United States Department of the Interior
Bureau of Land Management

Draft Environmental Assessment
DOI-BLM-NV-S010-2020-0086-EA

Lake Mead Complex
Wild Horse and Burro Gather Plan

U.S. Department of the Interior
Bureau of Land Management
Southern Nevada District
Las Vegas Field Office
4701 N Torrey Pines Dr
Las Vegas, NV 89130
(702)515-5000

1.0 Purpose and Need for Action

1.1 Introduction

This Environmental Assessment (EA) has been prepared to analyze the Bureau of Land Management's (BML) Las Vegas Field Office (LVFO) proposal to gather and remove excess wild horses and burros from within and outside the Lake Mead Complex (LMC). The gather plan would allow for an initial gather and follow-up maintenance gathers to be conducted over the next 10 years from the date of the initial gather operation to achieve and maintain appropriate management levels. The proposed gather would remove excess wild horses and burros from inside and outside Gold Butte Herd Management Area (HMA), Muddy Mountains Herd Area (HA), and El Dorado Mountains HA. Collectively, these three areas are referred to here as the Lake Mead Complex (LMC).

This EA is a site-specific analysis of the potential impacts that could result with the implementation of the Proposed Action. Preparation of an EA assists the BLM authorized officer to determine whether to prepare an Environmental Impact Statement (EIS) if significant impacts could result, or a Finding of No Significant Impact (FONSI) if no significant impacts are expected.

This document is tiered to the Las Vegas Resource Management Plan and Final Environmental Impact Statement signed October 1998 and is in conformance with the Lake Mead National Recreation Area Burro Management Plan and EIS signed April 1995.

1.2 Background

Since the passage of the Wild Free-Roaming Horses and Burros Act (WFRHBA) of 1971, BLM has refined its understanding of how to manage wild horse and burro population levels. By law, BLM is required to control any overpopulation, by removing excess animals, once a determination has been made that excess animals are present and removal is necessary. Program goals have always been to establish and maintain a "thriving natural ecological balance," which requires identifying the Appropriate Management Level (AML) for individual herds. In the past two decades, goals have also explicitly included conducting gathers and applying contraceptive treatments to achieve and maintain wild horse and burro populations within the established AML, so as to manage for healthy wild horse and burro populations and healthy rangelands. Other management efforts include using population inventories that rely on peer-reviewed methodology, and collecting genetic baseline data to support genetic health assessments. Decreasing the numbers of excess wild horses and burros on the range to levels within AML is consistent with findings and recommendations from the National Academy of Sciences (NAS), American Horse protection Association (AHPA), the American Association of Equine Practitioners (AAEP), Government Accountability Office (GAO), Office of Inspector General (OIG), among others, and with current BLM policy.

The LMC is located in the south eastern portion of Clark County, NV within the Southern Nevada District for BLM. The LMC comprises of approximately 274,000 acres of public land jointly managed by BLM and the National Park Service (NPS). Due to a lack of key forage species and the presence of the Mojave desert tortoise (*Gopherus agassizii*) there are no grazing allotments located within the LMC. See Appendix A Map.

In the Gold Butte HMA, Muddy Mountains HA, and El Dorado HA, the BLM manages for "0" wild horses. The Gold Butte HMA has an Appropriate Management Level (AML) range of 22-98 wild burros. The BLM manages Muddy Mountains and El Dorado HAs for "0" wild burros. These values for AML were established based on monitoring data and an in-depth analysis of habitat suitability for maintaining healthy wild horses and burros on rangelands over the long-term and were established through the Record of Decision (ROD) and Approved Las Vegas Resource Management Plan (RMP)/Environmental Impact

Statement (EIS) (October 1998) and the Lake Mead National Recreation Area Burro Management Plan and EIS (April 1995). The decision was reconfirmed in the 2005 Decision Record and EA NV-052-05-399 Johnnie, Muddy Mountains, and Wheeler Pass Herd Management Areas, Establishment of Appropriate Management Levels and the renewed memorandum of understanding (MOU) between the BLM and National Park Service in 2005.

The current estimated populations are approximately 36 wild horses within Muddy Mountains HA, and 554 wild burros associated with the complex. Those burros include approximately 514 in and near Gold Butte HMA, 38 I Muddy Mountains HA, and 7 in El Dorado Mountains HA. Approximately 5 wild burros have been seen within and outside the El Dorado HA. These numbers are based on the most recent aerial survey in the area, which used simultaneous double-observer methods for data recording (Griffin et al. 2020) and analysis (Lubow 2020). The survey was conducted in September 2019. Current estimates reflect projected herd growth since that time. Wild horse and burro numbers have increased an average of 15% to 20% per year since the HMA and HA's were last gathered. The current population of wild burros in the complex is about 25 times over the AML lower limit for the Gold Butte HMA.

The last gather for the LMC occurred in March 2007, when approximately 149 excess wild burros were removed from the complex.

Based upon all information available at this time, the BLM has determined that approximately 471 excess wild burros and 36 wild horses exist within the HMA and HAs and need to be removed. This assessment is based on the following factors including, but not limited to:

- An estimated total of 486 wild burros present in September 2019 in and near the complex (Lubow 2020). Applying a 15% expected annual herd growth rate to that total leads to a current estimate of ~559 burros (as of February 2021). Similarly, 30 wild horses were counted in the September 2019 survey. Assuming a 20% per year growth rate for wild horses, it is expected that approximately 36 wild horses are now present.
- Utilization monitoring completed in 2020 documents heavy to severe utilization of forage within riparian habitats, and extensive trampling and trailing damage by wild burros.
- Ongoing drought conditions have compromised the available forage resources within the HMA/HAs.

1.3 Purpose and Need for Action

The purpose of the Proposed Action is to remove excess wild horses and burros from within and outside the LMC over the next 10 years; to manage wild burros to achieve and maintain established AML ranges for the complex, to reduce the wild burro population growth rate in order to prevent undue or unnecessary degradation of the public lands associated with an overpopulation excess wild burros within and outside the complex, and to restore a thriving natural ecological balance and multiple use relationship on the public lands consistent with the provisions of Section 1333 (a) of the Wild Free- Roaming Horses and Burros Act of 1971 [1].

The need for the Proposed Action is to protect rangeland resources and to prevent unnecessary or undue degradation of the public lands associated with excess population of wild horses and burros within the Lake Mead Complex.

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

1.4 Land Use Plan Conformance

The Proposed Action is in conformance with the Las Vegas ROD and Approved RMP (October 1998) as required by regulation (43 CFR 1610.5-3(a)) as follows:

- **Objective:** "*In Herd Management Areas not constrained by desert tortoise restrictions, manage for healthy, genetically viable herds of wild horses and/or burros in a natural, thriving ecological balance with other rangeland uses.*"
- **Objective:** "*Maintain the wild, free-roaming character of the wild horses and burros on the public lands.*"

1.5 Relationship to Laws, Regulations, and Other Plans

- The Proposed Action is in conformance with the WFRHBA (as amended), applicable regulations at 43 CFR § 4700 and BLM policies. State Protocol Agreement between the Bureau of Land Management, Nevada and the Nevada Historic Preservation Office (1999)
- Lake Mead Complex Final Gather Plan Environmental Assessment NV-052-2007-69
- Lake Mead National Recreation Area Burro Management Plan and EIS (April 1995)
- Endangered Species Act – 1973
- Wilderness Act – 1964
- Organic Act of 1916
- National Environmental Policy Act of 1969 (as amended
- Migratory Bird Treaty Act (1918 as amended) and Executive Order 13186 (1/11/01)
- Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.)
- Federal Land Policy and Management Act (FLPMA) of 1976 (43 U.S.C. 1701 et seq.)
- American Indian Religious Freedom Act of 1979
- Archaeological Resource Protection Act of 1979
- National Historic Preservation Act of 1966, as amended
- Appropriations Act, 2001 (114 Stat. 1009) (66 Fed. Reg. 753, January 4, 2001)
- United States Department of the Interior Manual (910 DM 1.3).
- Fundamentals of Rangeland Health (43 CFR 4180)
- Johnnie, Muddy Mountains, and Wheeler Pass Herd Management Areas, Establishment of Appropriate Management Levels EA NV-052-05-399

1.6 Conformance with Rangeland Health Standards and Guidelines

- Mojave/Southern Great Basin Resource Advisory Council (RAC) Standards and Guidelines (February 12, 1997)
  Mojave/Southern Great Basin RAC Standards and Guidelines

1.7 Decision to be Made

The Authorized Officer would determine whether to implement all, part, or none of the Proposed Action as described in Section 2.2.1 to manage wild horses and burros within the LMC. The Authorized Officer would not set or adjust AML since these were set through previous decisions.

1.8 Scoping and Identification of Issues

Issues identified by the BLM interdisciplinary team are discussed in Chapter 3. Resources which were considered but would not be affected to the level requiring detailed analysis, are listed on Supplemental Authorities (Critical Elements of the Human Environment) table (section 3.2).

2.0 Description of the Alternatives

2.1 Introduction

This section of the EA describes the Proposed Action and No Action Alternative, including Alternatives that were considered but eliminated from detailed analysis:

- Proposed Action – Over a 10-year period, use gathers in order to achieve and maintain herd sizes within AML and apply fertility control vaccines to all released jennies within the Complex.
- No Action Alternative – Continuation of Existing Management.

The Proposed Action was developed to achieve and maintain the established AML so as to ensure a thriving natural ecological balance, remove excess wild horses and burros from the range, prevent further deterioration to the range, and ensure the long-term health of wild burros within the LMC. Under the No Action Alternative, no gather would occur, and no additional management actions would be undertaken to control the size of the wild horse and burro population at this time. The No Action Alternative would not achieve the identified Purpose and Need. The No Action Alternative does not comply with the WFRHBA of 1971, regulations, and the approved Las Vegas RMP (October 1998). However, it is analyzed in this EA to provide a basis for comparison with the Proposed Action, and to assess the effects of not conducting a gather at this time.

2.2.2 Proposed Action

The Proposed Action would gather and remove wild burros until the low AML is met and would gather and remove 100% of the existing wild horses (approximately 471 wild burros and 36 wild horses). BLM will conduct these gathers periodically over the next ten years to gather all wild horses and excess wild burros, to maintain AML. After the initial gather, any additional target removal numbers would be adjusted accordingly based off population inventories for the LMC and the resulting projection of excess animals over AML. Any jennies that would be released back into the Complex will be treated with a fertility control vaccine.

Under the Proposed Action, a sufficient number of burros would be gathered primarily from heavily concentrated areas within the project area to reduce resource impacts in the most impacted areas, and all burros residing outside the LMC boundary would be gathered and removed. All wild horses found within the LMC or found outside of its boundaries would be removed. All jennies released would be treated with fertility control vaccines (i.e., PZP ZonaStat vaccine, PZP-22 pellet vaccine, GonaCon vaccine). Vaccine application would follow existing SOPs (Appendix D). Based on available peer-reviewed scientific literature (Appendix D), it is expected that pregnant jennies would foal naturally after vaccination. Administration of vaccines could be by hand injection after a gather, or by darting, though it is not expected that jennies in the LMC will be approachable enough for darting to be successful. Genetic monitoring results, based on samples collected during gathers, would be used to inform BLM if there is a need to introduce additional fertile animals, to maintain adequate levels of observed heterozygosity (which is a measure of genetic diversity).

If gather efficiencies during the initial gather do not allow for the attainment of the Proposed Action during the initial gather (i.e., not enough burros are successfully captured to reach low AML), or if BLM is otherwise unable to permanently remove a sufficient number of excess burros to achieve low AML, the Las Vegas Field Office would return to the LMC to remove excess burros above low AML and would conduct follow-up gathers over a 10 year period after the initial gather to remove any additional wild burros necessary to achieve and maintain the overall herd size within the range of AML.

Population inventories and routine resource/habitat monitoring would be completed throughout the time period of the proposed action, to document current population levels, growth rates and areas of continued resource concern (burro concentrations, riparian impacts, over-utilization, etc.) prior to any follow-up gather. Maintenance gather activities would be conducted in a manner consistent with those described for

the initial gather and could be conducted year-round. Funding limitations and competing priorities might impact the timing of the initial gather, and any subsequent maintenance gathers.

2.2.2.1 Management Actions of the Proposed Action

- The ten-year period would begin after the first gather is initiated. Additional gathers over the following 10 years may be needed to reach the lower AML based on gather success, holding capacity limitations, population growth rates and other national gather priorities. Several factors such as animal condition, herd health, weather conditions, budget, or other considerations could result in adjustments to gathers and follow up gathers.
- Any burros residing outside of the Gold Butte HMA boundaries or found residing inside or outside of the Muddy Mountains and El Dorado HAs will be removed during gather operations.
- Any horses in the LMC would be gathered and removed.
- Gather operations would be conducted in accordance with the Comprehensive Animal Welfare Program (CAWP) for Wild Horses and Burro Gathers, which includes provisions of the Comprehensive Animal Welfare Program (BLM Permanent Instructional Memorandum 2021-002) (Appendix B). A combination of gather methods may be used to complete the management actions and the methods to be used would depend on the needs of the specific actions including management needs regarding emergency situations.
    - The primary gather methods used in the performance of gather operations include:
        - Helicopter Drive Trapping. This gather method involves utilizing a helicopter to herd wild horses and/or wild burros into a temporary trap.
        - Bait Trapping. This gather method involves utilizing bait (e.g., water or feed) to lure wild horses and/or wild burros into a temporary trap.
- Trap sites and temporary holding facilities will be located in previously used sites or other disturbed areas whenever possible.
- An Animal and Plant Inspection Service (APHIS) or other veterinarian may be on-site or on-call during the gather, as needed, to examine animals and make recommendations to BLM for care and treatment of wild horses and burros.
- Decisions to humanely euthanize animals in field situations will be made in conformance with BLM Instruction Memorandum (IM) 2015-70.
- Excess animals would be transported to the nearest BLM off-range corrals (ORC) with available space where they will be prepared (freezemarked, microchipped, vaccinated and de-wormed) for adoption, sale (with limitations) or off-range pastures (ORP).
- Funding limitations and competing priorities may require delaying the gather and population control component which would increase the number of horses and burros that would need to be gathered.
- Population inventories and routine resource/habitat monitoring would be completed between gathers to document current population levels, growth rates, and area of continued resource concern (horse and burro concentrations, riparian impacts, over-utilization, etc.) prior to any follow-up gather.
- At least 3-5 fertile burros will be introduced to the Gold Butte HMA, every 7 years. This action will be taken to augment genetic diversity in the herd.
- Genetic monitoring samples would be collected from wild burros during gather operations, for analysis to determine levels of genetic diversity, in keeping with BLM IM-2009-062. In the event that observed heterozygosity levels call for herd augmentation, additional fertile wild burros could be introduced to the Gold Butte HMA from other BLM-managed herds, in keeping with BLM H-4700-1 (2010).
- Biological and archeological specialists will be consulted as early as possible during the gather planning process to ensure that sensitive species and archeological sites/artifacts are avoided during gather operations.

