRHBA would need to be changed to allow this type of alternative. An administrative process to implement this alternative, which currently does not exist, would need to be developed.

Use Alternative Capture Techniques Instead of Helicopters to Capture Excess Wild Burros
An alternative using capture methods other than helicopters and bait/water trapping was suggested by the public. This alternative is technically infeasible and was eliminated from further consideration. These alternate methods could include chemical immobilization, net gunning, and wrangler/horseback drive trapping as potential methods for gathering burros. Net gunning techniques normally used to capture big game also rely on helicopters. Chemical immobilization is a very specialized technique and is strictly regulated. Currently, the BLM does not have sufficient expertise to implement either of these methods, and they would be impractical to use given the size of the Canyonlands HMA, access limitations, and approachability of the burros.

Use of wrangler on horseback drive-trapping to remove excess wild burros can be fairly effective on a very small scale, but due to the number of excess burros to be removed, the large geographic size of the Canyonlands HMA, access limitations, and approachability of the burros, this technique would be ineffective and impractical. Horseback drive-trapping is also very labor intensive and can be very harmful to the domestic horses and the wranglers used to herd the wild burros.

Designate the Canyonlands to be Managed Principally for Wild Burro Herds
This alternative would address the issue of excess wild burros in the Canyonlands HMA through the complete removal of authorized livestock grazing, instead of by gathering and/or removing excess wild horses and burros from the HMA. This alternative would be contrary to the Richfield Field Office RMP by allowing the wild horse and burro population to remain above AML. Therefore, this alternative does not meet the purpose and need to achieve and maintain the established AML.

This alternative is also inconsistent with the Wild Horse and Burro Act, which directs the Secretary to immediately remove excess wild horses and burros when a determination is made that such a removal is necessary to achieve a thriving natural ecological balance. The available monitoring data does not indicate a need to change the level of livestock grazing. Nor does the available monitoring data indicate that changes to AML are warranted at this time, since there is no evidence of changes in habitat conditions (such as greater availability of water) that would allow for increases in the wild burro AML.

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

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

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

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

Appendix 4

COMPREHENSIVE ANIMAL WELFARE PROGRAM

FOR WILD HORSE AND BURRO GATHERS

STANDARDS

Developed by

The Bureau of Land Management
Wild Horse and Burro Program

in collaboration with

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WELFARE ASSESSMENT STANDARDS for GATHERS

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STANDARDS

Standard Definitions

Major Standard: Impacts the health or welfare of WH&Bs. Relates to an alterable equipment or facility standard or procedure. Appropriate wording is "must," "unacceptable," "prohibited."

Minor Standard: unlikely to affect WH&Bs health or welfare or involves an uncontrollable situation. Appropriate wording is "should."

Lead COR = Lead Contracting Officer's Representative

COR = Contracting Officer's Representative

PI = Project Inspector

WH&Bs = Wild horses and burros

I. FACILITY DESIGN

A. Trap Site and Temporary Holding Facility

1. The trap site and temporary holding facility must be constructed of stout materials and must be maintained in proper working condition, including gates that swing freely and latch or tie easily. (**major**)
2. The trap site should be moved close to WH&B locations whenever possible to minimize the distance the animals need to travel.(minor)
3. If jute is hung on the fence posts of an existing wire fence in the trap wing, the wire should be either be rolled up or let down for the entire length of the jute in such a way that minimizes the possibility of entanglement by WH&Bs unless otherwise approved by the Lead COR/COR/PI. (minor)
4. Fence panels in pens and alleys must be not less than 6 feet high for horses, 5 feet high for burros, and the bottom rail must not be more than 12 inches from ground level. (**major**)

5. The temporary holding facility must have a sufficient number of pens available to sort WH&Bs according to gender, age, number, temperament, or physical condition. (**major**)
    a. All pens must be assembled with capability for expansion. (**major**)
    b. Alternate pens must be made available for the following: (**major**)
        1) WH&Bs that are weak or debilitated
        2) Mares/jennies with dependent foals
    c. WH&Bs in pens at the temporary holding facility should be maintained at a proper stocking density such that when at rest all WH&Bs occupy no more than half the pen area. (minor)
6. An appropriate chute designed for restraining WH&Bs must be available for necessary procedures at the temporary holding facility. This does not apply to bait trapping operations unless directed by the Lead COR/COR/PI. (**major**)
7. There must be no holes, gaps or openings, protruding surfaces, or sharp edges present in fence panels or other structures that may cause escape or possible injury. (**major**)
8. Padding must be installed on the overhead bars of all gates and chutes used in single file alleys. (**major**)
9. Hinged, self-latching gates must be used in all pens and alleys except for entry gates into the trap, which may be secured with tie ropes. (**major**)
10. Finger gates (one-way funnel gates) used in bait trapping must be constructed of materials approved by the Lead COR/COR/PI. Finger gates must not be constructed of materials that have sharp ends that may cause injuries to WH&Bs, such as "T" posts, sharpened willows, etc. (**major**)
11. Water must be provided at a minimum rate of ten gallons per 1000 pound animal per day, adjusted accordingly for larger or smaller horses, burros and foals, and environmental conditions, with each trough placed in a separate location of the pen (i.e. troughs at opposite ends of the pen). Water must be refilled at least every morning and evening. (**major**)
12. The design of pens at the trap site and temporary holding facility should be constructed with rounded corners. (minor)

13. All gates and panels in the animal holding and handling pens and alleys of the trap site must be covered with materials such as plywood, snow fence, tarps, burlap, etc. approximately 48" in height to provide a visual barrier for the animals. All materials must be secured in place.(**major**)

    These guidelines apply:

    a. For exterior fences, material covering panels and gates must extend from the top of the panel or gate toward the ground.(**major**)
    b. For alleys and small internal handling pens, material covering panels and gates should extend from no more than 12 inches below the top of the panel or gate toward the ground to facilitate visibility of animals and the use of flags and paddles during sorting. (minor)
    c. The initial capture pen may be left uncovered as necessary to encourage animals to enter the first pen of the trap. (minor)
14. Non-essential personnel and equipment must be located to minimize disturbance of WH&Bs. (**major**)
15. Trash, debris, and reflective or noisy objects should be eliminated from the trap site and temporary holding facility. (minor)

B. Loading and Unloading Areas

1. Facilities in areas for loading and unloading WH&Bs at the trap site or temporary holding facility must be maintained in a safe and proper working condition, including gates that swing freely and latch or tie easily. (**major**)
2. The side panels of the loading chute must be a minimum of 6 feet high and fully covered with materials such as plywood or metal without holes that may cause injury. (**major**)
3. There must be no holes, gaps or openings, protruding surfaces, or sharp edges present in fence panels or other structures that may cause escape or possible injury. (**major**)
4. All gates and doors must open and close easily and latch securely. (**major**)

5. Loading and unloading ramps must have a non-slip surface and be maintained in a safe and proper working condition to prevent slips and falls. Examples of non-slip flooring would include, but not be limited to, rubber mats, sand, shavings, and steel reinforcement rods built into ramp. There must be no holes in the flooring or items that can cause an animal to trip. (**major**)
6. Trailers must be properly aligned with loading and unloading chutes and panels such that no gaps exist between the chute/panel and floor or sides of the trailer creating a situation where a WH&B could injure itself. (**major**)
7. Stock trailers should be positioned for loading or unloading such that there is no more than 12" clearance between the ground and floor of the trailer for burros and 18" for horses. (minor)

II. CAPTURE TECHNIQUE

A. Capture Techniques

1. WH&Bs gathered on a routine basis for removal or return to range must be captured by the following approved procedures under direction of the Lead COR/COR/PI. (**major**)
   a. Helicopter
   b. Bait trapping
2. WH&Bs must not be captured by snares or net gunning. (**major**)
3. Chemical immobilization must only be used for capture under exceptional circumstances and under the direct supervision of an on-site veterinarian experienced with the technique. (**major**)

B. Helicopter Drive Trapping

1. The helicopter must be operated using pressure and release methods to herd the animals in a desired direction and should not repeatedly evoke erratic behavior in the WH&Bs causing injury or exhaustion. Animals must not be pursued to a point of exhaustion; the on-site veterinarian must examine WH&Bs for signs of exhaustion. (**major**)

2. The rate of movement and distance the animals travel must not exceed limitations set by the Lead COR/COR/PI who will consider terrain, physical barriers, access limitations, weather, condition of the animals, urgency of the operation (animals facing drought, starvation, fire, etc.) and other factors. (**major**)
    a. WH&Bs that are weak or debilitated must be identified by BLM staff or the contractors. Appropriate gather and handling methods should be used according to the direction of the Lead COR/COR/PI. (**major**)
    b. The appropriate herding distance and rate of movement must be determined on a case-by-case basis considering the weakest or smallest animal in the group (e.g., foals, pregnant mares, or horses that are weakened by body condition, age, or poor health) and the range and environmental conditions present. (**major**)
    c. Rate of movement and distance travelled must not result in exhaustion at the trap site, with the exception of animals requiring capture that have an existing severely compromised condition prior to gather. Where compromised animals cannot be left on the range or where doing so would only serve to prolong their suffering, euthanasia will be performed in accordance with BLM policy. (**major**)
3. WH&Bs must not be pursued repeatedly by the helicopter such that the rate of movement and distance travelled exceeds the limitation set by the Lead COR/COR/PI. Abandoning the pursuit or alternative capture methods may be considered by the Lead COR/COR/PI in these cases. (**major**)
4. When WH&Bs are herded through a fence line en route to the trap, the Lead COR/COR/PI must be notified by the contractor. The Lead COR/COR/PI must determine the appropriate width of the opening that the fence is let down to allow for safe passage through the opening. The Lead COR/COR/PI must decide if existing fence lines require marking to increase visibility to WH&Bs. (**major**)
5. The helicopter must not come into physical contact with any WH&B. The physical contact of any WH&B by helicopter must be documented by Lead COR/COR/PI along with the circumstances. (**major**)
6. WH&Bs may escape or evade the gather site while being moved by the helicopter. If there are mare/dependent foal pairs in a group being brought to a trap and half of an identified pair is thought to have evaded capture, multiple attempts by helicopter may

be used to bring the missing half of the pair to the trap or to facilitate capture by roping. In these instances, animal condition and fatigue must be evaluated by the Lead COR/COR/PI or on-site veterinarian on a case-by-case basis to determine the number of attempts that can be made to capture an animal.(**major**)

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

C. Roping

1. The roping of any WH&B must be approved prior to the procedure by the Lead COR/COR/PI. (**major**).
2. The roping of any WH&B must be documented by the Lead COR/COR/PI along with the circumstances. WH&Bs may be roped under circumstances which include but are not limited to the following: reunite a mare or jenny and her dependent foal; capture nuisance, injured or sick WH&Bs or those that require euthanasia; environmental reasons such as deep snow or traps that cannot be set up due to location or environmentally sensitive designation; and public and animal safety or legal mandates for removal. (**major**)
3. Ropers should dally the rope to their saddle horn such that animals can be brought to a stop as slowly as possible and must not tie the rope hard and fast to the saddle so as to intentionally jerk animals off their feet. (**major**)
4. WH&Bs that are roped and tied down in recumbency must be continuously observed and monitored by an attendant at a maximum of 100 feet from the animal. (**major**)
5. WH&Bs that are roped and tied down in recumbency must be untied within 30 minutes. (**major**)
6. If the animal is tied down within the wings of the trap, helicopter drive trapping within the wings will cease until the tied-down animal is removed. (**major**)
7. Sleds, slide boards, or slip sheets must be placed underneath the animal's body to move and/or load recumbent WH&Bs. (**major**)

8. Halters and ropes tied to a WH&B may be used to roll, turn, position or load a recumbent animal, but a WH&B must not be dragged across the ground by a halter or rope attached to its body while in a recumbent position. (**major**)
9. Animals captured by roping must be evaluated by the on-site/on-call veterinarian within four hours after capture, marked for identification at the trap site, and be re-evaluated periodically as deemed necessary by the on-site/on-call veterinarian. (**major**)

D. Bait Trapping

1. WH&Bs may be lured into a temporary trap using bait (feed, mineral supplement, water) or sexual attractants (mares/jennies in heat) with the following requirements:
   a. The period of time water sources other than in the trap site are inaccessible must not adversely affect the wellbeing of WH&Bs, wildlife or livestock, as determined by the Lead COR/COR/PI. (**major**)
   b. Unattended traps must not be left unobserved for more than 12 hours. (**major**)
   c. Mares/jennies and their dependent foals must not be separated unless for safe transport. (**major**)
   d. WH&Bs held for more than 12 hours must be provided with accessible clean water at a minimum rate of ten gallons per 1000 pound animal per day, adjusted accordingly for larger or smaller horses, burros and foals and environmental conditions. (**major**)
   e. WH&Bs held for more than 12 hours must be provided good quality hay at a minimum rate of 20 pounds per 1000 pound adult animal per day, adjusted accordingly for larger or smaller horses, burros and foals. (**major**)
      1) Hay must not contain poisonous weeds, debris, or toxic substances. (**major**)
      2) Hay placement must allow all WH&Bs to eat simultaneously. (**major**)

III. WILD HORSE AND BURRO CARE

A. Veterinarian

1. On-site veterinary support must be provided for all helicopter gathers and on-site or on-call support must be provided for bait trapping. (**major**)

2. Veterinary support must be under the direction of the Lead COR/COR/PI. The on-site/on-call veterinarian will provide consultation on matters related to WH&B health, handling, welfare, and euthanasia at the request of the Lead COR/COR/PI. All decisions regarding medical treatment or euthanasia will be made by the on-site Lead COR/COR/PI. (**major**)

B. Care

1. Feeding and Watering
   a. Adult WH&Bs held in traps or temporary holding pens for longer than 12 hours must be fed every morning and evening with water available at all times other than when animals are being sorted or worked. (**major)**
   b. Water must be provided at a minimum rate of ten gallons per 1000 pound animal per day, adjusted accordingly for larger or smaller horses, burros and foals, and environmental conditions, with each trough placed in a separate location of the pen (i.e. troughs at opposite ends of the pen). . (**major**)
   c. Good quality hay must be fed at a minimum rate of 20 pounds per 1000 pound adult animal per day, adjusted accordingly for larger or smaller horses, burros and foals. (**major**)
      i. Hay must not contain poisonous weeds or toxic substances. (**majo**r)
      ii. Hay placement must allow all WH&Bs to eat simultaneously. (**major**)
   d. When water or feed deprivation conditions exist on the range prior to the gather, the Lead COR/COR/PI should adjust the watering and feeding arrangements in consultation with the onsite veterinarian as necessary to provide for the needs of the animals. (minor)
2. Dust abatement
   a. Dust abatement by spraying the ground with water must be employed when necessary at the trap site and temporary holding facility. (**major**)

3. Trap Site
   a. Dependent foals or weak/debilitated animals must be separated from other WH&Bs at the trap site to avoid injuries during transportation to the temporary holding facility. Separation of dependent foals from mares must not exceed four hours unless the Lead COR/COR/PI authorizes a longer time or a decision is made to wean the foals. (**major**)
4. Temporary Holding Facility
   a. All WH&Bs in confinement must be observed at least once daily to identify sick or injured WH&Bs and ensure adequate food and water. (**major**)
   b. Foals must be reunited with their mares/jennies at the temporary holding facility within four hours of capture unless the Lead COR/COR/PI authorizes a longer time or foals are old enough to be weaned during the gather. (**major**)
   c. Non-ambulatory WH&Bs must be located in a pen separate from the general population and must be examined by the BLM horse specialist and/or on-call or on-site veterinarian as soon as possible, no more than four hours after recumbency is observed. Unless otherwise directed by a veterinarian, hay and water must be accessible to an animal within six hours after recumbency.(**major**)
   d. Alternate pens must be made available for the following: (**major**)
      1) WH&Bs that are weak or debilitated
      2) Mares/jennies with dependent foals
   e. Aggressive WH&Bs causing serious injury to other animals should be identified and relocated into alternate pens when possible. (minor)
   f. WH&Bs in pens at the temporary holding facility should be maintained at a proper stocking density such that when at rest all WH&Bs occupy no more than half the pen area. (minor)

C. Biosecurity

1. Health records for all saddle and pilot horses used on WH&B gathers must be provided to the Lead COR/COR/PI prior to joining a gather, including: (**major**)
   a. Certificate of Veterinary Inspection (Health Certificate, within 30 days).
   b. Proof of:
      1) A negative test for equine infectious anemia (Coggins or EIA ELISA test) within 12 months.
      2) Vaccination for tetanus, eastern and western equine encephalomyelitis, West Nile virus, equine herpes virus, influenza, *Streptococcus equi*, and rabies within 12 months.
2. Saddle horses, pilot horses and mares used for bait trapping lures must not be removed from the gather operation (such as for an equestrian event) and allowed to return unless they have been observed to be free from signs of infectious disease for a period of at least three weeks and a new Certificate of Veterinary Examination is obtained after three weeks and prior to returning to the gather. (**major**)
3. WH&Bs, saddle horses, and pilot horses showing signs of infectious disease must be examined by the on-site/on-call veterinarian. (**major**)
   a. Any saddle or pilot horses showing signs of infectious disease (fever, nasal discharge, or illness) must be removed from service and isolated from other animals on the gather until such time as the horse is free from signs of infectious disease and approved by the on-site/on-call veterinarian to return to the gather. (**major**)
   b. Groups of WH&Bs showing signs of infectious disease should not be mixed with groups of healthy WH&Bs at the temporary holding facility, or during transport. (minor)
4. Horses not involved with gather operations should remain at least 300 yards from WH&Bs, saddle horses, and pilot horses being actively used on a gather. (minor)

IV. HANDLING

A. Willful Acts of Abuse

1. Hitting, kicking, striking, or beating any WH&B in an abusive manner is prohibited. (**major**)
2. Dragging a recumbent WH&B without a sled, slide board or slip sheet is prohibited. Ropes used for moving the recumbent animal must be attached to the sled, slide board or slip sheet unless being loaded as specified in Section II. C. 8. (**major**)
3. There should be no deliberate driving of WH&Bs into other animals, closed gates, panels, or other equipment. (minor)
4. There should be no deliberate slamming of gates and doors on WH&Bs. (minor)
5. There should be no excessive noise (e.g., constant yelling) or sudden activity causing WH&Bs to become unnecessarily flighty, disturbed or agitated. (minor)

B. General Handling

1. All sorting, loading or unloading of WH&Bs during gathers must be performed during daylight hours except when unforeseen circumstances develop and the Lead COR/CO/PI approves the use of supplemental light. (**major**)
2. WH&Bs should be handled to enter runways or chutes in a forward direction. (minor)
3. WH&Bs should not remain in single-file alleyways, runways, or chutes longer than 30 minutes. (minor)
4. Equipment except for helicopters should be operated and located in a manner to minimize flighty behavior . (minor)

C. Handling Aids

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

2. Electric prods must not be used routinely as a driving aid or handling tool. Electric prods may be used in limited circumstances only if the following guidelines are followed:
    a. Electric prods must only be a commercially available make and model that uses DC battery power and batteries should be fully charged at all times. (**major**)
    b. The electric prod device must never be disguised or concealed. (**major**)
    c. Electric prods must only be used after three attempts using other handling aids (flag, shaker paddle, voice or body position) have been tried unsuccessfully to move the WH&Bs. (**major**)
    d. Electric prods must only be picked up when intended to deliver a stimulus; these devices must not be constantly carried by the handlers. (**major**)
    e. Space in front of an animal must be available to move the WH&B forward prior to application of the electric prod. (**major**)
    f. Electric prods must never be applied to the face, genitals, anus, or underside of the tail of a WH&B. (**major**)
    g. Electric prods must not be applied to any one WH&B more than three times during a procedure (e.g., sorting, loading) except in extreme cases with approval of the Lead COR/COR/PI. Each exception must be approved at the time by the Lead COR/COR/PI. (**major**)
    h. Any electric prod use that may be necessary must be documented daily by the Lead COR/COR/PI including time of day, circumstances, handler, location (trap site or temporary holding facility), and any injuries (to WH&B or human). (**major**)

V. TRANSPORTATION

A. General

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

2. WH&Bs identified for removal should be shipped from the temporary holding facility to a BLM facility within 48 hours. (minor)
   a. Shipping delays for animals that are being held for release to range or potential on-site adoption must be approved by the Lead COR/COR/PI. (**major**)
3. Shipping should occur in the following order of priority; 1) debilitated animals, 2) pairs, 3) weanlings, 4) dry mares and 5) studs. (minor)
4. Planned
5. transport time to the BLM preparation facility from the trap site or temporary holding facility must not exceed 10 hours. (**major**)
6. WH&Bs should not wait in stock trailers and/or semi-trailers at a standstill for more than a combined period of three hours during the entire journey. (minor)

B. Vehicles

1. Straight-deck trailers and stock trailers must be used for transporting WH&Bs. (**major**)
   a. Two-tiered or double deck trailers are prohibited. (**major**)
   b. Transport vehicles for WH&Bs must have a covered roof or overhead bars containing them such that WH&Bs cannot escape. (**major**)
2. WH&Bs must have adequate headroom during loading and unloading and must be able to maintain a normal posture with all four feet on the floor during transport without contacting the roof or overhead bars. (**major**)
3. The width and height of all gates and doors must allow WH&Bs to move through freely. (**major**)
4. All gates and doors must open and close easily and be able to be secured in a closed position. (**major**)
5. The rear door(s) of the trailers must be capable of opening the full width of the trailer. (**major**)
6. Loading and unloading ramps must have a non-slip surface and be maintained in proper working condition to prevent slips and falls. (**major**)

7. Transport vehicles more than 18 feet and less than 40 feet in length must have a minimum of one partition gate providing two compartments; transport vehicles 40 feet or longer must have at least two partition gates to provide a minimum of three compartments. (**major**)
8. All partitions and panels inside of trailers must be free of sharp edges or holes that could cause injury to WH&Bs. (**major**)
9. The inner lining of all trailers must be strong enough to withstand failure by kicking that would lead to injuries. (**major**)
10. Partition gates in transport vehicles should be used to distribute the load into compartments during travel. (minor)
11. Surfaces and floors of trailers must be cleaned of dirt, manure and other organic matter prior to the beginning of a gather. (**major**)

C. Care of WH&Bs during Transport Procedures

1. WH&Bs that are loaded and transported from the temporary holding facility to the BLM preparation facility must be fit to endure travel. (**major**)
   a. WH&Bs that are non-ambulatory, blind in both eyes, or severely injured must not be loaded and shipped unless it is to receive immediate veterinary care or euthanasia. (**major**)
   b. WH&Bs that are weak or debilitated must not be transported without approval of the Lead COR/COR/PI in consultation with the on-site veterinarian. Appropriate actions for their care during transport must be taken according to direction of the Lead COR/COR/PI. (**major**)
2. WH&Bs should be sorted prior to transport to ensure compatibility and minimize aggressive behavior that may cause injury. (minor)
3. Trailers must be loaded using the minimum space allowance in all compartments as follows: (**major**)
   a. 12 square feet per adult horse.
   b. 6.0 square feet per dependent horse foal.
   c. 8.0 square feet per adult burro.
   d. 4.0 square feet per dependent burro foal.