2.2.3 No Action Alternative

Under the No Action Alternative, no gather would occur, and no additional management actions would be undertaken to control the size or growth rates of the wild horse and burro population at this time. The No Action Alternative would not achieve the identified Purpose and Need. The No Action Alternative does not comply with the WFRHBA of 1971, regulations, and the approved Las Vegas RMP (October 1998) or Lake Mead Nation Recreation Area Burro Management Plan and EIS (April 1995). However, it is analyzed in this EA to provide a basis for comparison with the other action alternatives, and to assess the effects of not conducting a gather at this time.

2.3 Alternatives Considered but Dismissed from Detailed Analysis

2.3.1 Gather the HMA to the AML Upper Limit

This alternative was dismissed from detailed study because AML would be exceeded the foaling season following the initial gather. This would result in the need to follow up with another gather within one year, and in increased stress to individual wild burros and the herd and continuing resource damage due to wild burro overpopulation in the interim. Nor would this alternative be consistent with the WFRHBA, which upon determination excess wild horses and burros are present, requires their immediate removal.

2.3.2 Fertility Control Treatment Only (No Removal)

This alternative would rely only on the use of fertility control vaccines to limit herd growth of wild horses and burros. Experience has shown that herds will only decrease in response to management that only uses fertility vaccines (without gathers and removals) over time scales of 10 years or more, and only if the vast majority of females (i.e., 90%+) is treated and rendered infertile every year (such as, at Assateague National Seashore). Available fertility control vaccines require females to be identifiable and require revaccination (booster doses) to cause infertility for more than one year. It is not economical or practical to gather, uniquely mark, vaccinate, and release the majority of jennies every year in the Lake Mead Complex. A reliance on darting is not expected to lead to high enough rates of vaccination every year. Because use of a fertility control vaccine-only management would require a very long time to begin to reduce herd sizes, and because the burro herds present in the LMC are currently far greater than AML and are already causing ecological damage, this alternative would not meet the Purpose and Need for the Action, and would be contrary to the WFRHBA, and was dismissed from further study.

2.3.3 Field Darting with ZonaStat-H (Native PZP) and Gonacon (No Gathers, No Removal)

This alternative was eliminated from further consideration due to the difficulties inherent in darting wild burros in the project area. Field darting of wild burros may work well in small areas with good access, and where animals are acclimated to the presence of people who come to watch and photograph them. The size of the LMC is large (approximately 274,000 acres) and many areas do not have safe and ready access, including the wilderness areas. Approachability on the LMC is such that it is not expected that delivering vaccine dose via darting could be possible with any regularity. The presence of water sources within the LMC make it almost impossible to restrict wild burro access to be able to dart burros consistently. Burro behavior limits their approachability/accessibility, so that the number of jennies expected to be treatable via darting would be insufficient to control growth. Available fertility control vaccines require females to be identifiable and require revaccination (booster doses) to cause infertility for more than one year. Without gathering animals to give them unique identifiable marks, BLM would have difficulties keeping records of animals that have been treated due to common and similar colors and patterns. Annual darting of wild burros in large areas is unlikely to lead to the levels of treatment needed to cause ecologically meaningful population declines. For these reasons, and because the wild burro herds present in the LMC are currently far greater than AML and are already causing ecological damage, this alternative was determined to not be an effective or feasible method applying population controls to wild burros from the LMC.

2.3.4 Chemical Immobilization

Chemical immobilization as a method of capturing wild burros was not considered to be a viable alternative because it is a very specialized technique and is strictly regulated. Currently the BLM does not have sufficient expertise to implement this method and it would be impractical to use, given the size of the LMC, access limitations, and approachability of the burros.

2.3.5 Use of Wrangler on Horseback Drive-trapping

Use of wranglers on horseback drive-trapping to remove excess wild horses and burros can be somewhat effective on a small scale but due to the number of animals to be gathered, the large geographic size of the Complex, and lack of approachability of the animals, this technique would be ineffective and impractical as a substitute for helicopter trapping. Wild horses and burros often outrun and outlast domestic horses carrying riders. Helicopter assisted roping is typically only used if necessary and when the wild horses or burros are in close proximity to the gather site. For these reasons, this method was eliminated from further consideration.

2.3.6 Raising the Appropriate Management Level for Wild Horses and Burros

Raising the AML where there are known resource degradation issues associated with an overpopulation of wild horses and burros does not meet the Purpose and Need to restore a thriving natural ecological balance or meet Rangeland Health Standards. Delay of a gather until the AMLs can be reevaluated is not consistent with the WFRHBA, Public Rangelands Improvement Act (PRIA) or FLPMA or the existing Las Vegas RMP or Lake Mead NRA Burro Management Plan and EIS. Monitoring data collected within the LMC does not indicate that an increase in AML is warranted at this time. On the contrary, such monitoring data confirms the need to remove excess wild horses and burros above AML to reverse downward trends and promote improvement of rangeland health. Delay of a gather until AML can be evaluated and adjusted is not consistent with the WFRHBA, Public Rangelands Improvement Act (PRIA) or FLPMA or Las Vegas RMP or the Lake Mead NRA Burro Management Plan and EIS. Severe range degradation would occur in the meantime and large numbers of excess wild horses and burros would ultimately need to be removed from the range in order to achieve the AMLs or to prevent the death of individual animals under emergency conditions. This alternative was eliminated from further consideration because it is contrary to the WFRHBA which requires the BLM to manage the rangelands to prevent the range from deterioration associated with an overpopulation of wild horses and burros.

2.3.8 Wild Horse and Burro Numbers Controlled by Natural Means

This alternative was eliminated from further consideration because it is contrary to the WFRHBA which requires the BLM to prevent range deterioration associated with an overpopulation of wild horses and burros. The alternative of using natural controls to achieve a desirable AML has not been shown to be feasible in the past. Wild horses and burros in the Lake Mead Complex are not substantially regulated by predators or other natural factors. In addition, wild horses and burros are long-lived species with documented foal survival rates exceeding 95%, and they do not self-regulate their population growth rate (NAS 2013).

Survival rates for wild horses and burros on western public lands is generally high (Ransom et al. 2016). None of the significant natural predators from the ranges of the wild horses and burros in Europe and Asia –wolves, brown bears, and possibly one or more of the larger cat species – exist in significant numbers on the wild horse and burro ranges in the western United States. Predators such as mountain lions may prey on wild equids in some circumstances. However, monitoring indicates that the population of wild horses and burros within the LMC grows at a rate of about 15-20% per year. While mountain lions may reduce wild horse and burro herd growth rates in rare circumstances (Turner and Morrison 2001), they do not generally prevent horse and burro herds from growing, perhaps in part because smaller ungulates such as mule deer are preferred over horses and burros as prey for mountain lions (Knopff et al. 2010, Blake and

Gese 2016). Observed annual rates of growth in the LMC indicate that predator populations within the LMC are not sufficient to effectively slow wild horse and burro population growth. Further, wildlife management is the responsibility of the Nevada Department of Wildlife; BLM does not have the authority to manage predators within the state of Nevada.

Many wild horse and burro herds grow at sustained high rates of 15-25% per year, and the species is not 'self-regulating' (NAS 2013). The NAS report (2013) concluded that the primary way that equid populations would be regulated by density would be through increased competition for forage at high densities, which results in smaller quantities for forage available per animal, poorer body condition, decreased natality and survival, and a susceptibility to large mortality events when resource availability fluctuates (such as due to drought). The NAS (2013) also concluded that the effects of severely high horse and burro densities would include impacts to resource and herd health that are contrary to BLM management objectives and statutory and regulatory mandates. This alternative would result in a steady increase in the herd population which would continue to exceed the carrying capacity of the range, eventually resulting in a catastrophic mortality of wild horses and burros in the LMC, and irreparable damage to rangeland resources.

While some members of the public have advocated "letting nature take its course", allowing horses and burros to die of dehydration and starvation would be inhumane treatment and would be contrary to the WFRHBA, which mandates removal of excess wild horses and burros. The damage to rangeland resources that results from excess numbers of wild horses and burros is also contrary to the WFRHBA, which mandates the Bureau to "…*protect the range from the deterioration associated with over population…," "…remove excess animals from the range so as to achieve appropriate management levels…,"* and "…*to preserve and maintain a thriving natural ecological balance and multiple-use relationship in that area."*

Title 43 CFR § 4700.0-6 (a) states *"Wild horses shall be managed as self- sustaining populations of healthy animals in balance with other uses and the productive capacity of their habitat"* (emphasis added). As the vegetative resources are over utilized and degraded to the point of no recovery as a result of the wild horse and burro overpopulation, wild horses and burros would start showing signs of malnutrition and starvation. The weaker animals, generally the older animals, and the mares/jennies and foals, would be the first to be impacted. It is likely that a majority of these animals would die from starvation and dehydration in any a catastrophic die off. The resultant population could be heavily skewed towards the stronger stallions/jacks which could contribute to social disruption in the LMC. Competition between wildlife and wild horses and burros for forage and water resources would be severe. Wild horses and burros can be aggressive around water sources, and some wildlife may not be able to compete (reviewed in Crist et al 2019), which could lead to the death of individual animals. Wildlife habitat conditions would also deteriorate as wild horse and burro numbers above AML reduce herbaceous vegetative cover, damage springs, increase erosion, and could result in irreversible damage to the range. This degree of resource impact would likely lead to management of wild burros at a greatly reduced level if BLM is able to manage for wild burros at all on the range in the future. For these reasons, this alternative was eliminated from further consideration. This alternative would not meet the purpose and need for this EA which it is to remove excess wild horses and burros from within and outside the LMC and to reduce the wild burro population growth rates to manage wild horses and burros within established AML ranges.

3.0 Affected Environment

This section of the EA briefly discusses the relevant components of the human environment which would be either affected or potentially affected by the Proposed Action or No Action Alternative.

3.1 General Description of the Affected Environment

The LMC encompasses 274,000 acres of public land administered by BLM and 1.5 million acres of the Lake Mead National Recreation Area (NRA) administered by the National Park Service (NPS), within Clark County, NV, (Appendix A Map). Permanent water sources consist of Lake Mead and Lake Mojave and springs found within the HMA/HAs, though many of these are ephemeral and the animals primarily rely on the lake for their water source.

The LMC is located within the Mojave Desert. The primary use areas within the HMA/HAs is a desert surrounded by low, rocky desert mountains. The animals, at times, have to travel up to ten miles to and from water each day during the drier part of the year. Wild horses and burros drink at least once each day during the hotter part of the year but can survive by drinking every second day during the winter and early spring. Vegetation in the HMA/HAs is typical Mojave Desert shrub; low growing and able to survive long periods of drought. The vegetation consists of salt-tolerant plants such as saltbush, greasewood and rabbitbrush, with grasses such as galleta grass and Indian ricegrass. The mountains contain pinyon pine and juniper trees, with an understory of sagebrush and other mountain shrubs and small amounts of grass.

Climate in the area is quite harsh, with winter temperatures falling below 32 degrees Fahrenheit and summer temperature over 100 degrees. Rainfall averages only 4 to 5 inches per year, divided almost equally between summer and winter. Summer rains are localized, short and very intense while winter and spring rains are less intense and occur over a wider area.

Although the NPS is not required to manage burros, the agency recognized that burros inhabit lands managed by BLM which adjoin the Lake Mead National Recreation Area. In recognition of a mutual desire to work cooperatively in the management of burros in the area, a Memorandum of Understanding (MOU) was first developed between BLM and NPS in 1994. Amendment 2 to the MOU was approved in April of 2005. Under the MOU, the NPS developed the 1995 Lake Mead National Recreation Area Burro Management Plan and EIS which established burro utilization prescriptions, including areas of zero burro use, for the recreation area. The NPS, in consultation and coordination with the BLM, determines when burro removals within the NRA are necessary. Removal of burros is completed in accordance with approved removal plans developed by the NRA and/or BLM personnel and all removals are done in a safe and humane manner to prevent injury and minimize stress of the potential for heat exhaustion to the burros. Under the MOU, burros captured within the recreation area are placed within the BLM's adoption program.

No livestock grazing is authorized within the LMC; livestock grazing has not been authorized since the mid to late 1990's.

3.2 Description of Affected Resources/Issues

Table 2 lists the elements of the human environment subject to requirements in statute, regulation, or executive order which must be considered.

Supplemental Authorities (Critical Elements of the Human Environment)

Supplemental Authorities	Present	Affected	Rationale
ACECs	**Yes**	**NO**	The proposed project is within Gold Butte Part A and B ACEC but impacts to the R&I values are not anticipated. No further analysis is required.
Air Quality	**YES**	**NO**	The planning area is outside a non-attainment area. Implementation of the Proposed Action would result in small and temporary areas of disturbance.