4. The Lead COR/COR/PI in consultation with the receiving Facility Manager must document any WH&B that is recumbent or dead upon arrival at the destination. (**major**)
    a. Non-ambulatory or recumbent WH&Bs must be evaluated on the trailer and either euthanized or removed from the trailers using a sled, slide board or slip sheet. (**major**)
5. Saddle horses must not be transported in the same compartment with WH&Bs. (**major**)

VI. EUTHANASIA OR DEATH

A. Euthanasia Procedure during Gather Operations

1. An authorized, properly trained, and experienced person as well as a firearm appropriate for the circumstances must be available at all times during gather operations. When the travel time between the trap site and temporary holding facility exceeds one hour or if radio or cellular communication is not reliable, provisions for euthanasia must be in place at both the trap site and temporary holding facility during the gather operation. (**major**)
2. Euthanasia must be performed according to American Veterinary Medical Association euthanasia guidelines (2013) using methods of gunshot or injection of an approved euthanasia agent. (**major**)
3. The decision to euthanize and method of euthanasia must be directed by the Authorized Officer or their Authorized Representative(s) that include but are not limited to the Lead COR/COR/PI who must be on site and may consult with the on-site/on-call veterinarian. (**major**)
4. Photos needed to document an animal's condition should be taken prior to the animal being euthanized. No photos of animals that have been euthanized should be taken. An exception is when a veterinarian or the Lead COR/COR/PI may want to document certain findings discovered during a postmortem examination or necropsy. (minor)
5. Any WH&B that dies or is euthanized must be documented by the Lead COR/COR/PI including time of day, circumstances, euthanasia method, location, a

description of the age, gender, and color of the animal and the reason the animal was euthanized. (**major**)

6. The on-site/on-call veterinarian should review the history and conduct a postmortem physical examination of any WH&B that dies or is euthanized during the gather operation. A necropsy should be performed whenever feasible if the cause of death is unknown. (minor)

B. Carcass Disposal

1. The Lead COR/COR/PI must ensure that appropriate equipment is available for the timely disposal of carcasses when necessary on the range, at the trap site, and temporary holding facility. (**major**)
2. Disposal of carcasses must be in accordance with state and local laws. (**major**)
3. WH&Bs euthanized with a barbiturate euthanasia agent must be buried or otherwise disposed of properly. (**major**)
4. Carcasses left on the range should not be placed in washes or riparian areas where future runoff may carry debris into ponds or waterways. Trenches or holes for buried animals should be dug so the bottom of the hole is at least 6 feet above the water table and 4-6 feet of level earth covers the top of the carcass with additional dirt mounded on top where possible. (minor)

CAWP

REQUIRED DOCUMENTATION AND RESPONSIBILITIES OF LEAD COR/COR/PI

Required Documentation

Section	Documentation
II.B.5	Helicopter contact with any WH&B.
II.C.2	Roping of any WH&B.
III.B.3.a and III.B.4.b	Reason for allowing longer than four hours to reunite foals with mares/jennies. Does not apply if foals are being weaned.
III.C.1	Health status of all saddle and pilot horses.
IV.C.2.h	All uses of electric prod.
V.C.4	Any WH&B that is recumbent or dead upon arrival at destination following transport.
VI.A.5	Any WH&B that dies or is euthanized during gather operation.

Responsibilities

Section	Responsibility
I.A.10	Approve materials used in construction of finger gates in bait trapping
II.A.1	Direct gather procedures using approved gather technique.
II.B. 2	Determine rate of movement and distance limitations for WH&B helicopter gather.
II.B.2.a	Direct appropriate gather/handling methods for weak or debilitated WH&B.
II.B.3	Determine whether to abandon pursuit or use other capture method in order to avoid repeated pursuit of WH&B.
II.B.4	Determine width and need for visibility marking when using opening in fence en route to trap.
II.B.6	Determine number of attempts that can be made to capture the missing half of a mare/foal pair that has become separated.
II.B.7	Determine whether to proceed with gather when ambient temperature is outside the range of 10°F to 95°F for horses or 10°F to 100°F for burros.
II.C.1	Approve roping of any WH&B.
II.D.1.a	Determine period of time that water outside a bait trap is inaccessible such that wellbeing of WH&Bs, wildlife, or livestock is not adversely affected.
III.A.2	Direct and consult with on-site/on-call veterinarian on any matters related to WH&B health, handling, welfare and euthanasia.

III.B.1.e	Adjust feed/water as necessary, in consultation with onsite/on call veterinarian, to provide for needs of animals when water or feed deprivation conditions exist on range.
III.B.4.c	Determine provision of water and hay to non-ambulatory animals.
IV.C.2.g	Approve use of electric prod more than three times, for exceptional cases only.
V.A.1	Approve sorting, loading, or unloading at night with use of supplemental light.
V.A.2.a	Approve shipping delays of greater than 48 hours from temporary holding facility to BLM facility.
V.C.1.b	Approve of transport and care during transport for weak or debilitated WH&B.
VI.A.3	Direct decision regarding euthanasia and method of euthanasia for any WH&B; may consult with on-site/on-call veterinarian.
VI.B.1	Ensure that appropriate equipment is available for carcass disposal.

Appendix 5

SOPs for Population Growth Suppression Methods and Scientific Literature Review

A note to readers about contents of this appendix: *The following implementation and monitoring requirements listed in SOPs, below, are part of actions in Alternatives 1. After the SOPs for fertility control vaccines, SOPs for use of intrauterine devices are also included here only for comparative information. Following the SOPs, this appendix contains a literature review of the effects of fertility control vaccines and IUDs (i.e., applicable in Alternatives 1). Sex ratio manipulation is also address even though it is not part of any of the Alternatives.*

Standard Operating Procedures (SOPs) for Fertility Control Vaccines

SOPs common to all vaccine types

Identification

Animals intended for treatment must be clearly, individually identifiable to allow for positive identification during subsequent management activities. For captured animals, marking for identification may be accomplished by marking each individual with a freeze mark on the hip and/ or neck and a microchip in the nuchal ligament. In some cases, identification may be accomplished based by cataloguing markings that make animals uniquely identifiable. Such animals may be photographed using a telephoto lens and high-quality digital camera as a record of treated individuals.

Safety

Safety for both humans and animals are the primary consideration in all elements of fertility control vaccine use. Administration of any vaccine must follow all safety guidance and label guidelines on applicable EPA labeling.

Injection Site

For hand-injection, delivery of the vaccine should be by intramuscular injection, while the animal is standing still, into the left or right side, above the imaginary line that connects the point of the hip (hook bone) and the point of the buttocks (pin bone): this is the hip / upper gluteal area. For dart-based injection, delivery of the vaccine should be by intramuscular injection, while the animal is standing still, into the left or right thigh areas (lower gluteal / biceps femoralis).

Monitoring and Tracking of Treatments

1. Estimation of population size and growth rates (in most cases, using aerial surveys) should be conducted periodically after treatments.
2. Population growth rates of some herds selected for intensive monitoring may be estimated every year post-treatment using aerial surveys. If, during routine HMA field

monitoring (on-the-ground), data describing adult to foal ratios can be collected, these data should also be shared with HQ-261.

3. Field applicators should record all pertinent data relating to identification of treated animals (including photographs if animals are not freeze-marked) and date of treatment, lot number(s) of the vaccine, quantity of vaccine issued, the quantity used, the date of vaccination, disposition of any unused vaccine, the date disposed, the number of treated mares by HMA, field office, and State along with the microchip numbers and freeze-mark(s) applied by HMA and date. A summary narrative and data sheets will be forwarded to HQ-261 annually (Reno, Nevada). A copy of the form and data sheets and any photos taken should be maintained at the field office.
4. HQ-261 will maintain records sent from field offices, on the quantity of PZP issued, the quantity used, disposition of any unused PZP, the number of treated mares by HMA, field office, and State along with the freeze-mark(s) applied by HMA and date.

SOPs for one-year liquid PZP vaccine (ZonaStat-H)

ZonaStat-H vaccine (Science and Conservation Center, Billings, MT) would be administered through hand-injection or darting by trained BLM personnel or collaborating partners only. At present, the only PZP vaccine for dart-based delivery in BLM-managed wild horses or burros is ZonaStat-H. 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. Until the day of its use, ZonaStat-H must be kept frozen.

Animals that have never been treated with a PZP vaccine would receive 0.5 cc of PZP vaccine emulsified with 0.5 cc of Freund's Modified Adjuvant (FMA). Animals identified for re-treatment receive 0.5 cc of the PZP vaccine emulsified with 0.5 cc of Freund's Incomplete Adjuvant (FIA). Hand-injection of liquid PZP vaccine would be by intramuscular injection into the gluteal muscles while the animal is restrained in a working chute. The vaccine would be injected into the left hind quarters of the animal, above the imaginary line that connects the point of the hip (hook bone) and the point of the buttocks (pin bone).

For Hand-injection, delivery of the vaccine would be by intramuscular injection into the left or right buttocks and thigh muscles (gluteals, biceps femoris) while the animal is standing still.

Application of ZonaStat-H via Darting

Only designated darters would prepare the emulsion. Vaccine-adjuvant emulsion would be loaded into darts at the darting site and delivered by means of a projector gun.

No attempt to dart should be taken when other persons are within a 100-m radius of the target animal. The Dan Inject gun should not be used at ranges in excess of 30 m while the Pneu-Dart gun should not be used over 50 m.

No attempts would be taken in high wind (greater than 15 mph) or when the animal is standing at an angle where the dart could miss the target area and hit the flank or rib cage. The ideal is when the dart would strike the skin of the animal at a 90° angle.

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 animal. 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, for a maximum of one transfer (discard contents if not used on the second day). Refrigerated darts would not be used in the field.

A darting team should include two people. The second person is responsible for locating fired darts. The second person should also be responsible for identifying the animal and keeping onlookers at a safe distance.

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.

Attempts will be made to recover all darts. To the extent possible, all darts which are discharged and drop from the target animal 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 a 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.

In the event that a dart strikes a bone or imbeds in soft tissue and does not dislodge, the darter would follow the affected animal until the dart falls out or the animal can no longer be found. The darter would be responsible for daily observation of the animal until the situation is resolved.

SOPs for application of PZP-22 pelleted vaccine

PZP-22 pelleted vaccine treatment would be administered only by trained BLM personnel or designated partners. A treatment of PZP-22 is comprised of two separate injections: (1) a liquid dose of PZP vaccine (equivalent to one dose of ZonaStat-H) is administered using an 18-gauge needle primarily by hand injection; (2) the pellets are preloaded into a 14-gauge needle. For animals constrained in a working chute, these are delivered using a modified syringe and jabstick to inject the pellets into the gluteal muscles of the animals being returned to the range. The pellets are intended to release PZP over time. Until the day of its use, the liquid portion of PZP-22 must be kept frozen.

At this time, delivery of PZP-22 treatment would only be by intramuscular injection into the gluteal muscles while the animal is restrained in a working chute. The primer would consist of 0.5 cc of liquid PZP emulsified with 0.5 cc of adjuvant. Animals that have never been treated with a PZP vaccine would receive 0.5 cc of PZP vaccine emulsified with 0.5 cc of Freund's Modified Adjuvant (FMA). Animals identified for re-treatment receive 0.5 cc of the PZP vaccine emulsified with 0.5 cc of Freund's Incomplete Adjuvant (FIA). The syringe with PZP vaccine pellets would be loaded into the jabstick for the second injection. With each injection, the liquid or pellets would be injected into the left hind quarters of the animal, above the imaginary line that connects the point of the hip (hook bone) and the point of the buttocks (pin bone).
In the future, the PZP-22 treatment may be administered remotely using an approved long range darting protocol and delivery system if and when BLM has determined that the technology has been proven safe and effective for use.

SOPs for GonaCon-Equine Vaccine Treatments

GonaCon-Equine vaccine (USDA Pocatello Storage Depot, Pocatello, ID; Spay First!, Inc., Oklahoma City, OK) is distributed as preloaded doses (2 mL) in labeled syringes. Upon receipt, the vaccine should be kept refrigerated (4° C) until use. Do not freeze GonaCon-Equine. The vaccine has a 6-month shelf-life from the time of production and the expiration date will be noted on each syringe that is provided.

For initial and booster treatments, mares would ideally receive 2.0 ml of GonaCon-Equine.
Administering GonaCon Vaccine by Hand-Injection. Experience has demonstrated that only 1.8 ml of vaccine can typically be loaded into 2 cc darts, and this dose has proven successful. Calculations below reflect a 1.8 ml dose. For hand-injection, delivery of the vaccine should be by intramuscular injection, while the animal is standing still, into the left or right side, above the imaginary line that connects the point of the hip (hook bone) and the point of the buttocks (pin bone): this is the hip / upper gluteal area. A booster vaccine may be administered after the first injection to improve efficacy of the product over subsequent years.