Cultural Resources	**YES**	**NO**	An archaeologist will be consulted as early in the planning process as possible to ensure that these facilities are either within areas of previous disturbance or avoid impacts to cultural resources. To avoid impacts to cultural resources, trap sites and temporary holding facilities would be located in previously disturbed areas when possible. If locations are needed outside of disturbed areas an archaeologist would be required to review the location prior to construction of the facility to ensure that impacts to cultural resources are avoided.
Environmental Justice	**NO**	**NO**	Not present.
Fish Habitat	**NO**	**NO**	Not present.
Floodplains	**Yes**	**NO**	The Proposed Action includes minimal surface disturbance, there should be no impacts to any floodplains.
Forest and Rangelands/Vegetation	**YES**	**YES**	Present and affected – see analysis.
Fuels and Fire Management	**YES**	**NO**	Follow standard stipulations and mitigation measures to prevent human caused wildfires. Consult with the Fire Management Officer on current fire danger two weeks prior to field activities. See Appendix C for standard stipulations and mitigation measures.
Migratory Birds/Wildlife	**YES**	**YES**	Migratory birds and their nests may be present around and adjacent to the gather site resulting in potential displacement by noise from increased human presence, helicopter use and the increased density of horses and burros at the gather location. The primary direct impacts of the proposed action on wildlife would be killing or maiming of ground dwelling animals during access, set up of pens and potential trampling from increased horse/burro density to the area; displacement of individuals; and increased potential for harassment of wildlife. Indirect impacts may include, but are not limited to, noise, increased erosion, and spread of weeds. Wildlife species in the general area are common and widely distributed and the loss of a few individuals and/or habitat should have a negligible impact on populations of the species range wide. Only minimal impacts to wildlife are anticipated and a detailed analysis is not required. No impacts to BLM sensitive species are anticipated.
Native American Religious Concerns	**YES**	**NO**	New ground disturbance in the project area needs to be reviewed by district archaeologists. There will not be any historic properties under Section 106 that will be affected by the action.
Noxious Weeds	**YES**	**NO**	To prevent the risk for spread weeds, hay is to be free of any weed seeds and any noxious weeds or non-native invasive weeds would be avoided when establishing and accessing trap sites and holding facilities. In addition, standard stipulations and mitigation measures would be followed to prevent the spread of weeds. See Appendix C for standard stipulations and mitigation measures.
Prime or Unique Farmlands	**NO**	**NO**	Not present.
Riparian-Wetland Zones/Soils	**YES**	**YES**	Present- see analysis.
Federally Threatened, Endangered, Proposed, or	**YES**	**YES**	This project has a may affect, likely to adversely affect determination for the desert tortoise and no effect for

Candidate Animal Species and Critical Habitat			its designated critical habitat. This project will have no effect on any other federally listed species or designated critical habitat. Carry forward for analysis.
Water Quality	**YES**	**NO**	Reduced wild horse and burro populations as outlined within the Proposed Action will mitigate and improve water quality concerns within the LMC.
Waste (Hazardous or Solid)	**NO**	**NO**	Not present.
Wild and Scenic Rivers	**NO**	**NO**	Not present.
Wilderness and Wilderness Study Areas	**YES**	**YES**	Present-see analysis.
Wild Horse and Burro	**YES**	**YES**	Present- see analysis.

Critical elements of the human environment identified as present and potentially affected by the Proposed Action and/or the No Action Alternative include:

- Forest and Rangelands/Vegetation
- Migratory Birds/Wildlife
- Riparian-Wetland Zones/Soils
- Federally Threatened, Endangered, Proposed, or Candidate Animal Species and Critical Habitat
- Wild Horse and Burro
- Wilderness and Wilderness Study Areas

3.2.1 Forest and Rangelands/Vegetation

Floristically, the Proposed Action is within the Mojave Desert floristic province. The lower elevation vegetation of this area is characterized by Mojave creosote-bursage scrub, which is comprised largely of sparse shrub communities, with very little forage available. This area has been invaded by the non-native grass species red brome (*Bromus rubens*), which is not palatable to horses or burros most of the year. The area where the gather would take place is also habitat for multiple BLM sensitive species, some of which are also state endangered. A bee species (Mojave poppy bee – *Perdita meconis*)that pollinates one of these species has been petitioned for listing under the Endangered Species Act. Extirpations of this bee in Utah have been attributed to trampling by large ungulates.

Monitoring data collected from the LMC shows that heavy to severe utilization on key forage species is attributable to wild burros in areas surrounding key water sources. Wild burro numbers have continued to increase while wildlife numbers have remained fairly constant. Excess utilization in key grazing areas and trampling in riparian areas by wild burros is currently impacting rangeland health and inhibiting recovery of both uplands and riparian areas. Without the removal of wild horses and burros in excess of low-end AML we would see not improvement of rangeland resources. Many wild burros and horses are also residing for many months outside of the HMA/HA boundaries which is resulting in impacts to resources outside of their designated management areas.

The Proposed Action would impact vegetation temporarily with trampling and disturbance of vegetation occurring at gather sites and holding locations. Disturbance would occur to native vegetation in and around temporary gather corrals and holding facilities due to the use of vehicles and concentration of horses and burros in the immediate area of such facilities. The disturbed area; however, would make up less than one acre. Gather corrals and holding facility locations are usually selected in areas easily accessible to livestock trailers and standard equipment, utilizing roads, gravel pits or other previously disturbed sites, and which are accessible using existing roads. New roads are not created to construct capture corrals.

3.2.2 Migratory Birds/Wildlife

The project area contains riparian habitats, therefore potential impacts to neotropical migrants may be expected. If the gather occurs in the winter, this is when migratory species are not expected to be present within the HMA. However, in the event that weather or other factors (budget constraints, holding space limitations, etc.) prevent a winter gather, the gather could be during a portion of the migratory bird breeding season. The migratory bird breeding season generally occurs between February 15th through August 31st. Noise and activity from gathers occurring during this time may disturb migratory birds during the remaining portion of the breeding season. Migratory bird surveys would occur prior to gather sites being constructed during migratory bird breeding season to avoid or minimize potential impacts to breeding migratory birds.

Disturbance from the helicopter and wild horses and burros could occur but would be short-term and minimal. Damage to vegetation at trap sites would be on a small scale and would not have a measurable impact. Human presence at trap sites would temporarily disrupt wildlife activities. Short and long-term impacts would result from reducing wild horse numbers within the assessment area. The removal of excess wild horses would provide immediate benefit to migratory birds, special status species, and wildlife through less competition for forage and water and would allow gradual improvement of upland and riparian health.

3.2.3 Riparian-Wetland Zones/Soils

Water resources within the LMC are a limiting factor. There are about 1000 spring sources located within the LMC. However, only a handful of springs have the production capability to develop storage for long term use. During the summer months, the majority of the LMC herds water at Lake Mead and utilize the National Park lands, which are outside the HMA boundary as there is not enough water that can be stored at developed spring locations during dryer months. The current over-population of wild horses and burros is increasing beyond the production capability of the inland springs and there is significant resource damage and prevention of recovery of key sites and wildlife habitat. Even with the development of water storage and troughs of different inland springs, current water supply is unable to meet the demands of the excessive wild horse and burro populations within the LMC.

The LMC inland use areas contain small riparian areas and their associated plant species occur near seeps, springs, and along sections of perennial drainages. Many of these areas support limited riparian habitat and water flows. Available data show that wild horse and burro use of most of these areas currently ranges between heavy to severe use. Trampling and trailing damage by wild horses and burros is evident at most locations; Soil compaction and surface and rill erosion is evident.

In terms of direct impacts there are no negative impacts of the proposed action. However, in terms of indirect impacts, water quality will increase once wild horse and burro numbers are reduced. And under the no action alternative water quality will further deteriorate. The majority of the springs are allowed to flow naturally over the landscape, which currently gets impacted by wild horse and burro use. To avoid the direct impacts potentially associated with the gather operation, temporary trap sites and holding/processing facilities would not be located within riparian areas. Managing the wild horse and burro populations within the established AMLs over the next 10 years would be expected to initiate recovery of damaged riparian habitats. The amount of trampling/trailing would be reduced. Utilization of the available forage within the riparian areas would also be reduced to within allowable levels. Over the longer-term, continued management of wild horses and burros within the established AMLs would be expected to result in healthier, more vigorous vegetative communities. Hoof action on the soil around unimproved springs and stream banks would be lessened which should lead to increased stream bank stability and decreased compaction and erosion. Improved vegetation around riparian areas would dissipate stream energy associated with high flows, and filter sediment, resulting in associated

improvements in water quality. The Proposed Action would make progress towards achieving and maintaining proper functioning condition at riparian areas. There would also be reduced competition among wildlife, wild horses, and wild burros for the available water. But if the No Action Alternative is selected then water quality throughout the LMC will continue to decline.

3.2.4 Federally Threatened, Endangered, Proposed, or Candidate Animal Species and Critical Habitat

The only federally protected species known to occur in the vicinity of the project area is the threatened Mojave desert tortoise (*Gopherus agassizii*). The proposed project is within desert tortoise critical habitat.

The Proposed Project area supports and is adjacent to lands that support wildlife characteristic of the Mojave Desert. Desert tortoises can potentially survive and reproduce provided their basic habitat requirements are met. These requirements include a sufficient amount and quality of forage species; shelter sites for protection from predators and environmental extremes; suitable substrates for burrowing, nesting, and overwintering; various plants for shelter; and adequate area for movement, dispersal, and gene flow.

Historical survey data indicates that the project area and surrounding project area has low to moderate tortoise density and contains tortoise sign including live tortoises. Undisturbed lands within and adjacent to the Proposed Project site contain the key habitat requirements for desert tortoises to survive. Therefore, there is the potential for tortoises to be present within and adjacent to the proposed project site and may wander onto the project site during project related activities. Prior to gather activities wildlife biologists will be consulted to determine if the Proposed Project area resides within desert tortoise habitat and what mitigation measures may need to be followed during the gather operations. A recently- published study found a negative correlation between wild burro sign and desert tortoise sign (Berry et al. 2020), though other factors such as raven density and off-road vehicle activity may have stronger influence on tortoise demographic rates than wild equids.

3.2.4 Wild Horses and Burros

The LMC encompasses 274,000 acres of public land administered by BLM and 1.5 million acres of the Lake Mead National Recreation Area administered by the National Park Service (NPS), within Clark County, NV, (Appendix A). Permanent water sources consist of Lake Mead, Lake Mojave, and springs found within the HMA/HAs, though many of these are ephemeral and the animals primarily rely on the lake for their water source. Wild burros have been quite numerous in the LMC and its vicinity, such that it is expected that there has been a fairly high level of genetic interchange between groups of burros in the region. Wild burros living in the LMC are part of a larger metapopulation (NAS 2013) of wild burros, that includes other subpopulations living on other federal lands. Movements between subpopulations of the larger metapopulation have included natural movements (made by burros themselves) and human-facilitated movements.

The most recent aerial survey in the complex took place in September 2019. Based on a statistical analysis of the double-observer data collected in flight (Griffin 2020), it was estimated that there were a total of 486 burros on the Lake Mead Complex at that time (Lubow, 2020). At that point, there were estimated to be 390 adults and 57 foals in and around Gold Butte HMA, 29 adults and 3 foals in the Muddy Mountains HA, and 6 adults in the El Dorado HA (Lubow 2020). In surveys, yearlings are included with adults, and young-of-the-year are recorded as foals. Guidelines for population projection, based on a previous year's survey, are provided in the SOPs for wild horse and burro aerial surveys (Griffin et al. 2020). To calculate the expected current herd size in each area of the complex, the BLM added a conservative annual herd growth rate for burros, of 15% per year, applied once to the 2019

estimates. Based on that projection, the estimated herd size as of February 2021 has by now grown to 514 burros in Gold Butte HMA, 38 in Muddy Mountains HA, and 7 in El Dorado HA (559 total). 30 horses were seen in the Muddy Mountains HA during the September 2019 surveys. The number of observed wild horse groups in the September 2019 surveys was inadequate for statistical analysis. However, it is expected that, given a typical ~20% annual growth rate for wild horse herds, wild the number of horses in the complex has, by now, grown to approximately 36.

During the summer months, the majority of the LMC animals water on NPS administered lands at Lake Mead and Lake Mojave. Some horses and burros water at other ephemeral/intermittent springs to a lesser extent; these springs have a reduced amount of water available to wild horses and burros. The forage available within El Dorado and Muddy Mountains HAs was determined to be inadequate to maintain a healthy, genetically viable herd in the Johnnie, Muddy Mountains, and Wheeler Pass Herd Management Areas, Establishment of Appropriate Management Levels Environmental Assessment (EA NV-052-05-399), so AML was set to 0 for both areas.

Monitoring data shows heavy to severe utilization of available forage within a 1-2-mile radius of the available water. Burros are often traveling long distances to obtain adequate forage and social space. At the present time, wild burros are mostly in good physical condition but as populations continue to increase it is expected that the conditions of wild burros will decrease due to competition for forage resources.

3.2.5 Wilderness

The Wilderness Act of 1964 established a “National Wilderness Preservation System to be composed of federally owned areas designated by Congress as "wilderness areas", these shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness.” The Wilderness Act of 1964 mandates that wilderness areas are managed in a manner that maintains or enhances the areas wilderness character. Qualities of wilderness character include untrammeled, natural, undeveloped, outstanding opportunities for solitude or a primitive and unconfined type of recreation, and supplemental values. Although wilderness character is a complex idea and is not explicitly defined in the Wilderness Act, wilderness characteristics are commonly described as:

- Untrammeled- area where ecological systems are unhindered and free from intentional actions of modern human control or manipulation.
- Natural- area appears to have been primarily affected by forces of nature.
- Undeveloped- area is essentially without structures or installations, the use of motors or mechanical transportation, and retains its primeval character.
- Solitude or primitive and unconfined recreation- area provides opportunities for people to experience solitude or primeval and unrestricted recreation, including the values associated with physical and mental inspiration, discovery, and challenge.
- Supplemental values- complementary feature of value that are not captured in the other four characters, but where found are part of wilderness character.

The proposed project area includes seven wilderness areas managed by the National Park Service (NPS), Bureau of Land Management (BLM), or jointly between the two. Wilderness managed by the BLM include Lime Canyon and Jumbo Spring Wilderness Area. Wilderness managed by the NPS include Pinto Valley and Jimbilnan Wilderness Area. Wilderness areas jointly managed include Muddy Mountain, El Dorado, and Ireteba Peaks Wilderness Area. Each of these areas were designated by the Clark County Conservation of Public Land and Natural Resources Act of 2002 (CCCPLNRA). The CCCPLNRA

identifies that these areas contain unique and spectacular natural resources including priceless habitat for numerous species of plants and wildlife and thousands of acres of pristine land that remains in a natural state.

3.2.6 Wilderness Study Areas

Section 603 (c) of FLPMA directs how the BLM is to manage "lands under wilderness review," which includes WSAs. These lands are to be managed in a manner so as not to impair the suitability of such areas for preservation as wilderness, should congress act to either designate the area as wilderness or release the area from "study." Consequently, actions proposed within WSAs are to be evaluated based on their possible direct and indirect impacts on wilderness values of naturalness, solitude and primitive or unconfined recreation, and special features. The BLM has created the "non-impairment" standard to determine if there is any impact to wilderness characteristics. The non-impairment standard is defined by the use being temporary and not creating any new surface disturbance. Within the planning area the is the Million Hills WSA managed by the BLM. This area became a WSA in 1987.

4.0 Environmental Consequences

4.1 Introduction

This section of the EA documents the potential environmental impacts which would be expected with implementation of the Proposed Action and/or the No Action Alternative. These include the direct impacts (those that result from the management actions) and indirect impacts (those that exist once the management action has occurred).

4.2 Predicted Effects of Alternatives

The direct and indirect impacts to these resources which would be expected to result with implementation of the Proposed Action and No Action Alternative are discussed in detail below.

4.2.1 Forest and Rangelands/Vegetation

Impacts from the Proposed Action

The Proposed Action may have short-term, localized impacts to areas where corrals are set up and animals are gathered. However, removal of horses and burros over AML will increase vegetative cover across the range of the burros within the LMC and have a net beneficial effect to the rangeland as a result. Removal of animals over AML would also decrease the likelihood that the petitioned bee would be impacted by horses or burros. Overall impacts from the proposed action on vegetation communities and sensitive species would be positive.

Impacts from the No Action Alternative

Under the no action alternative wild horse and burro levels would continue to increase and as a result areas of vegetative communities (rangeland) across the LMC would continue to be over utilized by horses and burros. No short-term, localized disturbance would take place as no temporary corrals would be erected, but the continued presence of horses and burros over AML degrades habitat and removes forage plants for other wildlife species. Under the no action alternative, the impacts to the rangeland and to sensitive species would be detrimental.

4.2.2 Migratory Birds/Wildlife

Impacts from the Proposed Action

The Proposed Action would add slightly to impacts discussed in the reasonably foreseeable future actions through wild horse and burro gather activities. Disturbance to migratory birds, special status species, and wildlife from the helicopter and wild horses could occur but would be short-term and minimal. Damage to vegetation at trap sites would be on a small scale and would not have a measurable impact. Human presence at trap sites would disrupt wildlife activities. Short and long-term impacts would result from

reducing wild horse and burro numbers within the assessment area. The removal of excess wild horses and burros would provide immediate benefit to migratory birds, special status species, and wildlife through less competition for forage and water and would allow gradual improvement of upland and riparian health.

The project area contains riparian and creosote/sagebrush habitats, therefore potential impacts to neotropical migrants may be expected. If the gather occurs in the winter, this is when migratory species are not expected to be present within the HMA. However, in the event that weather or other factors (budget constraints, holding space limitations, etc.) prevent a winter gather, the gather could be during a portion of the migratory bird breeding season (February 15th – August 31st). Noise and activity from gathers occurring during this time period may disturb migratory birds during the remaining portion of the breeding season. Migratory bird surveys would occur prior to gather sites being constructed during migratory bird breeding season to avoid or minimize potential impacts to breeding migratory birds.

This impact would be minimal (generally less than 0.5 acre/trap site), temporary, and short-term (two weeks or less) in nature. Indirect impacts would be related to wild burro densities and patterns of use. The reduction in the current wild horse and burro populations would provide opportunity for vegetative communities to progress toward achieving a thriving natural ecological balance. The Proposed Action alternative would support a more diverse vegetative composition and structure through improvement and maintenance of healthy populations of native perennial plants. Habitat improvements would result for migratory bird species including loggerhead shrikes, Brewer's sparrows, sage thrashers, burrowing owls and migratory and resident raptor species. According to Paige and Ritter (1999), "Long–term heavy grazing may ultimately reduce prey habitat and degrade the vegetation structure for nesting and roosting. Light to moderate grazing may provide open foraging habitat."

Competition with wildlife for water at natural springs and seeps would be drastically reduced. More water would be available for a longer period of time for the number of burros at AML and wildlife species dependent on the same source(s).

Impacts from the No Action Alternative
Negative direct impacts such as disturbance and possible injury to wildlife due to a gather would not occur under this alternative, therefore resulting in less direct negative impacts. Beneficial indirect impacts to bird, wildlife, and special status species habitats, however, would not be realized and wild horse and burro numbers in excess of AML would result in continuing decline of habitat condition and could adversely affect the viability of some bird and wildlife populations.

4.2.3 Riparian-Wetland Zones/Soils
Impacts from the Proposed Action
Removal of excess wild horses and burros may increase vegetation cover, which in turn, may increase interception of precipitation. This may decrease surface water run-off and increase local infiltration rates. The composition of the recovering vegetation (native versus non-native vegetation) may also affect infiltration and precipitation interception based on variation in plant density. As the diverse coverage of grasses, trees, and shrubs increases, interception rates may increase, allowing for more infiltration of water into groundwater aquifers. Evapotranspiration rates may also be altered as a result of the proposed action, but such changes may be small. Wild burros are known to dig holes in the ground to access water in riparian areas (Lundgren et al. 2017), but that activity could persist, even if a lower number of burros is present.

In addition, the proposed action will help restore previous hydrologic conditions at perched aquifer fed wetlands and springs, which have been impacted by wild burros digging away soils and consuming

vegetation, causing severe erosion. This erosion and reduction in vegetation has resulted in a lowered potentiometric perched aquifer surface.

Impacts from the No Action Alternative

Under the no action alternative wild horse and burro levels would continue to increase and vegetative cover would continue to decrease. This removal of vegetation may decrease interception of precipitation on the surface as bare ground is exposed, especially following large-scale rain events. Loss of living vegetative cover from invasive species may increase surface water run-off. Such impacts may be most pronounced in the areas of concentrated animal numbers. Grazing affects the species composition and biomass production of native plant communities through selective foraging. Desert vegetation is very slow to recover if overgrazed or disturbed. As the currently unsustainable population levels continue to grow, that will likely reduce the overall density of vegetation, and interception rates may decline further, causing more surface water run-off. Overall, impacts from the proposed no action may include lower transpiration and decreased interception of water from a lack of mature vegetative cover.

Furthermore, under the no action alternative the severe erosion and lowering of the potentiometric of perched aquifer surfaces would continue, probably at an accelerated rate, potentially to a point where restoration would not be possible over any meaningful time scale.

4.2.4 Federally Threatened, Endangered, Proposed, or Candidate Animal Species and Critical Habitat

Impacts from the Proposed Action

The proposed action may have a short-term negative effect, likely to adversely affect determination for the federally threatened desert tortoise (*Gopherus agassizii*) and no effect for its designated critical habitat. The proposed project will have no effect on any other federally protected species or designated critical habitat due to absence of the species and/or habitat.

The potential negative primary direct impacts of the proposed action on the desert tortoise could result from activities related to burro gathering, and could include killing or maiming of tortoises, displacement of individuals, and increased potential for harassment of tortoises. If not noticed and avoided during gather activities, desert tortoises could be either injured, killed, or harassed. Indirect impacts could include increased noise, introduction and spread of weeds, and increased erosion potential. However, it is expected that, with the removal of wild horses and burros from the area under the proposed action, the desert tortoise population in the Lake Mead Complex area would ultimately benefit due to the reduced risk of trampling and less competition for forage and water.

Section 7 Consultation for this project is covered under the Programmatic Biological Opinion (08ENVS0-2019-f-0513) contingent on compliance with the terms and conditions. A copy of the terms and conditions has been provided with this document (Sec 7 Log # NV-052-20-041).

Impacts from the No Action Alternative

If no action is taken, horses and burros will continue to reproduce and further damage the landscape, water, and resources that native desert wildlife depends on. Increased presence of wild horses and burros, as well as open and illegal grazing, may have contributed to a decline in tortoise populations as well. Under the no action alternative, horses and burro will continue to deplete the landscape of water and forage for native species, including but not limiting to desert tortoise. Desert tortoise are also at risk of trampling.

4.2.5 Wild Horses and Burros

Impacts of the Proposed Action

Indirect impacts can occur to horses and burros after the initial stress event (capture) and could include increased social displacement or increased conflict between studs and between jacks. These impacts are known to occur intermittently during wild horse and burro gather operations. Traumatic injuries could occur and typically involve biting and /or kicking bruises. Horses and burros may potentially strike or kick gates, panels or the working chute while in corrals or trap which may cause injuries. After a gather, lowered competition for forage and water resources on desert rangelands would reduce stress and fighting for limited resources (water and forage) and promote healthier animals. Indirect individual impacts are those impacts which occur to individual wild horses and burros after the initial stress event and may include spontaneous abortions in mares and jennies. These impacts, like direct individual impacts, are known to occur intermittently during and after wild horse and burro gather operations. An example of an indirect individual impact would be the brief skirmish which occurs among studs following sorting and release into the stud/jack pen, which lasts less than a few minutes and ends when one stud/jack retreats. Traumatic injuries usually do not result from these conflicts. These injuries typically involve a bite and/or kicking with bruises which don't break the skin. Like direct individual impacts, the frequency of occurrence of these impacts among a population varies with the individual animal.

Foals are sometimes gathered that were orphaned on the range (prior to the gather) because the mother rejected it or died. These foals are usually in poor, unthrifty condition. Orphans encountered during gathers are cared for promptly and rarely die or have to be euthanized. It is unlikely that orphan foals would be encountered since majority of the foals would be old enough to travel with the group of wild horses or burros.

Gathering wild horses and burros during the summer months can potentially cause heat stress. Gathering wild horses and burros during the fall/winter months reduces risk of heat stress, although this can occur during any gather, especially in older or weaker animals. Adherence to the CAWP standards, and techniques used by the gather contractor or BLM staff would help minimize the risks of heat stress. Heat stress does not occur often, but if it does, death can result. Most temperature related issues during a gather can be mitigated by adjusting daily gather times to avoid the extreme hot or cold periods of the day. The BLM and the contractor would be pro-active in controlling dust in and around the holding facility and the gather corrals to limit the horses' and burros' exposure to dust.

The BLM has been gathering excess wild horses and burros from public lands since 1975, and has been using helicopters for such gathers since the late 1970's. Refer to Appendix B for information on the methods that are utilized to reduce injury or stress to wild horses and burros during gathers.

Since 2006, BLM Nevada has gathered over 40,000 excess animals. Of these, gather related mortality has averaged only 0.5%, which is very low when handling wild animals. Another 0.6% of the animals captured were humanely euthanized due to pre-existing conditions and in accordance with BLM policy. Scasta (2020) found similar results. This data affirms that the use of helicopters and motorized vehicles are a safe, humane, effective and practical means for gathering and removing excess wild horses and burros from the range.

Through the capture and sorting process, wild horses and burros are examined for health, injury and other defects. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy. BLM Euthanasia Policy IM 2015-070 is used as a guide to determine if animals meet the criteria and should be euthanized. Animals that are euthanized for non-gather related reasons include those with old injuries (broken hip, leg) that have caused the animal to suffer from pain or which prevent them from being able to travel or maintain body condition: old animals that have lived a successful life on the range, but now have few teeth remaining, are in poor body condition, or are weak from old age; and wild horses or burros that have congenital (genetic) or serious physical defects such as club foot, or sway

back and should not be returned to the range.

Temporary Holding Facilities During Gathers

Wild horses and burros gathered would be transported from the trap sites to a temporary holding corral within the complex in goose-neck trailers or straight-deck semi-tractor trailers. At the temporary holding corral, the wild horses and burros would be aged and sorted into different pens based on sex. The horses and burros would be provided ample supply of good quality hay and water. Mares/jennies and their un-weaned foals would be kept in pens together.

At the temporary holding facility, a veterinarian, would provide recommendations to the BLM regarding care, treatment, and if necessary, euthanasia of the recently captured wild horses and burros. Any animals affected by a chronic or incurable disease, injury, lameness or serious physical defect (such as severe tooth loss or wear, club foot, and other severe congenital abnormalities) would be humanely euthanized using methods acceptable to the American Veterinary Medical Association (AVMA).

Transport, Off-Range Corrals, and Adoption Preparation

Wild horses and burros removed from the range as excess would be transported to the receiving off-range corral (ORC, short-term holding facility) in a goose-neck stock trailer or straight-deck semi-tractor trailers. Trucks and trailers used to haul the wild horses and burros would be inspected prior to use to ensure wild horses and burros can be safely transported and that the interior of the vehicle is in a sanitary condition. Wild horses and burros would be segregated by age and sex when possible and loaded into separate compartments. Mares/jennies and their un-weaned foals may be shipped together. Transportation of recently captured wild horses and burros is limited to a maximum of 10 hours. During transport, potential impacts to individual horses or burros can include stress, as well as slipping, falling, kicking, biting, or being stepped on by another animal. Unless wild horses and burros are in extremely poor condition, it is rare for an animal to die during transport.

Upon arrival, recently captured wild horses and burros are off-loaded by compartment and placed in holding pens where they are fed good quality hay and water. Most wild horses and burros begin to eat and drink immediately and adjust rapidly to their new situation. At the ORC, a veterinarian provides recommendations to the BLM regarding care, treatment, and if necessary, euthanasia of the recently captured wild horses and burros. Any animals affected by a chronic or incurable disease, injury, lameness or serious physical defect (such as severe tooth loss or wear, club foot, and other severe congenital abnormalities) that was not diagnosed previously at the temporary holding corrals at the gather site would be humanely euthanized using methods acceptable to the AVMA. Wild horses and burros in very thin condition or animals with injuries are sorted and placed in hospital pens, fed separately and/or treated for their injuries. Recently captured wild horses and burros, generally mares/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.

After recently captured wild horses and burros have transitioned to their new environment, they are prepared for adoption or sale. Preparation involves freeze-marking the animals with a unique identification number, vaccination against common diseases, microchipping, castration, and de-worming. During the preparation process, potential impacts to wild horses and burros are similar to those that can occur during transport. Injury or mortality during the preparation process is low but can occur.

Mortality at ORCs 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.

Adoption

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

Sale with Limitation

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

Off-range Pastures

During the past 5 years (FY2015-2019), the BLM has removed approximately 30,000 excess wild horses or burros from the Western States. Most horses not immediately adopted or sold have been transported to Off-Range pastures in the Midwest given current Congressional prohibitions on selling excess animals without limitations, or on euthanizing healthy animals for which no adoption or sale demand exists as required by the WFRHBA. The adoption demand for burros has been such, that few to no burros are held in Off-range pastures.