Application of GonaCon-Equine via Darting
General practice guidelines for darting operations, as noted above for dart-delivery of ZonaStat-H, should be followed for dart-delivery of GonaCon-Equine. Wearing latex gloves, the applicator numbers darts and loads numbered darts with vaccine by attaching a loading needle (7.62 cm; provided by dart manufacturer) to the syringe containing vaccine and placing the needle into the cannula of the dart to the fullest depth possible. Slowly depress the syringe plunger and begin filling the dart. Periodically, tap the dart on a hard surface to dislodge air bubbles trapped within the vaccine. Due to the viscous nature of the fluid, air entrapment typically results in a maximum of approximately 1.8 ml of vaccine being loaded in the dart. The dart is filled to max once a small amount of the vaccine can be seen at the tri-ports.

Important! Do not load and refrigerate darts the night before application. When exposed to moisture and condensation, the edges of gel barbs soften, begin to dissolve, and will not hold the dart in the muscle tissue long enough for full injection of the vaccine. The dart needs to remain in the muscle tissue for a minimum of 1 minute to achieve dependable full injection. Sharp gel barbs are critical.

Darts should be weighed to the nearest hundredth gram by electronic scale when empty, when loaded with vaccine, and after discharge, to ensure that 90% (1.62 ml) of the vaccine has been injected. GonaCon weighs 0.95 grams/mL, so animals should receive 1.54 grams of vaccine to be considered treated. Animals receiving <50% should be darted with another full dose; those receiving >50% but <90% should receive a half dose (1 ml). All darts should be weighed to verify a combination of ≥1.62 ml has been administered. Therefore, every effort should be made to recover darts after they have fallen from animals.

Although infrequent, dart injections can result in partial injections of the vaccine, and shots are missed. As a precaution, it is recommended that extra doses of the vaccine be ordered to accommodate failed delivery (which may be as high as ~15 %). To determine the amount of vaccine delivered, the dart must be weighed before loading, and before and after delivery in the field. The scale should be sensitive to 0.01 grams or less, and accurate to 0.05 g or less.

For best results, darts with a gel barb should be used. (i.e. 2 cc Pneu-Dart brand darts configured with Slow-inject technology, 3.81 cm long 14 ga.tri-port needles, and gel collars positioned 1.27 cm ahead of the ferrule). One can expect updates in optimal dart configuration, pending results of research and field applications.

Darts (configured specifically as described above) can be loaded in the field and stored in a cooler prior to application. Darts loaded, but not used can be maintained in dry conditions at about 4° C and used the next day, but do not store in any refrigerator or container likely to cause condensation, which can compromise the gel barbs.

SOPs for Insertion of Y-shaped Silicone IUD for Feral Horses

<u>Background</u>: Mares must be open. A veterinarian must determine pregnancy status via palpation or ultrasound. Ultrasound should be used as necessary to confirm open status of mares down to at least 14 days for those that have recently been with stallions. For mares segregated from stallions, this determination may be made at an earlier time when mares are identified as candidates for treatment, or immediately prior to IUD insertion. Pregnant mares should not receive an IUD.

<u>Preparation</u>: IUDs must be clean and sterile. Sterilize IUDs with a low-temperature sterilization system, such as Sterrad.
The Introducer is two PVC pipes. The exterior pipe is a 29” length of ½” diameter pipe, sanded smooth at one end, then heat-treated to smooth its curvature further (Fig. 1). The IUD will be placed into this smoothed end of the exterior pipe. The interior pipe is a 29 ½” long, ¼” riser tube (of the kind used to connect water lines to sinks), with one end slightly flared out to fit more snugly inside the exterior pipe (Fig. 1), and a plastic stopper attached to the other end (Fig. 2).

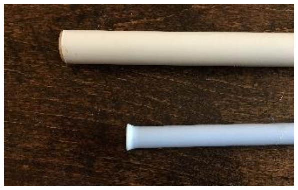

Figure 1. Interior and exterior pipes (unassembled), showing the ends that go into the mare

Figure 2. Interior pipe shown within exterior pipe. After the introducer is 4” beyond the os, the stopper is pushed forward (outside the mare), causing the IUD to be pushed out from the exterior pipe.

Introducers should be sterilized in Benz-all cold steriliant, or similar. Do not use iodine-based sterilant solution. A suitable container for sterilant can be a large diameter (i.e., 2”) PVC pipe with one end sealed and one end removable.

Prepare the IUD: Lubricate with sterile veterinary lube, and insert into the introducer. The central stem of the IUD goes in first (Fig. 3).

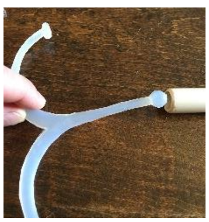

Figure 3. Insert the stem end of the IUD into the exterior pipe.

Fold the two ‘legs’ of the IUD, and push the IUD further into the introducer, until just the bulbous ends are showing (Fig. 4).

Figure 4. Insert the IUD until just the tips of the ‘legs’ are showing.

Restraint and Medication: The mare should be restrained in a padded squeeze chute to provide access to the rear end of the animal, but with a solid lower back door, or thick wood panel, for veterinarian safety. Only a veterinarian shall oversee this procedure and insert IUDs. Some practitioners may choose to provide sedation. If so, when the mare’s head starts to droop, it may be advisable to tie the tail up to prevent risk of the animal sitting down on the veterinarian’s arm (i.e., double half hitch, then tie tail to the bar above the animal).
Some practitioners may choose to provide a dose of long-acting progesterone to aid in IUD retention. Example dosage: 5mL of BioRelease LA Progesterone 300 mg/mL (BET labs, Lexington KY), *or* long-acting Altrenogest). No other intrauterine treatments of any kind should be administered at the time of IUD insertion.

Insertion Procedure:

- ➔ Prep clean the perineal area.
- ➔ Lubricate the veterinarian's sleeved arm and the Introducer+IUD.
- ➔ Carry the introducer (IUD-end-first) into the vagina.
- ➔ Dilate the cervix and gently move the tip of the introducer past the cervix.
- ➔ Advance the end of the 1/2" PVC pipe about 4 inches past the internal os of the cervix.
- ➔ Hold the exterior pipe in place, but push the stopper of the interior pipe forward, causing the IUD to be pushed out of the exterior pipe, into the uterus.
- ➔ Placing a finger into the cervical lumen just as the introducer tube is removed from the external os allows the veterinarian to know that the IUD is left in the uterus, and not dragged back into or past the cervix.
- ➔ Remove the introducer from the animal, untie the tail.

Mares that have received an IUD should be observed closely for signs of discharge or discomfort for 24 hours following insertion after which they may be released back to the range.

Label for Y-Shaped Silicone IUD for Feral Horses

Y-Shaped Silicone IUD for Feral Horses

The *Y-Shaped Silicone IUD for Feral Horses* is an intrauterine device (IUD) comprised solely of medical-grade, inert, silicone that is suitable for use in female feral horses (free-roaming or "wild" *Equus caballus*). Intended users include government agencies with feral horses in their management purview, Native American tribes that have management authority over feral horses, and authorized feral horse care or rescue sanctuaries that manage feral horses in a free ranging environment.

The *Y-Shaped Silicone IUD for Feral Horses* can mitigate or reduce feral horse population growth rates because these IUDs can provide potentially reversible fertility control for female feral horses. This IUD prevents pregnancy by its physical presence in the mare's uterus as long as the IUD stays in place. In trials, approximately 75% of mares living and breeding with fertile stallions retained the *Y-Shaped Silicone IUD for Feral Horses* over two breeding seasons. None of the mares that kept their IUDs became pregnant during an experimental trial. After IUD removal, the majority of mares returned to fertility.

Directions for Use:

The *Y-Shaped Silicone IUD for Feral Horses* is to be placed in the uterus of feral horse mares by a veterinarian. The *Y-Shaped Silicone IUD for Feral Horses* is intended for use in feral mares that are at least approximately 1 year old, where age is determined based on available evidence, such as tooth eruption pattern.

IUDs must be sterilized before use. The IUD is inserted into the uterus using a thin, tubular applicator, similar to a shielded culture tube commonly used in equine reproductive veterinary medicine, in a manner similar to methods used for uterine culture of domestic mares. Feral mares with IUDs should be individually marked and identified (i.e., with an RFID microchip, or via visible freeze-brand on the hip or neck).

Caution:

These IUDs are only to be used in mares that are confirmed to be not pregnant. Checking pregnancy status can be accomplished by methods such as a transrectal palpation and/or ultrasound performed by a veterinarian. If a *Y-Shaped Silicone IUD for Feral Horses* is inserted in the uterus of a pregnant mare, it may cause the pregnancy to terminate, and the IUD to be expelled.

Manufactured for:
U.S. Bureau of Land Management (97949)
1340 Financial Blvd., Reno, NV 89052
EPA Est.: 97628-MI-1

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 (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). 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. 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. The NAS report (2013) includes information (pairwise genetic 'fixation index' values for sampled WH&B herds) confirming that WH&B in the vast majority of HMAs are genetically similar to animals in multiple other HMAs.

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.

Fertility Control Vaccines
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 wild and feral burros (Turner et al. 1996, French et al. 2017, French et al. 2020, Kahler and Boyles-Griffin 2022). 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, Carey et al. 2019), 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 the exact timing for the return to fertility in mares boosted more than once with GonaCon-Equine has not been quantified, 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.

Direct Effects: PZP Vaccines
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, 2018c, French et al. 2020). 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, French et al. 2020). 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, Carey et al. 2019). 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.

Direct Effects: GnRH Vaccines
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, Nolan et al. 2018c), 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, Nolan et al. 2018c). 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 or jennies 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 and jennies, 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, French et al. 2020). 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. French et al. (2020) documented fewer visible follicles and reduced uterine horn diameter in PZP treated jennies; 25% of treated burros returned to fertility during that study. 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.

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 boostered doses of GonaCon-Equine indicate that it can have high efficacy and longer-lasting effects in free-roaming horses (Baker et al. 2017, 2018) 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, 2018). 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, 2018). 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, Nolan et al. 2018c). It is worth repeating that those vaccines do not have the same formulation as GonaCon.

Results from horses (Baker et al. 2017, 2018) 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, 2018). 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, 2018) 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. 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. If long-term treatment resulted in permanent infertility for some treated mares, 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. 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 may lead to four or more years with relatively high rates (80+%) of additional infertility expected (Baker et al. 2018). 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.

Effects on Existing Pregnancies, Foals, and Birth Phenology: PZP 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.

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 fertility control vaccines 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 seasonal 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.

Effects of Marking and Injection

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 range, 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 and jennies (Roelle and Ransom 2009, Bechert et al. 2013, French et al. 2017, Baker et al. 2018, French et al. 2020), 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. French et al. (2020) observed localized swelling, transient lameness in PZP vaccine-treated burros, and sterile abscesses in 87% of those treated jennies. 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, 2018).

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).

Indirect Effects: PZP Vaccines

One expected long-term, indirect effect on wild horses treated with fertility control would be an improvement in their overall health (Turner and Kirkpatrick 2002). Many treated mares would not experience the biological stress of reproduction, foaling and lactation as frequently as untreated mares. The observable measure of improved health is higher body condition scores (Nuñez et al. 2010). After a treated mare returns to fertility, her future foals would be expected to be healthier overall and would benefit from improved nutritional quality in the mare's milk. This is particularly to be expected if there is an improvement in rangeland forage quality at the same time, due to reduced wild horse population size. Past application of fertility control has shown that mares' overall health and body condition remains improved even after fertility resumes. PZP treatment may increase mare survival rates, leading to longer potential lifespan (Turner and Kirkpatrick 2002, Ransom et al. 2014a) that may be as much as 5-10 years (NPS 2008). To the extent that this happens, changes in lifespan and decreased foaling rates could combine to cause changes in overall age structure in a treated herd (i.e., Turner and Kirkpatrick 2002, Roelle et al. 2010), with a greater prevalence of older mares in the herd (Gross 2000, NPS 2008). Observations of mares treated in past gathers showed that many of the treated mares were larger than, maintained higher body condition than, and had larger healthy foals than untreated mares (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). 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 range 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 (NPS 2008). Reducing the numbers of wild horses that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild horses, and thereby could eliminate the need to send additional excess horses from this area to off-range holding corrals or pastures for long-term holding.

A principal 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 thriving natural ecological balance, vegetation resources would be expected to recover, improving the forage available. With rangeland conditions more closely approaching a thriving natural ecological balance, and with a less concentrated distribution of wild horses and burros, 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 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). 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 range could reduce long-term holding costs for such horses, which are difficult to adopt, and could negate the compensatory reproduction that can follow removals (Kirkpatrick and Turner 1991).

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

Reduced population growth rates and smaller population sizes could also allow for continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse habitat quality. As the local horse abundance nears or is maintained at the level necessary to achieve a thriving natural ecological balance, vegetation resources would be expected to recover, improving the forage available to wild horses and wildlife throughout the area. With rangeland conditions more closely approaching a thriving natural ecological balance, and with a less concentrated distribution of wild horses across the range, 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: PZP Vaccines

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. Also, despite any potential changes in band infidelity due to PZP vaccination, horses continued to live in social groups with dominant stallions and one or more mares. 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.

In separate work in a long-term study of semi-feral Konik ponies, Jaworska et al. (2020) showed that neither infanticide nor feticide resulted for mares and their foals after a change in dominant stallion. Nuñez et al. 2014 wrote that these effects "…may be of limited concern when population reduction is an urgent priority." Nuñez (2018) and Jones et al. (2019, 2020) noted 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. No biologically significant 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 may 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)."

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).

Ransom et al. (2014b) and Baker et al. (2018) 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) and Baker et al. (2018) 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 (i.e., see the table of Fst vales *in* NAS 2013). 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, 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 chosen to follow these guidelines in some cases, 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 Hog Creek HMA Population Management Plan EA (DOI-BLM-ORWA-V000-2017-0026-EA), BLM clearly identified that maintaining a 50:50 sex ratio was appropriate because the herd size at the low end of AML was only 30 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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Effects of Intrauterine Devices (IUDs)

Based on promising results from published, peer-reviewed studies in domestic mares, BLM has begun to use IUDs to control fertility as a wild horse and burro fertility control method on the range. The initial management use was in mares from the Swasey HMA, in Utah. The BLM has supported and continues to support research into the development and testing of effective and safe IUDs for use in wild horse mares (Baldrighi et al. 2017, Holyoak et al. 2021). However, existing literature on the use of IUDs in horses allows for inferences about expected effects of any management alternatives that might include use of IUDs and support the apparent safety and efficacy of some types of IUDs for use in horses. Overall, as with other methods of population growth suppression, use of IUDs and other fertility control measures are expected to help reduce population growth rates, extend the time interval between gathers, and reduce the total number of excess animals that will need to be removed from the range.

The 2013 National Academies of Sciences (NAS) report considered IUDs and suggested that research should test whether IUDs cause uterine inflammation, and should also test how well IUDs stay in mares that live and breed with fertile stallions. Since that report, a recent study by Holyoak et al. (2021) indicate that a flexible, inert, Y-shaped, medical-grade silicone IUD design prevented pregnancies in all the domestic mares that retained the device, even when exposed to fertile stallions. Domestic mares in that study lived in large pastures, mating with fertile stallions. Biweekly ultrasound examinations showed that IUDs stayed in 75% of treated mares over the course of two breeding seasons. The IUDs were then removed so the researchers could monitor the mares' return to fertility. In that study, uterine health, as measured in terms of inflammation, was not seriously affected by the IUDs, and most mares became pregnant within months after IUD removal. The overall results are consistent with results from an earlier study (Daels and Hughes 1995), which used O-shaped silicone IUDs. Similarly, a flexible IUD with three components connected by magnetic force (the 'iUPOD') was retained over 90 days in mares living and breeding with a fertile stallion; after IUD removal, the majority of mares became pregnant in the following breeding season (Hoopes et al. 2021).

IUDs are considered a temporary fertility control method that does not generally cause future sterility (Daels and Hughes 1995). Use of IUDs is an effective fertility control method in women, and IUDs have historically been used in livestock management, including in domestic horses. Insertion of an IUD can be a very rapid procedure, but it does require the mare to be temporarily restrained, such as in a squeeze chute. IUDs in mares may cause physiological effects including discomfort, infection, perforation of the uterus if the IUD is hard and angular, endometritis, uterine edema (Killian et al. 2008), and pyometra (Klabnik-Bradford et al. 2013). In women, deaths attributable to IUD use may be as low as 1.06 per million (Daels and Hughes 1995). The effects of IUD use on genetic diversity in a given herd should be comparable to those of other temporary fertility control methods; use should reduce the fraction of mares breeding at any one time but does not necessarily preclude treated mares from breeding in the future, as they survive and regain fertility.

The exact mechanism by which IUDs prevent pregnancy is uncertain, but may be related to persistent, low-grade uterine inflammation (Daels and Hughes 1995, Gradil et al. 2021, Hoopes et al. 2021), Turner et al. (2015) suggested that the presence of an IUD in the uterus may, like a pregnancy, prevent the mare from coming back into estrus. However, some domestic mares did exhibit repeated estrus cycles during the time when they had IUDs (Killian et al. 2008, Gradil et al. 2019, Lyman et al. 2021, Hoopes et al. 2021). The main cause for an IUD to not be effective at contraception is its failure to stay in the uterus (Daels and Hughes 1995, NAS 2013). As a result, one of the major challenges to using IUDs to control fertility in mares on the range is preventing the IUD from being dislodged or otherwise ejected over the course of daily activities, which could include, at times, frequent breeding.

At this time, it is thought that any IUD inserted into a pregnant mare may cause the pregnancy to terminate, which may also cause the IUD to be expelled. For that reason, it is expected that IUDs would only be inserted in non-pregnant (open) mares. Wild mares receiving IUDs would be checked for pregnancy by a veterinarian prior to insertion of an IUD. This can be accomplished by transrectal palpation and/or ultrasound performed by a veterinarian. Pregnant mares would not receive an IUD. Only a veterinarian would apply IUDs in any BLM management action. The IUD is inserted into the uterus using a thin, tubular applicator similar to a shielded culture tube, and would be inserted in a manner similar to that routinely used to obtain uterine cultures in domestic mares. If a mare has a zygote or very small, early phase embryo, it is possible that it will fail to be detected in screening, and may develop further, but without causing the expulsion of the IUD. Wild mares with IUDs would be individually marked and identified, so that they can be monitored occasionally and examined, if necessary, in the future, consistent with other BLM management activities.

Using metallic or glass marbles as IUDs may prevent pregnancy in horses (Nie et al. 2003) but can pose health risks to domestic mares (Turner et al. 2015, Freeman and Lyle 2015). Marbles may break into shards (Turner et al. 2015), and uterine irritation that results from marble IUDs may cause chronic, intermittent colic (Freeman and Lyle 2015). Metallic IUDs may cause severe infection (Klabnik-Bradford et al. 2013).

In domestic ponies, Killian et al. (2008) explored the use of three different IUD configurations, including a silastic polymer O-ring with copper clamps, and the “380 Copper T” and “GyneFix” IUDs designed for women. The longest retention time for the three IUD models was seen in the “T” device, which stayed in the uterus of several mares for 3-5 years. Reported contraception rates for IUD-treated mares were 80%, 29%, 14%, and 0% in years 1-4, respectively. They surmised that pregnancy resulted after IUD fell out of the uterus. Killian et al. (2008) reported high levels of progesterone in non-pregnant, IUD-treated ponies.

Soft or flexible IUDs may cause relatively less discomfort than hard IUDs (Daels and Hughes 1995). Daels and Hughes (1995) tested the use of a flexible O-ring IUD, made of silastic, surgical-grade polymer, measuring 40 mm in diameter; in five of six breeding domestic mares tested, the IUD was reported to have stayed in the mare for at least 10 months. In mares with IUDs, Daels and Hughes (1995) reported some level of uterine irritation but surmised that the level of irritation was not enough to interfere with a return to fertility after IUD removal.

More recently, several types of soft or flexible IUDs have been tested for use in breeding mares. When researchers attempted to replicate the O-ring study (Daels and Hughes 1995) in an USGS / Oklahoma State University (OSU) study with breeding domestic mares, using various configurations of silicone O-ring IUDs, the IUDs fell out at unacceptably high rates over time scales of less than 2 months (Baldrighi et al. 2017, Lyman et al. 2021). Subsequently, the USGS / OSU researchers tested a Y-shaped IUD to determine retention rates and assess effects on uterine health; retention rates were greater than 75% for an 18-month period, and mares returned to good uterine health and reproductive capacity after removal of the IUDs (Holyoak et al. 2021). These Y-shaped silicone IUDs are considered a pesticide device by the EPA, in that they work by physical means (EPA 2020). The University of Massachusetts has developed a magnetic IUD that has been effective at prolonging estrus and preventing pregnancy in domestic mares (Gradil et al. 2019, Joonè et al. 2021, Gradil et al. 2021, Hoopes et al. 2021). After insertion in the uterus, the three subunits of the device are held together by magnetic forces as a flexible triangle. A metal detector can be used to determine whether the device is still present in the mare. In an early trial, two sizes of those magnetic IUDs fell out of breeding domestic mares at high rates (Holyoak et al., unpublished results), but more recent trials have shown that the magnetic IUD was retained even in the presence of breeding with a fertile stallion (Hoopes et al. 2021). The magnetic IUD was used in two trials where mares were exposed to stallions, and in one where mares were artificially inseminated; in all cases, the IUDs were reported to stay in the mares without any pregnancy (Gradil 2019, Joonè et al. 2021, Gradil et al. 2021, Hoopes et al. 2021).

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Appendix 6
Affixing Radio Collars

Introduction
The purpose of this document is to provide detailed methods that would be used for fitting radio collars on wild horse mares and burro jennies. This document does not include methods for chemical immobilization, care, and maintenance of horses during gathers, while in captivity, or for any other handling procedures beyond those needed for fitting a radio collar.

It is now common to use radio collars fitted with VHF transmitters, GPS recorders, or satellite transmitters to obtain and record data on animal movement and other activities. Understanding the daily life of the focal species can lead to improvements in animal behavior and ecological knowledge (King, 2013). While most radio collars are considered to be minimally invasive, they can impose a cost on the animal carrying them. Thus, guidelines have been developed for a weight ratio (a collar should not exceed 5% of the animal's body weight) and best practice in their use (Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee, 1998, Sikes et al., 2011). Collars have the potential to cause injury to the animal wearing them. However, when the collar is fitted correctly and monitored regularly it can provide invaluable data without any measurable impact on the study animal.

Telemetry collars have been used extensively on carnivores (Germain et al., 2008; Creel and Christianson, 2009; Hunter et al., 2010; e.g., Broekhuis et al., 2013; Cozzi et al., 2013, Dellinger et al., 2013), rodents (Chambers et al., 2000; Solomon et al., 2001; Koprowski et al., 2007), and some ungulates (Johnson et al., 2000; Creel et al., 2005; Ito et al., 2005; Allred et al., 2013, Buuveibaatar et al., 2013; Latombe et al., 2013). However, they have not been as commonly used on equids (Hennig et al. 2020). A few studies have used this tool to examine habitat use, movements, and behavior of zebra (Fischhoff et al., 2007; Sundaresan et al., 2007; Brooks and Harris, 2008) and Asiatic wild asses (Kaczensky et al., 2006, 2008, 2011). Before 2010, fewer published studies had used telemetry collars on feral horses (Committee on Wild Horse and Burro Research, 1991; Asa, 1999; Goodloe et al., 2000; Hampson et al., 2010).

Although some research has been conducted on wild horse use of vegetation and habitat (e.g. Beever and Brussard, 2000), little has been done recently, and long-term, fine-scale data on habitat use has rarely been recorded. It can be beneficial to resource managers to have a detailed understanding of wild equid seasonal habitat use and movements on public lands. Due to the scale of some of the Herd Management Areas (HMAs), it is logistically challenging to collect habitat use data via direct observation. Utilization of GPS and VHF collars for marking and locating individuals can provide fine-scale monitoring data about where wild horses and burros spend their time and how they use their habitat.

From March 2015 through March 2016, researchers at the U.S. Geological Survey (USGS) conducted a year-long preliminary study on captive wild horses and burro jennies to determine proper fit and wear of radio collars (Schoenecker et al., 2014). The condition of wild horses wearing radio collars was compared to non-collared controls and documented with photographs. In addition, the behavior of both collared individuals and controls was recorded for one hour daily, in order to quantify any impact of the collar on their behavior and health. At the end of the study period (March 2016) the collars were removed (Schoenecker et al., 2020).