Potential impacts to wild horses and burros from transport to adoption, sale or Off-range Pastures (ORP) are similar to those previously described. One difference is that when shipping wild horses and burros for adoption, sale or ORP, animals may be transported for a maximum of 24 hours. Immediately prior to transportation, and after every 24 hours of transportation, animals are offloaded and provided a minimum of 8 hours on-the-ground rest. During the rest period, each animal is provided access to unlimited amounts of clean water and 2 pounds of good quality hay per 100 pounds of body weight with adequate bunk space to allow all animals to eat at one time. The rest period may be waived in situations where the anticipated travel time exceeds the 24-hour limit but the stress of offloading and reloading is likely to be greater to the animals than the stress involved in the additional period of uninterrupted travel.

Off-range pastures are designed to provide excess wild horses with humane, and in some cases life-long care in a natural setting off the public rangelands. There wild horses are maintained in grassland pastures large enough to allow free-roaming behavior (i.e., the horses are not kept in corrals) and with the forage, water, and shelter necessary to sustain them in good condition. About 37,616 wild horses that are in excess of the current adoption or sale demand (because of age or other factors such as economic recession), are currently located on private land pastures in Oklahoma, Kansas, and South Dakota [SAB1], And Iowa, Missouri, Wyoming, Montana, Nebraska, & Utah. Establishment of an ORP is subject to a separate NEPA and decision-making process. Located in mid or tall grass prairie regions of the United States, these ORPs are highly productive grasslands compared to the more arid western rangelands. These pastures comprise about 400,000 acres (an average of about 10-11 acres per animal).

Of the animals currently located in ORPs, less than one percent is age 0-4 years, 49 percent are age 5-10 years, and about 51 percent are age 11+ years.

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

Euthanasia and Sale Without Limitation

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

Wild Burros Remaining in the Complex Following the Gather

Under the Proposed Action, the post-gather population of wild burros may start as low as about 30 wild burros, which is near the low end of the AML range for the Lake Mead Complex, and then grow over time. It is also possible that, due to the difficulty of gather operations in such an area as LMC, which includes wilderness areas, the BLM may only be able to gather the burro herd down to a somewhat larger starting size. Reducing population size would also ensure that the remaining wild burros are healthy and vigorous, and not at risk of death or suffering from starvation due to insufficient habitat coupled with the effects of frequent drought (lack of forage and water).

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

As a result of lower density of wild burros across the complex 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 rates 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 to the growth rates and population size over time.

The remaining wild burros not captured are expected to maintain their social structure and herd demographics (age and sex ratios). No observable effects to the remaining population associated with the gather impacts would be expected except a heightened shyness toward human contact.

No baseline genetic information is yet available for the wild burros living in the LMC generally, or in the Gold Butte HMA specifically. Genetic monitoring in the herd will be possible after hair follicle samples have been collected from gathered animals. Removing burros so that the remaining herd size in the Gold Butte HMA is approximately 30 after the initial gather, then increasing over time, is not expected to prevent genetic viability in this herd for three reasons. First, the BLM has the expectation that the existing burro herd has a relatively high genetic diversity (as measured by observed heterozygosity), due to a history of mixed breed ancestry, relative proximity to other historic burro populations (such as in the Grand Canyon NP and Parashant NM areas), and the currently large population size. This expectation is testable, based on analysis of genetic samples that would be collected at the time of the first gather. Second, under the proposed action BLM will take mitigation measures to augment genetic diversity in the herd (BLM 2010). The proposed action includes regularly-scheduled, planned introductions of at least 3-5 fertile burros per 7 years (using that time period as approximately 1 generation). This number of introduced animals should far exceed the rules of thumb suggesting that one effective migrant per generation is generally adequate to prevent significant loss of genetic diversity (Mills and Allendorf 1996). If results of genetic monitoring from the initial gather or future gathers indicate that it would be warranted, even more fertile burros can be introduced to the herd to augment genetic diversity. Third, the effects of the fertility control vaccines applied to jennies are expected to be temporary (see Appendix D), and will not generally prevent treated jennies from reproducing in the future.

Impacts to the rangeland as a result of the current overpopulation of wild burros would be reduced under the gather and removal alternative. Territorial fighting among jacks would be expected to 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 burros 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 horse and 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. Traumatic injuries usually do not result from these conflicts. These injuries typically involve a bite and/or kicking with bruises which don't break the skin. Like direct individual impacts, the frequency of occurrence of these impacts among a population varies with the individual animal.

Spontaneous abortion events among pregnant jennies following capture is also rare, though poor body condition can increase the incidence of such spontaneous abortions. Given the timing of these gathers, 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 rejects the foal. This occurs most often with young mothers or very young foals,
- The foal and mother become separated during sorting, and cannot be matched,
- The jenny dies or must be humanely euthanized during the gather,

- The foal is ill, weak, or needs immediate special care that requires removal from the mother,
- The mother does not produce enough milk to support the foal.

Sometimes, 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 rarely die or have to be euthanized.

Most 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 and burros are normally weaned between four and six months of age.

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

During summer gathers, roads and corrals may become dusty, depending upon the soils and specific conditions at the gather area. The BLM ensures that contractors mitigate any potential impacts from dust by slowing speeds on dusty roads and watering down corrals and alleyways. Despite precautions, it is possible for some animals to develop complications from dust inhalation and contract dust pneumonia. This is rare, and usually affects animals that are already weak or otherwise debilitated due to older age or poor body condition. Summer gathers pose increased risk of heat stress, so contractors use techniques that minimize heat stress, such as conducting gather activities in the early morning, when temperatures are coolest, and stopping well before the hottest period of the day. The helicopter pilot also brings in the horses and burros at an easy pace. If there are extreme heat conditions, gather activities are suspended during that time. Water consumption is monitored, and horses or burros are often lightly sprayed with water as the corrals are being sprayed to reduce dust. The wild horses and burros appear to enjoy the cool spray during summer gathers. Individual animals are also monitored, and veterinary or supportive care administered as needed. Electrolytes can be administered to the drinking water during gathers that involve animals in weakened conditions or during summer gathers. Additionally, BLM Wild Horse and Burro staff maintains supplies of electrolyte paste if needed to directly administer to an affected animal. As a result of adherence to SOPs and care taken during summer gathers, potential risks to wild horses and burros associated with summer gathers can be minimized or eliminated.

During winter gathers, wild horses and burros are often located in lower elevations, in less steep terrain due to snow cover in the higher elevations. Subsequently, the animals are closer to the potential gather corrals, and need to maneuver less difficult terrain in many cases. However, snow cover can increase fatigue and stress during winter gathers, therefore the helicopter pilot allows horses and burros to travel slowly at their own pace. The Contractor may plow trails in the snow leading to the gather corrals to make it easier for animals to travel to the gather site and to ensure the wild horses and burros can be safely gathered. Snowy conditions, though, are not frequently expected in this locale.

Through the capture and sorting process, wild horses and burros are examined for health, injury and other defects. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy. BLM Euthanasia Policy IM-2015-070 is used as a guide to determine if animals meet the criteria and should be euthanized (refer to SOPs Appendix B). Animals that are euthanized for non-gather related reasons include those with old injuries (broken hip, leg) that have caused the animal to suffer from pain or which prevent them from being able to travel or maintain body condition; old animals that have lived a successful life on the range, but now have few teeth remaining, are in poor body condition, or are weak from old age; and wild horses or burros that have congenital (genetic) or serious physical defects such

as club foot, or sway back and should not be returned to the range.

Any jennies released back into the Complex would be held briefly in a temporary or permanent corral, individually marked, treated with fertility control vaccines (i.e., PZP ZonaStat vaccine, PZP-22 pellet vaccine, GonaCon-Equine), and returned to the range. Individual marking would include a uniquely numbered RFID chip inserted into the nuchal ligament and could include freeze brand identification. For practical use by BLM, RFID chips can only be read if the animal is in close proximity to a chip reader (for example, because the animal is constrained). If animals have unique hip freezebrands or neck freezebrand marks, then they could be identified as candidates to receive booster doses of fertility control vaccine via darting. However, darting in the LMC is not expected to be practical, for reasons noted in section 2.3.3. Effects of fertility control vaccine are primarily a reduced fertility rate in treated jennies. Other effects may include associated changes in estrus cyclicity, injection site reactions, and increased longevity. A thorough review of the effects of fertility control vaccines is included in Appendix D.

Genetic monitoring would be conducted following gathers, to establish a baseline level of genetic diversity in the herd during the initial gather, and subsequent levels of genetic diversity during follow-up gathers. Having some portion of the jennies in the herd temporarily infertile should not prevent the herd from being self-sustaining and genetically viable. Under the proposed action, at least 3-5 fertile animals would be introduced from another HMA, approximately every 7 years. This action is expected to increase the genetic diversity in the herd, to reduce the negative effects of potential inbreeding and genetic drift. Should genetic monitoring results indicate that introduction of additional fertile burros is warranted to increase genetic diversity in the herd, BLM can take that action.

Impacts of the No Action Alternative

Under the No Action Alternative, there would be no active management to control the population size within the established AML at this time. In the absence of a gather, wild horse and burro populations would continue to grow at an average rate of approximately 15-20% per year. Without a gather and removal now, the wild horse and burro populations would grow to approximately 800 animals in four years' time based on the average annual growth rate.

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

4.2.6 Wilderness

Impacts from the Proposed Action

Under the Proposed Action there would be neither a negative nor beneficial impact to the undeveloped quality of wilderness character as the Proposed Action would not authorize any developments, motorized vehicles, or landing of aircraft within the wilderness boundaries. The Proposed Action would negatively impact the untrammeled quality of wilderness character as an anthropocentric management approach is

being taken to manage wild horse and burro populations. The Proposed action will negatively impact the opportunity for solitude and primitive recreation during gather and monitoring activities. This impact will result from the presence and sound of helicopter use, the entirety of the wilderness areas will not be negatively impacted as the action is ephemeral by nature, though this quality of wilderness character will be impacted where the presence and sound of helicopter use is prevalent. Some wild burros may have visible freezemarks, to aid in identification of vaccinated individuals. The proposed action aims to remove excess wild horses and burros to reduce their population to the low-level AML in the planning area. Managing wild horse and burro populations at appropriate AML will be a positive benefit to the natural quality of wilderness character as it is expected to result in a healthy herd level and reduce negative impacts to the landscape from excess wild horses and burros. Excess wild horses and burros may compete with native populations of wildlife, trample native vegetation, and trample watersheds and other riparian areas.

Impacts of the No Action Alternative
The No Action Alternative would not result in any direct impacts from gather operations. Under the No Action Alternative there would be neither a negative or beneficial impact to the untrammeled, undeveloped, or solitude or primitive an unconfined recreation quality of wilderness character. However, the natural quality of wilderness character may be indirectly impacted if the wild horse and burro populations exceed the allotted AML. The excess population may impact the natural quality of wilderness character by competing with native wildlife for forage utilization, trample native vegetation, trample watersheds and other riparian areas.

4.2.7 Wilderness Study Area

Impacts from the Proposed Action
The Proposed Action would meet the non-impairment standard as the Proposed Action is a temporary use and would result in no new surface disturbance. The Proposed Action is aimed at removing wild horse and burro populations more than the AML, the Proposed Action has a defined time period is not chronic and will not create a demand for this type of use. Additionally, the proposed action will not create any new surface disturbance in the Million Hills WSA. The opportunity for solitude and primitive recreation characteristic will be temporary impacted by the presence and sound of helicopters. This impact will be limited to gather and monitoring operations. The natural quality of wilderness characteristics may be benefited by managing the wild horse and burro population at the allotted AML. The Proposed Action will not impair the suitability of the Million Hill WSA for preservation as wilderness should Congress decide to act.

Impacts of the No Action Alternative
The No Action Alternative would meet the non-impairment standard as the No Action Alternative is a temporary use and would result in no new surface disturbance. The No Action Alternative would not result in any direct impacts from gather operations. Under the No Action Alternative there would be neither a negative or beneficial impact to the undeveloped or solitude or primitive an unconfined recreation characteristic. However, the natural characteristic may be indirectly impacted if the wild horse and burro populations exceed the allotted AML. The excess population may impact the natural characteristic by competing with native wildlife for forage utilization, trample native vegetation, trample watersheds and other riparian areas.

4.3 Cumulative Effects

The NEPA regulations define cumulative impacts as impacts on the environment that result from the incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions (40 CFR 1508.7).

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The cumulative impacts study area (CSA) for the purposes of evaluating cumulative impacts is the Lake Mead Complex.

According to the 1994 BLM *Guidelines for Assessing and Documenting Cumulative Impacts*, the cumulative analysis should be focused on those issues and resource values identified during scoping that are of major importance. Accordingly, the issues of major importance to be analyzed are:

4.3.1 Past, Present, and Reasonably Foreseeable Future Actions

4.3.1.1 Forest and Rangelands/Vegetation

Impacts of the Proposed Action

Cumulative impacts to vegetation in the Lake Mead area include disturbance from OHV, creation of new routes, and mineral extraction. Several sensitive species of plants occur in gypsum soils within the area, and these soils are easily disturbed and slow to recover. Cumulative impacts from the proposed action will result in a lower level of impact to sensitive plants and vegetation as removal of the wild horses and burros will decrease impacts on these resources.

Impacts of the No Action

Cumulative impacts from the no action alternative would result in higher overall and sustained disturbance to Mojave desert vegetation and sensitive species, as not removing these animals would result in a herd that would continue to increase in number and contribute to impacts on vegetation in the Lake Mead area.

4.3.1.2 Migratory Birds/Wildlife

Impacts of the Proposed Action

Desert ecosystems are slow to recover. These areas have been negatively impacted by wild horses and burros particularly due to areas being over the AML capacity. As these populations are established and continue to grow, the environment and resources are negatively impacted from over grazing, trampling and depleted water sources. Increases in horse and burro populations also increases the potential for increased casual use and human presence to these locations.

Disturbance to migratory birds from the helicopter and wild horses could occur but would be short-term and minimal. Damage to vegetation at trap sites would be on a small scale and would not have a measurable impact. Human presence at trap sites would disrupt wildlife activities. Short and long-term impacts would result from reducing wild horse and burro numbers within the assessment area.

The removal of excess wild horses and burros would provide immediate benefit to migratory birds, special status species, and wildlife through less competition for forage, nest sites and water thus would allow gradual improvement of upland and riparian health.

Impacts of the No Action

Under the no action alternative wild horse and burro levels would continue to increase and result in areas of vegetative communities to continue to be over utilized by horses and burros. The continued presence of horses and burros over AML degrades habitat and removes forage plants and potential nest sites for avian species and other wildlife. Under the no action alternative, the impacts to the rangeland and to sensitive species would be detrimental.