Radio collars consist of a ~2-inch-wide strap/belt made of soft pliable plastic-like material (Figure 1). Some are oval shaped with adjustments on both sides of the collar, and others are teardrop shaped with adjustments at the top of the collar so it can be fitted to different neck sizes. This is the most optimal shape for the neck of equids. Attached to the belt of the collar is a battery pack and transmitter module. These may either be combined in the same unit or placed at the top and bottom of the collar to counterbalance each other. The size of the battery is determined by the amount of power needed, both in terms of length of deployment, and how much data will be recorded by the collar. The type of transmitter used will depend on the study, but all principles stated here for collar fitting and use apply regardless of communication systems used.

Collars can be placed on horses' and burros' necks when they are in a padded squeeze chute during a gather. It takes between 7 and 12 minutes to fit a collar on the animal. The transmitter should be functioning and turned on before the collar is fitted, then checked that it is working correctly before the animal is released.

Fitting of the collar

Fitting a collar requires an understanding of the neck circumference and shape; that is, when the head of the animal is raised the collar should be tight, and when the head is down grazing the collar will become looser (Figures 2, 3). The collar should rest just behind the ears of the equid and be tight enough so it does not slip down the neck, yet loose enough that it does not interfere with movement when the neck is flexed. The collar must fit snugly to minimize rubbing. USGS researchers used 0-1 finger spacing between collar and neck, depending on the season collar is deployed to give consideration to the potential for weight gain. Other studies (e.g., Committee on Wild Horse and Burro Research, 1991) have had problems with the fitting of collars due to animals gaining weight in spring, or losing weight in winter, causing collars to become too tight or too loose. In the USGS study, researchers did notice collars were looser or tighter at different times during the year, but it did not affect the behavior of collared mares or jennies, or cause sores or wounds on mares or jennies. Whenever collars are deployed, they should be fitted by experienced personnel who can attach the collar quickly but proficiently to minimize handling stress on the animal.

Impacts of the Use of Radio Collars or Tail Tags

Based on numerous studies that have used modern radio collars with remote releases and tags to study the ecology of wild ungulates and equids in particular, these devices have minimal effects on the animals wearing them. The impact of radio collars and tags is very minimal. From March 2015 through March 2016 researchers at the USGS conducted a preliminary study on captive wild horses and burro jennies to determine proper fit and wear of radio collars (Schoenecker et al., 2014). The condition of wild horses wearing radio collars was compared to non-collared controls and documented with photographs. In addition, both collared individuals and controls were observed for 80 minutes each week for 14 weeks in order to quantify any impact of the collar on their behavior and health. At the end of the study period (March 2016) the collars were removed. Preliminary analyses indicate that mares had almost no impact in terms of rubbing or wear from radio collars and behavior of collared and uncollared mares did not differ (Schoenecker et al., 2020). There was also no impact of radio tags on behavior or wear. Preliminary data on a study completed in 2020 confirms these finding (USGS, unpublished data). If new data are published from more recent studies, the procedures for use of collars and tail tags may be updated accordingly. The BLM has supported other ecological studies in which wild mares and jennies living on-range were radio collared with similar collars and were monitored for health and any effects of collars via monthly welfare checks. Such collars, with the timed and remotely triggerable drop-off mechanisms, have been used in Adobe Town, Conger, Eagle, Frisco, Swasey, and Sulphur HMAs (mares) and in Sinbad HMA and Lake Pleasant HMA (jennies). The timed and remote-release drop off mechanisms have proven safe for use; the same authors who urged researchers to report any problems with equid radio collars in Hennig et al. (2020) have not reported such problems in their subsequent papers (Hennig et al. 2018, Esmaileh et al. 2021, Hennig et al. 2021, Hennig et al. 2022, King et al. 2022).

There are some possible effects from the use of collars. On males, on rare occasions, a collar over an ear has been observed, so no males would be collared. Also, collars may be fitted too tightly, or a horse may grow, tightening the collar. If neck abrasions or sores caused by a collar are observed and have not healed within 4 weeks of when it is observed, the collar's remote release would be deployed or the horse would be captured as soon as possible to remove the collar. If these situations are observed, the triggerable remote-release function would be deployed remotely. If that remote release failed, the collar would be removed after capturing the animal through approved methods in the proposed action. Neck abrasions or sores have not been reported in studies where equids have been collared (e.g., Collins et al., 2014, Hennig et al. 2018, Esmaileh et al. 2021, Hennig et al. 2021, Hennig et al. 2022, King et al. 2022).

No effects are expected from the tags; however, it is possible that they may form an irritation to individuals should vegetation get tangled in the tail. In this case it is expected that the tag would ultimately rip out of the hair (leaving no injury) as the horse rubs it. Details on tag fitting in horses are in Schoenecker et al. (2020).

The use of collar and tag technology in monitoring may help with understanding how free-roaming horses move across the HMAs and use increasingly scarce resources. Applying this technology in free-roaming horses and burros could provide the opportunity to better monitor resource use, habitat preference, home range and movement patterns. The mathods could be incorporated into investigations of social structure and dynamics and monitoring the effects of contraceptive use. Such information may or might be useful in informing future management decisions.

Figure 1. Two collar designs to use on wild horses and burros; one is teardrop shaped, and the other is oval shaped from Collins et al. (2014).

Figure 2. Burro jenny fitted with a radio collar in the USGS study showing appropriate placement of collars higher on the neck, behind ears.

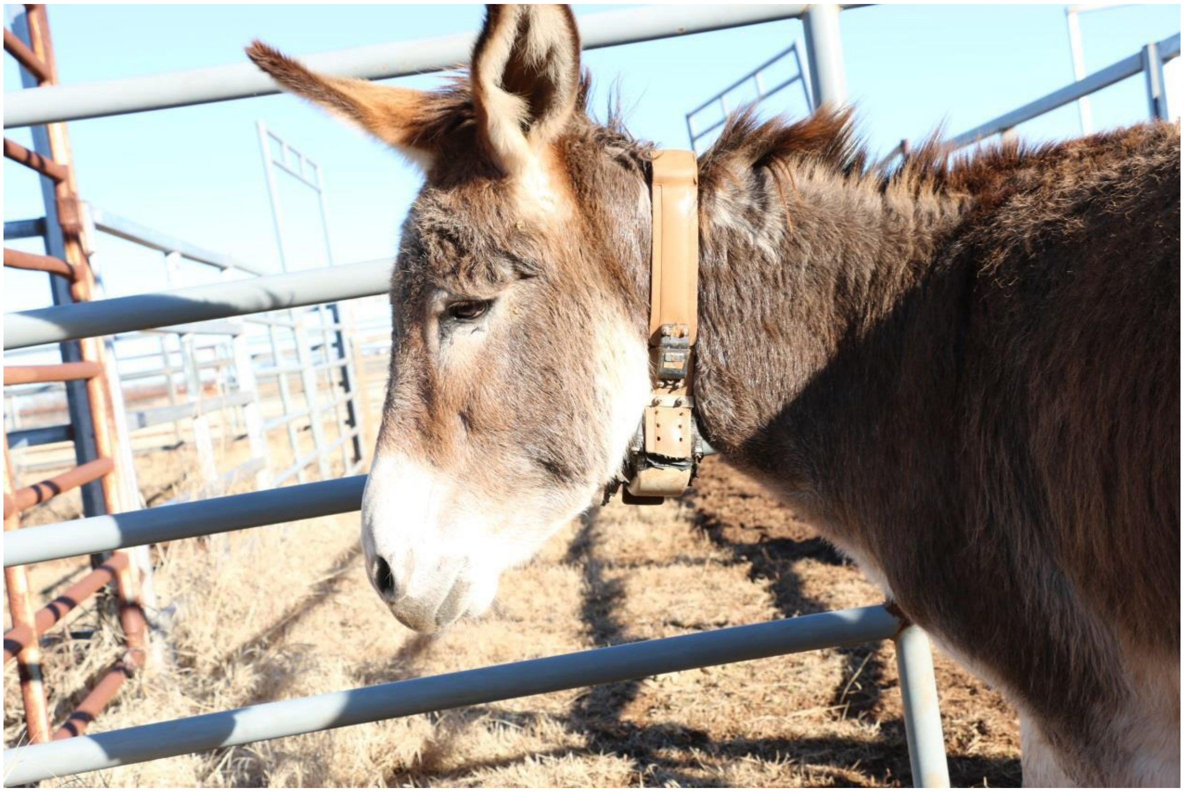

Figure 3. Wild horse mares fitted with radio collars in the USGS study showing head up and head down and demonstrating appropriate placement of collars higher on the neck just behind the ears.


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Appendix 7

Observation Protocol and Ground Rules

These rules were created to ensure the safety of both the humans and the animals at the gather site(s).

A scheduled public observation day provides a more structured mechanism for interested members of the public to see the wild horse gather activities at a given site. The Bureau of Land Management (BLM) attempts to allow the public to get an overall sense of the gather process and has available staff who can answer questions that the public may have. The public rendezvous at a designated place and are escorted by BLM representatives to and from the gather site.

- The BLM will schedule observation days to provide the media and public opportunities to view activities during the wild horse gather.
- To provide a safe environment for the animals, BLM staff, contractors and members of the public/media, requests will be accepted on a first come, first served basis and be limited to **10 people** per observation day unless otherwise approved by the authorized BLM official overseeing the gather. The BLM recommends all appointments be made as far in advance as possible in order to help us schedule and confirm your request and will make every reasonable effort to accommodate the public.
- Observation days and gather operations may be suspended if bad weather conditions create unsafe flying conditions.
- The BLM will notify observers as soon as possible if an observation day is canceled due to bad weather.
- Observers must provide their own 4-wheel drive high clearance vehicle and appropriate shoes, clothing, and food.
- Observers are prohibited from riding in government and contractor vehicles and equipment.
- Visitors arriving at the rendezvous site without an appointment will not be allowed to participate in the observation day.
- BLM representatives will escort visitors to and from the gather and/or temporary holding facility.
- Visitors will be assigned to a BLM representative and must stay with that person at all times.
- Visitors are **NOT** permitted to walk around the gather site unaccompanied by a BLM representative.
- The BLM will clearly identify observation areas and visitors **must** stay within these designated areas.
- Observers are prohibited from climbing/trespassing onto or in the trucks, equipment, or corrals, which is the private property of the contractor.
- Visitors must direct their questions/comments to either a designated BLM representative or the BLM spokesperson on site, and not engage other BLM/contractor staff and disrupt their gather duties/responsibilities.
- BLM may make the BLM/contractor staff available during down times for a Q&A session.
- When given the signal that the helicopter is close to the gather site bringing horses in, visitors must sit down in areas specified by BLM representatives and must not move or talk as the horses are guided into the corral.

Observers will be polite, professional, and respectful to BLM managers and staff and the contractor/employees.

Visitors who do not cooperate and follow the rules will be escorted off the gather site by BLM law enforcement personnel and will be prohibited in participating in any subsequent observation days.

Non-Scheduled Observation Day Protocol and Ground Rules

Non-scheduled observation days are days when the public is welcome to attend a gather on public land, or on specified private lands where permission has been granted. The public is responsible for their own safety and health in their travels to and from the gather site.

- BLM staff may be limited on these days to answer questions.
- Visitors must direct their questions/comments to either a designated BLM representative or the BLM spokesperson on site, and not engage other BLM/contractor staff and disrupt their gather duties/responsibilities.
- The public will be expected to remain in designated observation areas.
- Visitors are **NOT** permitted to walk around the gather site unaccompanied by a BLM representative.
- The BLM will clearly identify observation areas and visitors **must** stay within these designated areas.
- Observers are prohibited from climbing/trespassing onto or in the trucks, equipment or corrals, which is the private property of the contractor.
- Observers must provide their own 4-wheel drive high clearance vehicle and appropriate shoes, clothing, and food.
- When given the signal that the helicopter is close to the gather site bringing horses in, visitors must sit down in areas specified by BLM representatives and must not move or talk as the horses are guided into the corral.
- Gather operations may be suspended if bad weather conditions create unsafe flying conditions. Notification of suspension of gather operations will be made to the public that is present as soon as possible.
- Visitors must direct their questions/comments to either a designated BLM representative or the BLM spokesperson on site, and not engage other BLM/contractor staff and disrupt their gather duties/responsibilities.
- BLM may make the BLM/contractor staff available during down times for a Q&A session.

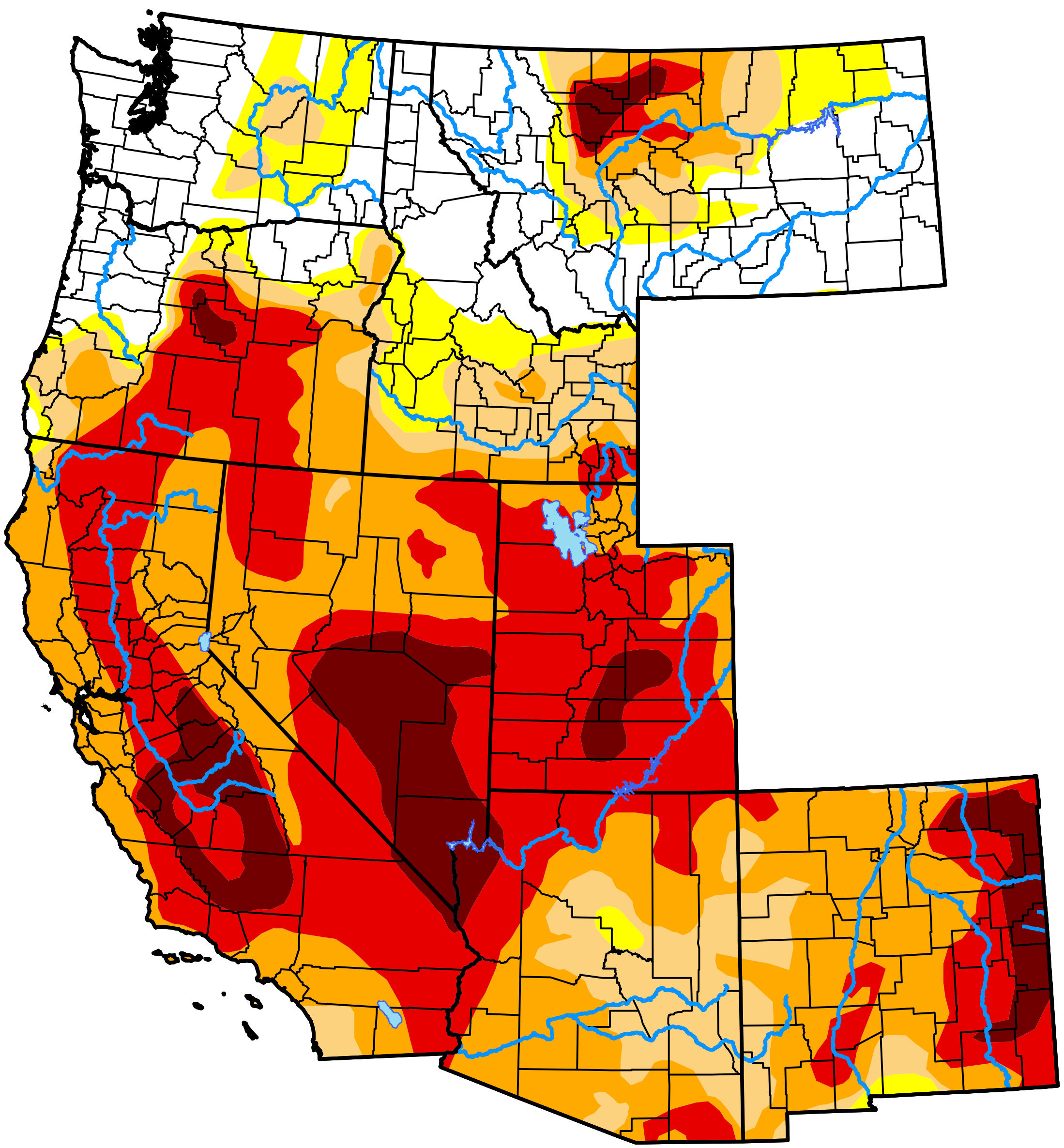
Observers will be polite, professional, and respectful to BLM managers and staff and the contractor/employees.

Visitors who do not cooperate and follow the rules will be escorted off the gather site by BLM law enforcement personnel and will be prohibited in participating in any subsequent observation days.

Appendix 8

U.S. Drought Monitor
West

July 12, 2022
(Released Thursday, Jul. 14, 2022)
Valid 8 a.m. EDT



Intensity:

☐	None
■	D0 Abnormally Dry
■	D1 Moderate Drought
■	D2 Severe Drought
■	D3 Extreme Drought
■	D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

Author:
Brian Fuchs
National Drought Mitigation Center

droughtmonitor.unl.edu

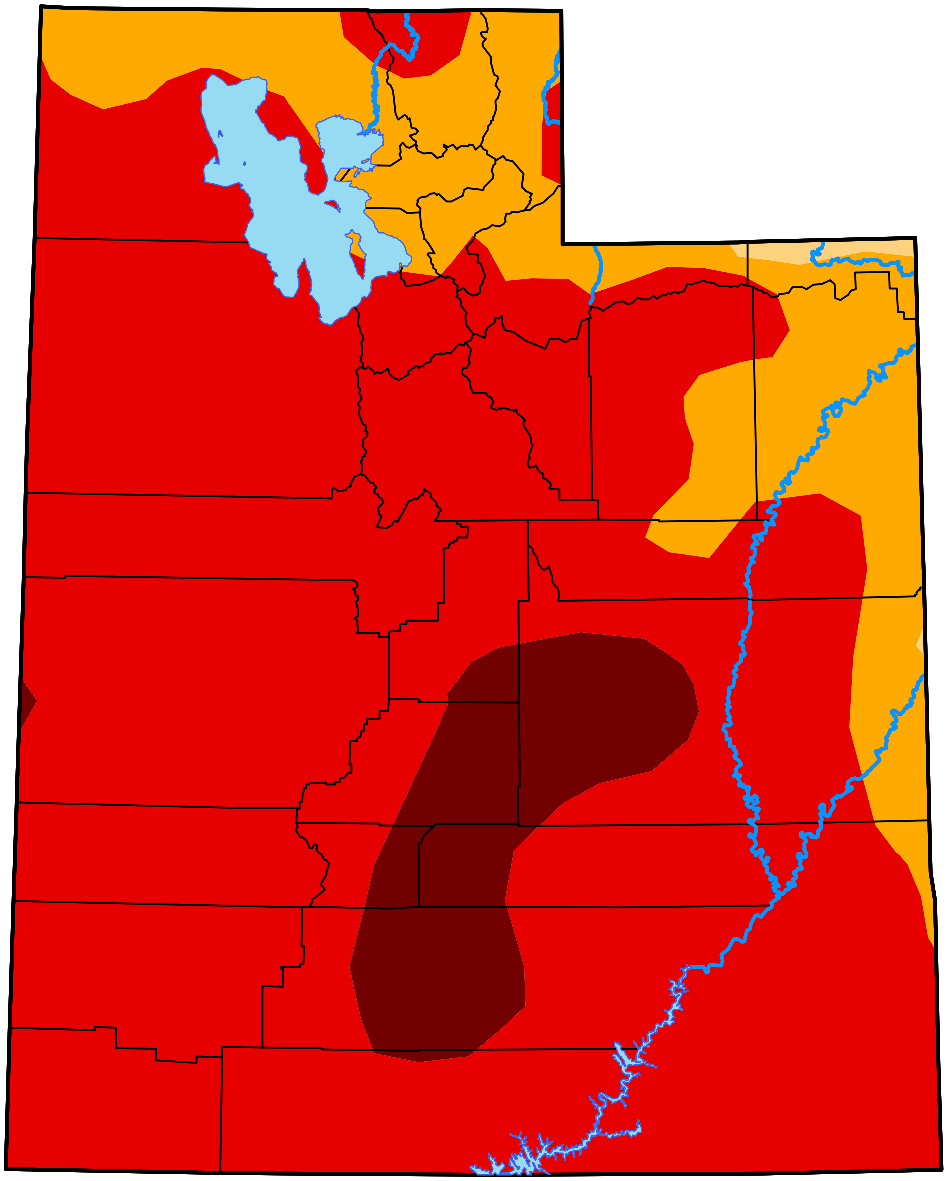
U.S. Drought Monitor

Utah

July 19, 2022

(Released Thursday, Jul. 21, 2022)

Valid 8 a.m. EDT



Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

Author:

Brian Fuchs
National Drought Mitigation Center

droughtmonitor.unl.edu

Appendix 9

MEMORANDUM

To: Chad Hunter (BLM)
CC: Gus Warr, Paul Griffin, Scott Fluer, Hollè Waddell (BLM)
From: Michelle Crabb (BLM) WHB Program Population Biologist
Date: 07/14/2022
RE: Statistical analysis for 2022 survey of burro abundance in Canyonlands, herd management area, UT

Summary Table

Survey Area and Dates	**Start date**	**End date**	**Area names**	**Area IDs**
	3/17/2022	3/17/2022	Canyonlands HMA	UT0571
Type of Survey	Simultaneous double-observer			
Aviation Details	Pilot: Brandon Bolton, Reeder Helicopters, Helicopter: A-Star 350 B3, #N352R			
Agency Personnel	Observers: Chad Hunter, Jeff Reese, Jessica Bulloch (BLM) Helicopter manager: Juan Torrealday, Court Christensen (BLM)			

Summary Narrative

In March 2022 Bureau of Land Management (BLM) personnel conducted simultaneous double-observer aerial surveys of the wild burro populations in the Canyonlands Herd Management Area (HMA; Figure 1). Surveys were conducted using methods recommended by BLM policy (BLM 2010) and a National Academy of Sciences review (NRC 2013) with detailed field methods described in Griffin et al. (2020). These data were analyzed using methods in Ekernas and Lubow (2019) to estimate sighting probabilities for wild burros, with sighting probabilities then used to correct the raw counts for systematic biases (undercounts) that are known to occur in aerial surveys (Lubow and Ransom 2016), and to provide confidence intervals (which are measures of uncertainty) associated with the abundance estimates.

Table 1. Estimated abundance (Estimated No. Burros) is for the number of burros in the surveyed areas at the time of survey. 90% confidence intervals are shown in terms of the lower limit (LCL) and upper limit (UCL). The coefficient of variation (CV) is a measure of precision; it is the standard error as a percentage of the estimated abundance. Number of burros seen (No. Burros Seen) leads to the estimated percentage of burros that were present in the surveyed area, but that were not recorded by any observer (Estimated % Missed). The estimated number of burros associated with each HMA but located outside the HMA's boundaries (Est. No. burros Outside HMA) is already included in the total estimate for that HMA.

Area	Age Class	Estimated No. Burros	LCL[a]	UCL	Std Err	CV	No. Burros Seen	Estimated % Missed	Estimated No. Groups	Estimated Group Size	Foals Per 100 Adults[b]	Est. No. Burros Outside HMA
Canyonlands HMA	Total	115	107	143	12.7	11.1%	107	7.0%	25	4.6	5.5	45
	Foals	6	6	9	1.2	20.3%	6					
	Adults	109	101	135	12.1	11.1%	101					
Glen Canyon National Recreation Area	Total	6	6	8	1.4	22.9%	6	0%	2	3.0	0	6
	Foals	0					0					
	Adults	6	6	8	1.4	22.9%	6					
Survey Total	Total	121	113	149	13	10.7%	113	6.6%	27	4.5	5.2	51
	Foals	6	6	9	1.2	20.3%	6					
	Adults	115	107	141	12.4	10.8%	107					

[a] The lower 90% confidence limit is based on bootstrap simulation results or the number of burros seen, whichever is higher.
[b] The estimated ratio of foals to adults reflects what was observed during this March survey. This ratio does not represent the full cohort of foals for this year.