4.3.1.3 Riparian-Wetland Zones/Soils

Impacts of the Proposed Action

Cumulative impacts to vegetation in the Lake Mead area include disturbance from OHV, creation of new routes, and soil erosion from reduction of native plant materials. Soil erosion will decrease and water quality will increase once wild horse and burro numbers are reduced. Hoof action on the soil around unimproved springs and stream banks would be lessened which should lead to increased stream bank stability and decreased compaction and erosion. Improved vegetation around riparian areas would dissipate stream energy associated with high flows, and filter sediment, resulting in associated improvements in water quality. The Proposed Action would make progress towards achieving and maintaining proper functioning condition at riparian areas.

Impacts of the No Action
And under the no action alternative soil erosion impacts and water quality will further deteriorate and/or at a higher rate than under current AML.

4.3.1.4 Federally Threatened, Endangered, Proposed, or Candidate Animal Species and Critical Habitat

Impacts of the Proposed Action
Cumulative impacts to desert tortoise and their habitat can result from the incremental removal of undisturbed habitat having long term impacts due to the slow recovery of semi-arid environments and increase the potential for invasion of non-native vegetation and lead to long-term loss of potential forage, and nesting/burrowing and cover sites. Cumulative impacts of the proposed action may result in recovery of areas that have been heavily impacted by wild horses and burros resulting in increased forage potential, reduced risk of trampling, potentially reducing the spread of weeds and increased water quality and availability at spring locations.

Impacts of the No Action
Under the no action alternative wild horse and burro levels would continue to increase and result in areas of vegetative communities to continue to be over utilized by horses and burros. The continued presence of horses and burros over AML degrades habitat and removes forage plants and potential burrow sites for desert tortoise. Desert tortoise are additionally at higher risk of being trampled. Under the no action alternative, the impacts to the desert tortoise would be detrimental.

4.3.1.5 Wild Horses and Burros

The Las Vegas RMP designated the Lake Mead Complex for the long term management of wild horse and burro populations along with the 1995 Lake Mead National Recreation Area Burro Management Plan, which was reaffirmed in April of 2005 with a memorandum of understanding (MOU) between the National Park Service and BLM. These documents designated approximately 178,000 acres for wild burro management within the Gold Butte Herd Management Area, confirmed the El Dorado Herd Area as a 0 AML for wild burros, and converted the Muddy Mountains Herd Management Area to a Herd Area with a 0 AML for wild horses and burros due to lack of critical resources.

The actions which have influenced today's wild horse and burro populations are primarily gathers, with the last one having taken place in 2007, when 149 wild burros were removed from the Complex.

4.3.1.6 Wilderness

Impacts of the Proposed Action
As a result of the Proposed Action, removal of excess wild horse and burro populations to manage the areas at an appropriate AML, would not have a long-term impact to wilderness character. There may be an ephemeral impact to wilderness character, but this will be confined by the gather operations, predominantly impacted by the presence and sound of helicopter use during the action. There are no RFFA that would combine with the Proposed Action to have a long-term impact to the wilderness

character.

Impacts of the No Action
The No Action Alternative would not result in direct impacts from gather operations. The opportunity for solitude and primitive recreation and untrammeled quality of wilderness character would not be affected. However, the natural quality of wilderness character may be indirectly impacted. If the wild horse/burro populations exceed their AML, the potential herd health and impacts to the landscape from excess wild horses and burros may occur.

4.3.1.7 Wilderness Study Areas
Impacts of the Proposed Action
As a result of the Proposed Action, removal of excess wild horse and burro populations to manage the areas at an appropriate AML, would not have a long-term impact to wilderness characteristics. There may be an ephemeral impact to wilderness characteristics, but this will not impact the BLMs ability to implement the non-impairment standard of the Million Hills WSA. There are no RFFA that would combine with the Proposed Action to have a long-term impact to the wilderness characteristics.

Impacts of the No Action
The No Action Alternative would not result in direct impacts from gather operations. The opportunity for solitude and primitive recreation, the size of Million Hills WSA, and apparent naturalness would not be affected. The no action alternative would not impact the BLMs ability to implement the non-impairment standard of the Million Hills WSA.

4.4 Reasonably Foreseeable Future Actions

4.4.1 Wild Horses and Burros
Over the next 10-year period, reasonably foreseeable future actions include gathers about every 3-4 years to remove excess wild burros in order to manage population size within the established AML range. The excess animals removed would be transported to ORC where they would be prepared for adoption, sale (with limitations), or ORP. A relatively small number of female burros would be returned to the Gold Butte HMA after treatment with fertility control vaccine. A small number of burros would be introduced from other HMAs, to ensure that genetic diversity remains adequate to prevent negative effects of inbreeding on viable foal production.

4.5 Summary of Past, Present, and Reasonably Foreseeable Future Actions

Impacts of the Proposed Action
The cumulative effects associated with the capture and removal of excess wild horses and burros includes gather-related mortality of less than 1% of the captured animals, about 5% per year associated with transportation, short-term holding, adoption or sale with limitations and about 8% per year associated with long-term holding. This compares with natural mortality on the range ranging from about 5-8% per year for foals (animals under age 1), about 5% per year for horses ages 1-15, and 5-100% for animals age 16 and older (Garrott and Taylor 1990, Jenkins 1996, Ransom et al. 2016). In situations where forage and/or water are limited, mortality rates increase, with the greatest impact to young foals, nursing mares and jennies, and older horses and burros. Animals can experience lameness associated with trailing to/from water and forage, foals may be orphaned (left behind) if they cannot keep up with their mother, or animals may become too weak to travel. After suffering, often for an extended period, the animals may die. Before these conditions arise, the BLM generally removes the excess animals to prevent their suffering from dehydration or starvation.

While humane euthanasia and sale without limitation of healthy horses and burros for which there is no adoption demand is authorized under the WFRHBA, Congress prohibited the use of appropriated funds between 1987 and 2004 and has again since 2010 for this purpose.

Potential impacts on wild jennies treated with fertility control vaccines, and associated potential effects on the herd, are detailed in Appendix D.

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

Impacts of the No Action Alternative
Under the No Action Alternative, the wild horse and burro populations could exceed 800 animals in four years. Movement outside the LMC would be expected as greater numbers of horses and burros search for food and water for survival, thus impacting larger areas of public lands. Heavy to excessive utilization of the available forage would be expected. Eventually, ecological plant communities would be damaged to the extent that they are no longer sustainable, and the wild horse and burro population would be expected to crash.

Emergency removals could be expected in order to prevent individual animals from suffering or death as a result of insufficient forage and water. Considering that water hauling has been required in recent years, and that the herd continues to grow, these emergency removals could occur as early as 2021. During emergency conditions, competition for the available forage and water increases. This competition generally impacts the oldest and youngest horses and burros as well as lactating mares and jennies first. These groups would experience substantial weight loss and diminished health, which could lead to their prolonged suffering and eventual death. If emergency actions are not taken, the overall population could be affected by severely skewed sex ratios towards stallions and jacks as they are generally the strongest and healthiest portion of the population. An altered age structure would also be expected.

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

5.0 Mitigation Measures

5.1 Forest and Rangelands/Vegetation

- All locations for gathering and staging will be cleared with the BLM botanist prior to use to avoid impacts to rare plant populations (which are often in areas with less vegetation).

5.2 Migratory Birds/Wildlife

- If a gather is to occur during the bird breading season (February 15th to September 1st), a biologist is required to survey the trap location to ensure no birds are nesting within the vicinity.
- In compliance with the Migratory Bird Treaty Act, habitat-altering projects or portions of projects should be scheduled outside of the bird breeding season, which generally occurs February 15th through August 31st. If a project has to occur during the breeding season, then a qualified biologist must survey the area for nests, including ground nesting species, immediately prior to commencement of project activities. If any active nests are found, an appropriately sized buffer area must be established and maintained until the young birds fledge. If feasible, the buffer area should connect to suitable, undisturbed habitat. As the above dates are a general guideline, any active nests that are observed outside this range, must be avoided as described above.
- Any infrastructure for projects will be designed and constructed in a manner that does not allow open pipes that birds or other wildlife could be trapped in. This includes fencing, gates, or other materials with open holes. All open pipes will be capped or secured so that wildlife cannot access.

5.3 Riparian-Wetland Zones/Soils

- All locations for gathering and staging wild horses and burros (other than bait traps) should occur at least .25 miles away from natural water sources and riparian areas and should occur in previously disturbed areas to reduce impacts to intact biocrust areas.

5.4 Federally Threatened, Endangered, Proposed, or Candidate Animal Species and Critical Habitat

- The section 7 consultation for this project is covered under the current Programmatic Biological Opinion (08ENVS0-2019-f-0513) contingent on compliance with the terms and conditions. **A copy of the terms and conditions has been provided for this project (Sec 7 Log # NV-052-20-041).**
- If a gather is required to occur in an area not previously disturbed, a biologist will be required to clear the area where the trap site is to be placed.

5.5 Wild Horses and Burros

- The BLM COR and PI assigned to the gather would be responsible for ensuring contract personnel abide by the contract specifications and the CAWP standards (Appendix B). Ongoing monitoring of forage condition and utilization, water availability, aerial population surveys, and animal health would continue. A small number of ertile burros would be periodically introduced to the herd to maintain high levels of heterozygosity. Sampling genetic materials (hair follicles) during gather events would allow for ongoing analysis of genetic diversity (as per BLM IM 2009-062).

5.6 Wilderness

- Prior to any future action that includes wilderness a notice of proposed action (NOPA) must be made available.
- Prior to any future action that includes wilderness, the action must be individually analyzed using the minimum requirement decision guide (MRDG) process.
- Timing of activities will consider recreation use patterns whenever possible. Action should be scheduled to avoid known high-use times such as weekends and hunting season.

- All trap sites, holding facilities, or any other wilderness development must be outside of wilderness boundaries.
- There must be no landing of aircraft within wilderness boundary. Landing aircraft is defined by 43 CFR 6302.20 as drop or pick up any material, supplies or person by means of aircraft, including a helicopter, hang glider, hot air balloon, parasail, or parachute.

5.7 Wilderness Study Areas

- Prior to any future action that includes Million Hills WSA, the action must be individually analyzed by the district wilderness specialist.
- Timing of activities will consider recreation use patterns whenever possible. Action should be scheduled to avoid known high-use times such as weekends and hunting season.
- All trap sites and holding facilities must be in previously disturbed areas or outside of the wilderness boundary.
- Any motorized/mechanized travel and landing of aircraft must not create any new surface disturbance.

6.0 Consultation and Coordination

The Battle Mountain District Office held the state-wide public hearing regarding motorized vehicle and aircraft on June 25, 2020; one public participant attended, written comments were also received until July 2, 2020 and their comments were entered into the record for this hearing. Specific concerns included: (1) support of the use of helicopters and the gathering of excess wild horses, (2) Against the use of helicopters and the gathering of excess wild horses, (3) Ensure humane treatment during gather operations (4) Transparency. Standard Operating Procedures were reviewed in response to these concerns and no changes to the SOPs were indicated based on this review.

7.0 Public Involvement

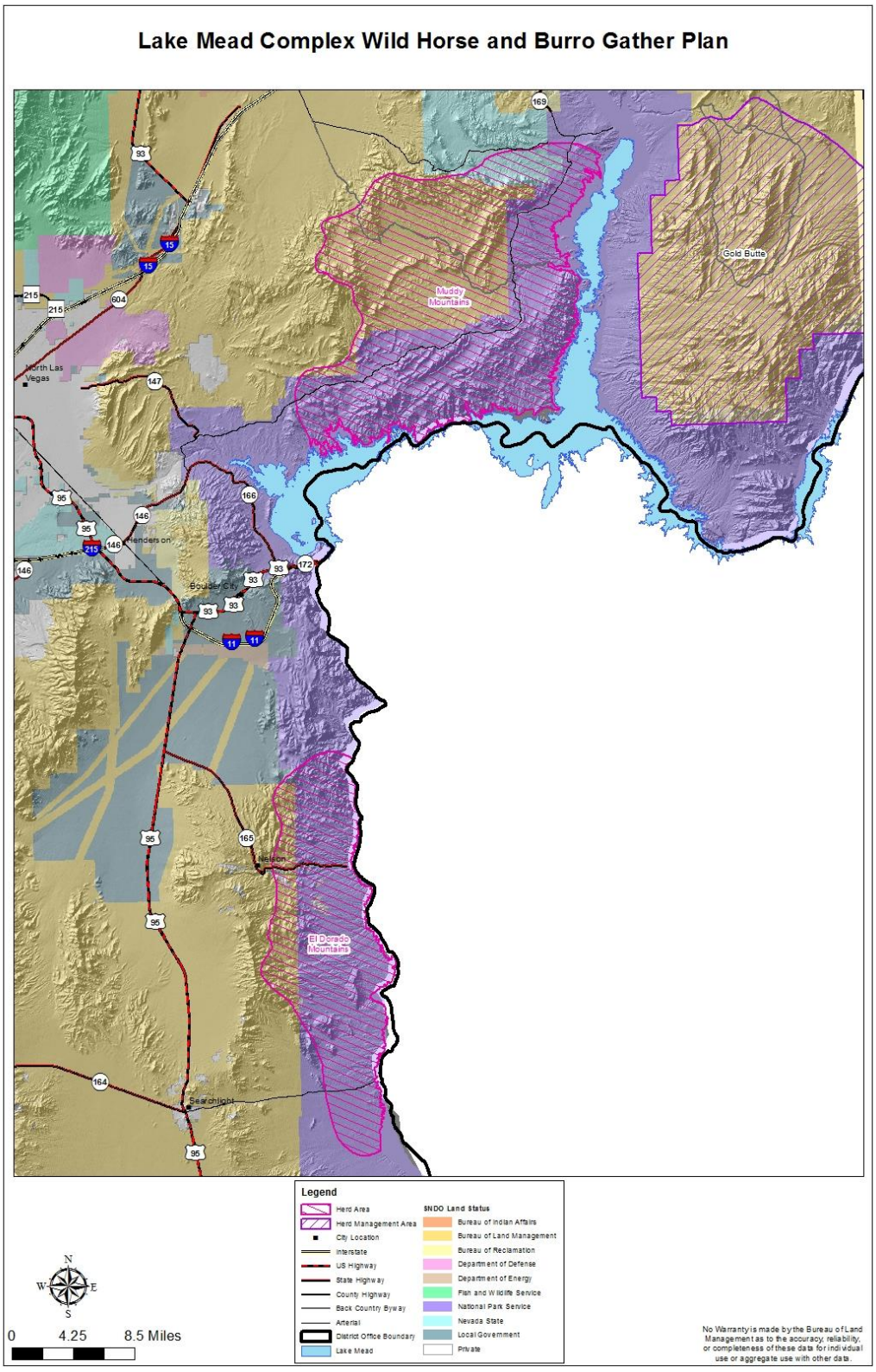
The draft environmental assessment will be made available on the BLM National NEPA Register and to interested individuals, agencies and groups for a 30-day public review and comment period.

8.0 Appendices

Appendix A – Maps
Appendix B – Gather Operations Standard Operating Procedures/Comprehensive Animal Welfare Program
Appendix C – Standard Stipulations and Mitigation Measures
Appendix D – Fertility Control Vaccines SOPs and Literature Review
Appendix E – Literature Cited

Appendix A. Maps

Lake Mead Complex
(AZ Lands Not Shown)



Appendix B. Gather Operations Standard Operating Procedures/Comprehensive Animal Welfare Program (PIM 2021-002)

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

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

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

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

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

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

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

Helicopter Gather Methods used in the Performance of Gather Contract Operations

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

All gather attempts shall incorporate the following:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

FEEDING AND WATERING

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

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

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

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

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

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

TRAP SITE

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

TEMPORARY HOLDING FACILITY

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

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

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

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

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

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

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

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

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

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

temporary holding to the BLM facility will not exceed 10 hours. Animals that are to be released back into the capture area may need to be transported back to the original trap site per direction of the LCOR.

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

Helicopter Drive Trapping

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

HANDLING

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

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

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

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

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

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

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

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

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

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

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

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

MOTORIZED EQUIPMENT

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

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

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

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

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

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

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

TRANSPORTATION

A. General

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

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

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

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

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

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

B. Vehicles

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

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

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

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

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

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

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

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

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

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

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

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

C. Care of WH&B's during Transport Procedures

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

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

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

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

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

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

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

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

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

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

EUTHANASIA or DEATH

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

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

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

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

5. Carcasses left on the range should not be placed in washes or riparian areas where future runoff may carry debris into ponds or waterways. Trenches or holes for buried animals should be dug so the bottom

of the hole is at least 6 feet above the water table and 4-6 feet of level earth covers the top of the carcass with additional dirt mounded on top where possible.

COMMUNICATIONS

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

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

SAFETY AND SECURITY

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

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

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

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

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

BIOSECURITY

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

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

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

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

1. Any saddle or pilot horses showing signs of infectious disease (fever, nasal discharge or illness) must be removed from service and isolated from other animals on the gather until such time as the horse is free from signs of infectious disease and approved by the on-site/on-call veterinarian to return to the gather.

2. WH&B's showing signs of infectious disease will normally not be mixed with groups of healthy WH&B's at the temporary holding facility, or during transport..

PUBLIC AND MEDIA INTERACTION

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

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

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

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

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

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

CONTRACTOR-FURNISHED PROPERTY

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

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

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

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

BLM ROLES AND RESPONSIBILITIES

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

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

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

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

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

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

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

SITE CLEARANCES
a. Prior to setting up a trap or temporary holding facility, BLM will conduct all necessary legal reviews and clearances (NEPA, ARPA, NHPA, etc.). All proposed site(s) must be inspected by a government archaeologist. Once archaeological clearance has been obtained, the trap or temporary holding facility

may be set up. Said clearance shall be coordinated and arranged for by the COR/ PI, or other BLM employees.

Water and Bait Trapping Standard Operating Procedures

The work consists of the capture, handling, care, feeding, daily rate and transportation of wild horses and/or burros from the States of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah and Wyoming. The method of capture will be with the use of bait and/or water traps in accordance with the standards identified in the Comprehensive Animal Welfare Program (CAWP) for Wild horse and Burro Gathers, Bureau of Land Management (BLM) Permanent Instruction Memorandum 2021-002. Items listed in the sections of the Statement of Work (SOW) either are not covered or deviate from the CAWP, the SOW takes precedence over the CAWP when there is conflicting information. Extended care, handling and animal restraint for purposes of population growth suppression treatments may be required for some trapping operations. The contractor shall furnish all labor, supplies, transportation and equipment necessary to accomplish the individual task order requirements with the exception of a Government provided restraint fly chute, as needed for population growth suppression. The work shall be accomplished in a safe and humane manner and be in accordance with the provisions of 43 CFR Part 4700, the CAWP, the specifications and provisions included in this SOW, and any subsequent SOW documents issued with individual task orders. The primary concern of the contractor shall be the safety of all personnel involved and the humane capture and handling of all wild horses and burros. It is the responsibility of the contractor to provide appropriate safety and security measures to prevent loss, injury or death of captured wild horses and burros.

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

Trapping activities would be on the HA/HMA/WHBT or outside areas specified in the task order. However, trapping could be required on adjacent land, federal, state, tribal, military, or private property. If trapping operations include work on military and/or other restricted areas, the BLM will coordinate all necessary clearances, such as background checks, to conduct operations for equipment and personnel.

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

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

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

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

Facility design to include traps, wings, alleys, handling pens, finger gates, and temporary holding facilities, etc. shall be constructed, maintained and operated to handle the wild horses and burros in a safe and humane manner in accordance with the standards identified in the Comprehensive Animal Welfare Program (CAWP) for Wild Horse and Burro Gathers, Bureau of Land Management (BLM) Permanent Instruction Memorandum 2021-002.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Public and Media

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

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

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

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

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

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

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

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

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

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

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

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

a. The proper operation, service and maintenance of all contractor furnished property are the responsibility of the Contractor. The BLM reserves the right to remove from service any contractor personnel or contractor furnished equipment which, in the opinion of the contracting officer or COR/PI violate contract rules, are unsafe or otherwise unsatisfactory. In this event, the Contractor will be notified in writing to furnish replacement personnel or equipment within 48 hours of notification. All such replacements must be approved in advance of operation by the Contracting Officer or his/her representative.

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

c. All accidents occurring during the performance of any task order shall be immediately reported to the COR/PI.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Prior to implementation of gather operations, gather sites and temporary holding facilities would be evaluated to determine their potential for containing cultural resources. To avoid cultural resources, a BLM archaeologist will be consulted in the early planning process to confirm appropriate areas for facilities that avoids cultural resources. If not in a disturbed area, alternative locations will include previously inventoried areas to avoid cultural resources.

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

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

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

Appendix C. Standard Stipulations and Mitigation Measures

1. Fire and Fuels

1.1. Compliance with fire restrictions is mandatory while fire restrictions are in effect (43 CFR 9212). Fire restrictions are generally enacted May through October. Fire restriction orders are available for review at BLM district offices and on the BLM website. Contact the Southern Nevada District Office on current fire danger two weeks prior to ground activities.

1.2. The use of standard fire prevention measures should be practiced at all times (43 CFR 2805.12). Conditions that support wildfires can occur any time of the year in Southern Nevada.

1.3. All wildfires are to be immediately reported to the Las Vegas Interagency Communication Center at (702) 631-2350 and the appropriate the NTTR liaison. Accommodations to allow immediate safe entry of firefighting apparatus and personnel are required as allowed and authorized by the USAF. The BLM provides wildfire response to the NTTR.

1.4. An Origin and Cause Investigation will be carried out on any human caused fire by BLM law enforcement or their designated representative and the USAF. To minimize disturbance of potential evidence located at the fire scene, the applicant/proponent shall properly handle and preserve evidence in coordination with the BLM. The BLM shall pursue cost recovery for all costs and damages incurred from human-caused fires on when the responsible party(s) has been identified and evidence of legal liability or intent exists. Legal liability includes, but is not limited to, negligence and strict liability (including statutory and contractual liability), products liability, etc.

2. Invasive Species and Noxious Weeds

2.1. The Proponent will keep their project area free of state-listed noxious weeds to the extent practicable. The Proponent shall perform monitoring for invasive species/noxious weeds during field activities. Any detections of noxious weeds should be reported to the SNDO Weed Management Specialist immediately (702-515-5000) to determine the best course action.

2.2. In order to reduce the accidental spread of noxious weeds, the Proponent and/or any contractors shall avoid or minimize all types of travel through a state listed noxious weed-infested areas that can be carried to the project area. In order to minimize the threat of spreading noxious weeds project-related equipment (i.e. undercarriages and wheel wells) should be cleaned of all mud, dirt, and plant parts before moving into relatively weed-free areas or out of relatively weed-infested areas. Project workers shall inspect, remove, and dispose of weed seed and plant parts found on their clothing and personal equipment, bag the product, and dispose of it in a dumpster. If you have questions, consult with the BLM SNDO noxious weed coordinator.

2.3. During Project activities the Proponent shall:

2.3.1. Inspect the Project Area for noxious weeds prior to any ground disturbance.

2.3.2. Limit the size of any vegetation and/or ground disturbance to the absolute minimum necessary to perform the activity safely and as designed.

2.3.3. Begin activities in weed free areas whenever feasible before operating in weed-infested areas.

2.3.4. Locate equipment storage, machine and vehicle parking or any other area needed for the temporary placement of people, machinery and supplies in areas that are relatively weed-free.

2.3.5. Avoid or minimize all types of travel through weed-infested areas or restrict major activities to periods of time when the spread of seed or plant parts are least likely.

2.3.6. Use hay or feed that is certified weed free.

3. MIGRATORY BIRD MITIGATION MEASURES

3.1.1. Trap sites will not be set up near known populations of sensitive species, or in riparian areas, or within Wilderness Study Areas (WSA). In order to avoid potential impacts to breeding migratory birds from gather sites, a nest survey would be conducted by a biologist familiar with birds of the area, within potential breeding habitat prior to any surface disturbance proposed during the avian breeding season (March 1st through August 31st). Surveys must be conducted a maximum of three (3) days prior to disturbance and are valid for only 3 days. If 3 days from the time of the survey pass, the area must be surveyed again.

3.1.2. All active nests are to be protected until the nest is either abandoned (due to the birds own will) or the nestlings fledge (fledge in this instance means to be no longer dependent on the nest). This includes active nests found outside the breeding season, as well as nests found after construction activities have begun.

3.1.3. Protecting active nests involves establishing disturbance-free buffers within which activities are restricted. Buffer distances are determined by species biology, susceptibility to disturbance, and temperament. Example buffer distances for various species are listed in the BLM's Southern Nevada Nesting Bird Management Plan (2019).

Appendix D. Fertility Control Vaccines SOPs and Literature Review

Standard Operating Procedures for PZP Vaccine Treatments; One-Year Liquid Vaccine

The following implementation and monitoring requirements are part of the Proposed Action:

1. Fertility vaccine would be administered through darting by trained BLM personnel or collaborating partners only. For any darting operation, the designated personnel must have successfully completed a nationally recognized wildlife darting course and who have documented and successful experience darting wildlife under field conditions.
2. All jennies targeted for treatment will be clearly identifiable through photographs to enable darters and HMA managers to positively identify the animals during the project and at the time of removal during subsequent gathers. This will be accomplished by marking each individual with a freeze mark on the hip. Additionally, ear tags may be placed in an ear to assist in positively identifying individuals when they are long haired.
3. 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. Designated darters will follow safety guidance on EPA labeling for all adjuvants.
4. Delivery of the vaccine would be by intramuscular injection into the left or right hip/gluteal muscles while the jenny is standing still.
5. Safety for both humans and the burro is the foremost consideration in deciding to dart a jenny. The Dan Inject® gun would not be used at ranges in excess of 30 m while the Pneu-Dart® gun would not be used over 50 m, and no attempt would be taken when other persons are within a 30-m radius of the target animal.
6. 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 hip/gluteal region and hit the rib cage. The ideal is when the dart would strike the skin of the horse (or burro) at a perfect 90° angle.
7. If a loaded dart is not used within two hours of the time of loading, the contents would be transferred to a new dart before attempting another horse (or burro). If the dart is not used before the end of the day, it would be stored under refrigeration and the contents transferred to another dart the next day. Refrigerated darts would not be used in the field.
8. No more than two people should be present at the time of a darting. The second person is responsible for locating fired darts. The second person should also be responsible for identifying the horse (or burro) and keeping onlookers at a safe distance.
9. To the extent possible, all darting would be carried out in a discreet 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.
10. Attempts will be made to recover all darts. To the extent possible, all darts which are discharged and drop from the burro at the darting site would be recovered before another darting occurs. In exceptional situations, the site of a lost dart may be noted and marked, and recovery efforts made at a later time. All discharged darts would be examined after recovery in order to determine if the charge fired and the plunger fully expelled the vaccine. Personnel conducting darting operations should be equipped with a two-way radio or cell phone to provide a communications link with the Project Veterinarian for advice and/or assistance. In the event of a veterinary emergency, darting personnel would immediately contact the Project Veterinarian, providing all available information concerning the nature and location of the incident.

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

Monitoring and Tracking of Treatments

1. At a minimum, estimation of population growth rates using helicopter or fixed-wing surveys will be conducted before any subsequent gather. During these surveys it is not necessary to identify which foals were born to which jennies; only an estimate of population growth is needed (i.e. # of foals to # of adults).
2. Population growth rates of herds selected for intensive monitoring will be estimated every year post-treatment using helicopter or fixed-wing surveys. During these surveys it is not necessary to identify which foals were born to which jennies, only an estimate of population growth is needed (i.e. # of foals to # of adults). If, during routine HMA field monitoring (on-the-ground), data describing jenny to foal ratios can be collected, these data should also be shared with the NPO for possible analysis by the USGS.
3. An Application Data sheet will be used by field applicators to record all pertinent data relating to identification of the jenny (including photographs if jennies are not freeze-marked) and date of treatment. Each applicator will submit an Application Report and accompanying narrative and data sheets will be forwarded to the NPO (Reno, Nevada). A copy of the form and data sheets and any photos taken will be maintained at the field office.