Abundance Results

The estimated total burro abundance within the surveyed area is reported in Table 1. Observers recorded 26 burro groups, of which 25 burro groups had data recorded properly 'on protocol' and that could be used to compute statistical estimates of sighting probability. All of the 26 groups seen were used to calculate the abundance estimate. Any burro groups that were seen twice (double counted), or that were identified as domestic and privately owned, were not used to calculate abundance; however, such groups can be used to parameterize sighting probability if they were recorded on protocol. Coefficient of variation (Table 1) values of less than 10% indicate high precision resulting from high detection probabilities; values between 10-20% indicate medium precision resulting from lower detection probabilities; and values greater than 20% indicate low precision resulting from very low detection probabilities.

Double observer aerial surveys of burros typically contain unmodeled heterogeneity in detection probabilities (discussed below) that cause abundance estimates to be biased too low. Consequently, the abundance estimate presented in Table 1 is likely to be substantially lower than the true number of burros present in the surveyed area. For reference, a 2017 double observer burro survey and analysis of Sinbad HMA, UT, underestimated burro abundance by approximately 25% compared to tallies of known individuals (Hennig et al. 2022). In the absence of better information, it is likely that the true abundance of burros in these HMA is at least 25% more than the values reported in Table 1 (Estimated No. Burros). However, it is not possible from the available data, or the analysis presented here to assess the actual additional percentage that should be added.

The mean estimated size of detected burro groups, after correcting for missed groups, was 4.5 burros/group across the surveyed area, with a median of 3.0 burros/group. There were an estimated 5.2 foals per 100 adult burros at the time of these surveys (Table 1). The estimated ratio of foals to adults reflects what was observed during this March survey. This ratio does not represent the full cohort of foals for this year.

Sighting Probability Results

The combined front observers saw 60% of the burro groups (72.4% of the burros) seen by any observer, whereas the back seat observers saw 88% of all burro groups (84.8% of burros) seen (Table 2). At least one observer (front or back) missed 52.0% of burro groups seen by the other. These results demonstrate that simple raw counts do not fully reflect the true abundance without statistical corrections for missed groups, made possible by the double observer method and reported here. Direct counts from aerial surveys underestimate true abundance because some animals are missed by all observers; this analysis corrects for that bias (Lubow and Ransom 2016). The analysis method used for the surveyed areas were based on simultaneous double-observer data collected during these surveys.

The sample size of observations following protocol was 25 burro groups. Survey datasets with sample size less than 20 groups cannot be analyzed using these methods; sample sizes of 20 to

40 groups are considered low and have high risk of containing unmodeled heterogeneity in sighting probability; sample sizes of 41-100 groups are moderate and can estimate effects of many but likely not all potential sightability covariates; and sample sizes >100 groups are large and can account for most sightability covariates.

Unmodeled heterogeneity in detection probability is a systematic problem in double observer aerial surveys of burros, and solving this problem is an area of active research. Burros are difficult to see from the air, and some types of groups are so difficult to see (e.g. groups that are small, standing still, and in heavy tree cover) that they are practically never detected by any observer. When certain types of groups are never seen, their sightability characteristics cannot be described by any set of covariates, and this class of groups disappears from the analysis. Conversely, other types of groups are easy to see (e.g. large groups in open vegetation, close to the helicopter, and running) and every observer sees them nearly every time. The "easy-to-see" types of groups thereby become over-represented in the data. Furthermore, covariates that sharply reduce detection probability might never be described and thus cannot be modeled. For example, with the 1-mile spacing sometimes used in these surveys, burro groups that were ½ mile or more from a transect line may have been so rarely detected by any observer that accurate correction factors could not be estimated for those kinds of groups. As a result of heterogeneity, the double observer model tends to over-estimate detection probability for the burro population as a whole. When the detection probability estimate is biased high, the correction factor for how many groups were missed is biased too low. Consequently, unmodeled heterogeneity in detection probability causes double observer analyses to underestimate true burro abundance.

All models used in the double-observer analysis contained an estimated intercept common to all observers. Informed by *a priori* reasoning and preliminary analyses I evaluated 2 additional possible effects on sighting probability by fitting models for all possible combinations with and without these effects, resulting in 4 alternative models. The 2 additional effects examined were: (1) burro group size; (2) observations by backseat observers. I did not consider effects on detection probability of visual field, vegetation cover, animal activity, lighting conditions, and snow cover due to insufficient variation in the values of this covariate. Covariates and their relative effect on sighting probability are shown in Table 3.

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

There was strong support for observations by backseat observers (84.4% of AICc model weight), and weak support for the effect of group size (30.6%). As expected, visibility was higher for burro groups that were larger (Table 3).

Estimated overall sighting probabilities, p, for the combined observers ranged across burro groups from 0.53-0.95. Sighting probability was <0.9 for 1 (4%) observed groups. In aggregate across all observed groups, the overall “correction factor” that was added on to the total number of wild burros seen was 7.1%. That is to say: 113 burros were seen, and adding another 7.1% of that number seen equals the total estimate of 121 burros (Table 1). A different but mathematically equivalent interpretation is listed in Table 1 in the “Estimated % Missed” column, which shows that, overall, 6.6% of the burros that were estimated to be present during the survey were never seen by any of the observers (Table 1). However, as noted earlier, the true number of burros in the surveyed area is likely to be at least 25% greater than the values in Table 1, based on preliminary results from Hennig et al (2022).

Assumptions and Caveats

Results from this double observer analysis are a conservative estimate of abundance. True abundance values are likely to be at least 25% higher, and almost certainly not lower, than abundance estimates in Table 1 because of several potential sources of bias listed below. Results should always be interpreted with a clear understanding of the assumptions and implications.

1. The results obtained from these surveys are estimates of the burros present in the surveyed area at the time of the survey and should not be used to make inferences beyond this context. Abundance values reported here may vary from the annual March 1 population estimates for the HMA; aerial survey data are just one component of all the available information that BLM uses to make March 1 population estimates. Aerial surveys only provide information about the area surveyed at the time of the survey, and do not account for births, deaths, movements, or any management removals that may have taken place afterwards.

2. Simultaneous double-observer analyses cannot account for undocumented animal movement between, within, or outside of the surveyed area. Fences and topographic barriers can provide deterrents to animal movement, but even these barriers may not present continuous, unbroken, or impenetrable barriers. It is possible that the surveys did not extend as far beyond a boundary as burros might move. Consequently, there is the possibility that temporary emigration from the surveyed area may have contributed to some animals that are normally resident having not being present at the time of survey. In principle, if the level of such movement were high, then the number of animals found within the survey area at another time could differ substantially. If there were any wild burros that are part of a local herd but were outside the surveyed areas, then Table 1 underestimates true abundance.

3. The validity of the analysis rests on the assumption that all groups of animals are flown over once during a survey period, and thus have exactly one chance to be counted by the front and back seat observers, or that groups flown over more than once are identified and considered only once in the analysis. Animal movements during a survey can potentially bias results if those movements result in unintentional over- or under-counting of burros. Groups counted more than once would constitute ‘double counting,’ which would lead to estimates that are biased higher than the true number of groups present. Groups that were never available to be seen (for example due to temporary emigration out of the study area or undetected movement from an unsurveyed area to an already-surveyed area) can lead to estimates that are negatively biased compared to the

true abundance. The use of two helicopters at the same time in this survey is a technique that can improve the inference strength about estimated herd size, because the entire survey area is covered in half the time – thus, reducing the number of possible overnight movements and reducing the risk of groups being counted twice or not at all.

Survey SOPs (Griffin et al. 2020) call for observers to identify and record 'marker' animals (with unusual coloration) on paper, and variation in group sizes helps reduce the risk of double counting during aerial surveys. Observers are also to take photographs of many observed groups and use those photos after landing to identify any groups that might have been inadvertently recorded twice. Unfortunately, there is no effective way to correct for the converse problem of burros fleeing and thus never having the opportunity for being detected. Wild burros tend to move more slowly than wild horses. Despite this, because observers can account for burro movements leading to double counting, but cannot account for movement causing burros to never be observed, animal movements can contribute to the estimated abundance (Table 1) potentially being lower than true abundance.

4. The simultaneous double observer method assumes that all burro groups with identical sighting covariate values have equal sighting probability. If there is additional variability in sighting probability not accounted for in the sighting models, such heterogeneity could lead to a negative bias (underestimate) of abundance. In other words, under most conditions the double-observer method underestimates abundance.

5. The analysis assumes that the number of animals in each group is counted accurately. Standard Operating Procedures (Griffin et al. 2020) specify that all groups with more than 20 animals are photographed and photos scrutinized after the flight to correct counts. Smaller groups, particularly ones with poor sighting conditions such as heavy tree cover, could also be undercounted. Undercounting can be common for burro groups, some members of which may stay immobile and under cover, even when a helicopter circles back overhead for counting. Any such undercounting would lead to biased estimates of abundance.

Evaluation of Survey and Recommendations

Visibility conditions were very good throughout the survey, and it appears that survey protocols were followed well except that in the future "burro" datasheets should be used instead of "horse" datasheets. Most burro surveys distances record distance from the transect at 100m increments, which allows for more precise estimates of detection probability. Because distances were recorded at larger increments there was insufficient variation in the values to include it in the analysis. Most burro surveys characteristically have a steep drop-off in detection probability as a function of distance, and not being able to include distance in this analysis may result in lower abundance estimates than if distance was included. Pooling data from Canyonlands HMA surveys across multiple years would be very helpful for the analysis, and I encourage that survey conditions be kept as reasonably similar across years (same aircraft type, the same pilot, same observers, same season, etc.) as much as possible. I was unable to combine previous Canyonlands surveys because a different helicopter was used with a different field of view.

The survey covered all parts of the HMA and extended beyond HMA boundaries in most places, particularly east and west of the HMA. A few groups of burros were observed near the edge of the surveyed area. The Orange Cliffs in Glen Canyon National Recreation Area restrict burro movement farther east, although there are no obvious natural deterrents to burro movements that would contain them within the boundaries of the survey area to the west. Consequently, it is difficult to be sure there were no additional burros outside of the HMA, and results should be understood to represent the burros present only in the area surveyed, which may not represent all burros that occasionally occupy the Canyonlands HMA and immediate vicinity. Careful consideration should be given to where burros were located near the edge of the area surveyed when planning whether to extend the survey area further in future surveys to ensure covering all areas potentially occupied by burros associated with the HMA, or to confirm that the current survey boundaries do cover the full extent of burros' range in this area.

Table 2. Tally of raw counts of burros and burro groups by observer (front, back, and both) for combined data from the Canyonlands HMA surveyed in March 2022.

Observer	Groups seen[a] (raw count)	Burros seen (raw count)	Actual sighting rate[b] (groups)	Actual sighting rate[b] (burros)
Front	15	76	60.0%	72.4%
Back	22	89	88.0%	84.8%
Both	12	60	48.0%	57.1%
Combined	25	105		

[a] Includes only groups and burros where protocol was followed.
[b] Percentage of all groups seen that were seen by each observer.

Table 3. Effect of observers and sighting condition covariates on estimated sighting probability of burro groups for both front and rear observers during the March 2022 survey. Baseline case (bold) for burros presents the predicted sighting probability for a group of 3.0 burros (the median group size observed), with average back-seat observer. Other example cases vary a covariate or observer, one effect at time, as indicated in the left-most column, to illustrate the relative magnitude of each effect. Sighting probabilities for each row should be compared to the baseline (first row) to see the effect of the change in each observer or condition. Baseline values are shown in bold wherever they occur. Sighting probabilities are weighted averages across all 4 models considered (Burnham and Anderson 2002).

	Sighting Probability		
	Front Observer[a]	Back Observer[b]	Combined Observers
Baseline	**55.3%**	**82.1%**	92.0%
Effect of Group size (N=1)	53.5%	80.9%	91.1%
Effect of Group size (N=10)	61.1%	85.1%	94.2%
Effect of Back=Front	**55.3%**	55.3%	80.0%

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

[b] Sighting probabilities for back observers for burro groups that are potentially visible on the same side of the aircraft as the observer. Sighting probability in the back is 0 for groups on the opposite side or centerline.

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Figure 1. Map of 2022 Canyonlands HMA survey tracks flown (black lines), approximate locations of observed burro groups (black and white circles), and HMA boundaries (blue).