Standard Operating Procedures for GonaCon Vaccine Treatments

Administering the GonaCon Vaccine by Hand-Injection

1. For initial and booster treatments, mares would ideally receive 2.0 ml of GonaCon-Equine. However, 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.
2. With each injection, the vaccine should be injected into the left or right hind quarters of the mare, above the imaginary line that connects the point of the hip (hook bone) and the point of the buttocks (pin bone).
3. 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. 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.
4. A booster vaccine may be administered 90 or more days after the first injection to improve efficacy of the product over subsequent years.
5. Free ranging animals may be photographed using a telephoto lens and high quality digital receiver as a record of treated individuals, and the injection site can be recorded on data sheets to facilitate identification by animal markings and potential injection scars.
6. A tracking system would be maintained by NPO detailing the 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 freeze-mark(s) applied by HMA and date.

Preparation of Darts for GonaCon Vaccine Remote Delivery:

1. The vaccine 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. 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. Important: label instructions must be followed for this product.
2. 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 (~15 %). To determine the amount of vaccine delivered, the dart must be weighed before loading, and before and after delivery in the field.
3. 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)
4. Wearing latex gloves, darts are numbered and filled 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.
5. 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.
6. 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 a cooler at about 4° C and used the next day, but do not store in a refrigerator or any other container likely to cause condensation.

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 and burro populations or, when used in combination with gathers, to reduce horse and burro 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 and burro 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 and burro 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 and burros requires capturing and handling, the risks and costs associated with capture and handling of horses and burros 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. BLM and other users have used PZP vaccines in burros, and GonaCon-Equine is also approved for use in burros. 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 and burro 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), in feral burros on Caribbean islands (Turner et al. 1996, French et al. 2017), and in wild burros at Black Mountain HMA, in Arizona. 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 is also now produced by a company called "SpayFIRST, Inc." (Norman, Oklahoma). 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 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 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). PZP vaccines do not appear to interact with other organ systems, as antibodies specific to PZP protein do not crossreact with tissues outside of the reproductive system (Barber and Fayrer-Hosken 2000).

Research has demonstrated that contraceptive efficacy of an injected liquid PZP vaccine, such as ZonaStat-H, is approximately 90% or more for mares treated twice in the first year (Turner and Kirkpatrick 2002, Turner et al. 2008). The highest success for fertility control has been reported when the vaccine has been applied November through February. High contraceptive rates of 90% or more can be maintained in horses that are given a booster dose annually (Kirkpatrick et al. 1992). Approximately 60% to 85% of mares are successfully contracepted for one year when treated simultaneously with a liquid primer and PZP-22 pellets (Rutberg et al. 2017, 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 and burros 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 is specifically intended for horses and burros, and 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 and burros. 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 from conceiving foals, but BLM acknowledges that long-term infertility, or permanent sterility, could be a result for some number of individual wild horses and burros receiving PZP vaccinations. The rate of long-term or permanent sterility following vaccinations with PZP is hard to predict for individual horses and burros, but that outcome appears to increase in likelihood as the number of doses increases (Kirkpatrick and Turner 2002). Permanent sterility for mares treated consecutively in each of 5-7 years was observed by Nuñez et al. (2010, 2017). In a graduate thesis, Knight (2014) suggested that repeated treatment with as few as three to four years of PZP treatment may lead to longer-term sterility, and that sterility may result from PZP treatment before puberty. Repeated treatment with PZP led long-term infertility in Przewalski's horses receiving as few as one PZP booster dose (Feh 2012). However, even if some number of mares become sterile as a result of PZP treatment, that potential result would be consistent with the contraceptive purpose that motivates BLM's potential use of the vaccine.

In some number of individual mares, PZP vaccination may cause direct effects on ovaries (Gray and Cameron 2010, Joonè et al. 2017b, Joonè et al. 2017c, Joonè et al. 2017d, Nolan et al. 2018b). Joonè et al. (2017a) noted reversible effects on ovaries in mares treated with one primer dose and booster dose. Joonè et al. (2017c) and Nolan et al. (2018b) documented decreased anti-Mullerian hormone (AMH) levels in mares treated with native or recombinant PZP vaccines; AMH levels are thought to be an indicator of ovarian function. Bechert et al. (2013) found that ovarian function was affected by the SpayVac PZP vaccination, but that there were no effects on other organ systems. Mask et al. (2015) demonstrated that equine antibodies that resulted from SpayVac immunization could bind to oocytes, ZP proteins, follicular tissues, and ovarian tissues. It is possible that result is specific to the immune response to SpayVac, which may have lower PZP purity than ZonaStat or PZP-22 (Hall et al. 2016). However, in studies with native ZP proteins and recombinant ZP proteins, Joonè et al. (2017a) found transient effects on ovaries after PZP vaccination in some treated mares; normal estrus cycling had resumed 10 months after the last treatment. SpayVac is a patented formulation of PZP in liposomes that led to multiple years of infertility in some breeding trials (Killian et al. 2008, Roelle et al. 2017, Bechert and Fraker 2018), but unacceptably poor efficacy in a subsequent trial (Kane 2018). Kirkpatrick et al. (1992) noted effects on horse ovaries after three years of treatment with PZP. Observations at Assateague Island National Seashore indicated that the more times a mare is consecutively treated, the longer the time lag before fertility returns, but that even mares treated 7 consecutive years did eventually return to ovulation (Kirkpatrick and Turner 2002). Other studies have reported that continued PZP vaccine applications may result in decreased estrogen levels (Kirkpatrick et al. 1992) but that decrease was not biologically significant, as ovulation remained similar between treated and untreated mares (Powell and Monfort 2001). Bagavant et al. (2003) demonstrated T-cell clusters on ovaries, but no loss of ovarian function after ZP protein immunization in macaques.

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, 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 or burros 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 or burro 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 or burro 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 (Roelle and Ransom 2009, Bechert et al. 2013, French et al. 2017, Baker et al. 2018), but swelling or local reactions at the injection site are expected to be minor in nature. Roelle and Ransom (2009) found that the most time-efficient method for applying PZP is by hand-delivered injection of 2-year pellets when horses are gathered. They observed only two instances of swelling from that technique. Whether injection is by hand or via darting, GonaCon-Equine is associated

with some degree of inflammation, swelling, and the potential for abscesses at the injection site (Baker et al. 2013). Swelling or local reactions at the injection site are generally expected to be minor in nature, but some may develop into draining abscesses. Use of remotely delivered vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached. The dart-delivered PZP formulation produced injection-site reactions of varying intensity, though none of the observed reactions appeared debilitating to the animals (Roelle and Ransom 2009) but that was not observed with dart-delivered GonaCon (McCann et al. 2017). Joonè et al. (2017a) found that injection site reactions had healed in most mares within 3 months after the booster dose, and that they did not affect movement or cause fever.

Long-lasting nodules observed did not appear to change any animal's range of movement or locomotor patterns and in most cases did not appear to differ in magnitude from naturally occurring injuries or scars. Mares treated with one formulation of GnRH-KHL vaccine developed pyogenic abscesses (Goodloe 1991). Miller et al. (2008) noted that the water and oil emulsion in GonaCon will often cause cysts, granulomas, or sterile abscesses at injection sites; in some cases, a sterile abscess may develop into a draining abscess. In elk treated with GonaCon, Powers et al. (2011) noted up to 35% of treated elk had an abscess form, despite the injection sites first being clipped and swabbed with alcohol. Even in studies where swelling and visible abscesses followed GonaCon immunization, the longer term nodules observed did not appear to change any animal's range of movement or locomotor patterns (Powers et al. 2013, Baker et al. 2017, 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 and burros treated with fertility control would be an improvement in their overall health (i.e., 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 and burro 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 and burros 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 and burros that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild horses and burros, and thereby could eliminate the need to send additional excess horses and burros from this area to off-range holding corrals or pastures for long-term holding.

A principle motivation for use of contraceptive vaccines or sex ratio manipulation is to reduce population growth rates and maintain herd sizes at AML. Where successful, this should allow for continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse and burro habitat quality, and well-being of animals living on the range. As the population nears or is maintained at the level necessary to achieve a 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 and burros using the water sources, and less fighting among horses and burros accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild horses and burros. Wild horses and burros would also have to travel less distance back and forth between water and desirable foraging areas. Among mares in the herd that remain fertile, a higher level of physical health and future reproductive success would be expected in areas where lower horse and burro population sizes lead to increases in water and forage resources. While it is conceivable that widespread and continued treatment with fertility control vaccines could reduce the birth rates of the population to such a point that birth is consistently below mortality, that outcome is not likely unless a very high fraction of the mares present are all treated in almost every year.

Indirect Effects: GnRH Vaccines

As noted above to PZP vaccines, an expected long-term, indirect effect on wild horses and burros 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 or burros, 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 and burros 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 and burros that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild horses and burros, and thereby could eliminate the need to send additional excess horses and burros 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 and burro habitat quality. As the local horse and burro 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 burros 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 and burros 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 and burros using the water sources, and less fighting among horses and burros accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild horses and burros. Wild horses and burros 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 and burros 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 and burros, or mildly adverse in the sense that effects are expected to be transient and to not affect all treated animals.

PZP vaccine-treated mares and jennies 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. 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." Jennies and their foals, typically, do not live in harems, so the behavioral effects of PZP documented in mares may not be expected in PZP-treated jennies.

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 or burro 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 need to be considered. Kirkpatrick et al. (2010) concluded that: "the larger question is, even if subtle alterations in behavior may occur, this is still far better than the alternative," and that the "…other victory for horses is that every mare prevented from being removed, by virtue of contraception, is a mare that will only be delaying her reproduction rather than being eliminated permanently from the range. This preserves herd genetics, while gathers and adoption do not."

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

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

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 or burros have recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses or burros, 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 and burros 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 and burros 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 and burros 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 and burros in most herd management areas are descendants of a diverse range of ancestors coming from many breeds of domestic horses and burros. 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 and burros) 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 populations of wild horses and burros 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 or burros 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 and burros 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.

Appendix E. Literature Cited

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

Ashley, M.C., and D.W. Holcombe. 2001. Effects of stress induced by gathers and removals on reproductive success of feral horses. Wildlife Society Bulletin 29:248-254.

Baker, D.L., J.G. Powers, M.O. Oehler, J.I. Ransom, J. Gionfriddo, and T.M. Nett. 2013. Field evaluation of the Immunocontraceptive GonaCon-B in Free-ranging Horses (*Equus caballus*) at Theodore Roosevelt National Park. Journal of Zoo and Wildlife Medicine 44:S141-S153.

Baker, D.L., J.G. Powers, J. Ransom, B. McCann, M. Oehler, J. Bruemmer, N. Galloway, D. Eckery, and T. Nett. 2017. Gonadotropin-releasing hormone vaccine (GonaCon-Equine) suppresses fertility in free-ranging horses (*Equus caballus*): limitations and side effects. Proceedings of the 8th International Wildlife Fertility Control Conference, Washington, D.C.

Baker D.L., J.G. Powers, J.I. Ransom, B.E. McCann, M.W. Oehler, J.E. Bruemmer, N.L. Galloway, D. C. Eckery, and T. M. Nett. 2018. Reimmunization increases contraceptive effectiveness of gonadotropin-releasing hormone vaccine (GonaCon-Equine) in free-ranging horses (Equus caballus): Limitations and side effects..PLoS ONE 13(7): e0201570.

Balet, L., F. Janett, J. Hüsler, M. Piechotta, R. Howard, S. Amatayakul-Chantler, A. Steiner, and G. Hirsbrunner, 2014. Immunization against gonadotropin-releasing hormone in dairy cattle: Antibody titers, ovarian function, hormonal levels, and reversibility. Journal of Dairy Science 97:2193-2203.

Bagavant, H., C. Sharp, B. Kurth, and K.S.K. Tung. 2002. Induction and immunohistology of autoimmune ovarian disease in cynomolgus macaques (Macaca fascicularis). American Journal of Pathology 160:141-149.

Barber, M.R., and R.A. Fayer-Hosken. 2000. Evaluation of somatic and reproductive immunotoxic effects of the porcine zone pellucida vaccination. Journal of Experimental Zoology 286:641-646.

Bartholow, J.M. 2004. An economic analysis of alternative fertility control and associated management techniques for three BLM wild horse herds. USGS Open-File Report 2004-1199.

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

Bechert, U., J. Bartell, M. Kutzler, A. Menino, R. Bildfell, M. Anderson, and M. Fraker. 2013. Effects of two porcine zona pellucida immunocontraceptive vaccines on ovarian activity in horses. The Journal of Wildlife Management 77:1386-1400.

Bechert, U.S., and M.A. Fraker. 2018. Twenty years of SpayVac research: potential implications for regulating feral horse and burro populations in the United States. Human-Wildlife Interactions 12:117-130.

Berry, K.H., J.L. Yee, and L.M. Lyren. 2020. Feral Burros and Other Influences on Desert Tortoise Presence in the Western Sonoran Desert. Herpetologica 76:403-413.

Boedeker, N.C., L.A.C. Hayek, S. Murray, D.M. De Avila, and J.L. Brown. 2012. Effects of a gonadotropin-releasing hormone vaccine on ovarian cyclicity and uterine morphology of an Asian elephant (Elephas maximus). Journal of Zoo and Wildlife Medicine 43:603-614.

Bohrer, B.M., W.L. Flowers, J.M. Kyle, S.S. Johnson, V.L. King, J.L. Spruill, D.P. Thompson, A.L. Schroeder, and D.D. Boler. 2014. Effect of gonadotropin releasing factor suppression with an immunological on growth performance, estrus activity, carcass characteristics, and meat quality of market gilts. Journal of Animal Science 92:4719-4724.

Botha, A.E., M.L. Schulman, H.J. Bertschinger, A.J. Guthrie, C.H. Annandale, and S.B. Hughes. 2008. The use of a GnRH vaccine to suppress mare ovarian activity in a large group of mares under field conditions. Wildlife Research 35:548-554.

Brown, B.W., P.E. Mattner, P.A.Carroll, E.J. Holland, D.R. Paull, R.M. Hoskinson, and R.D.G. Rigby. 1994. Immunization of sheep against GnRH early in life: effects on reproductive function and hormones in rams. Journal of Reproduction and Fertility 101:15-21.

Bureau of Land Management (BLM). 2010. BLM-4700-1 Wild Horses and Burros Management Handbook. Washington, D.C.

Bureau of Land Management (BLM). 2021. Permanent Instruction Memorandum 2021-002; Comprehensive animal welfare program for wild horse and burro gathers. Washington, D.C.

Carey, K.A., A. Ortiz, K. Grams, D. Elkins, J.W. Turner, and A.T. Rutberg. 2019. Wildlife Research 46:713-718.

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

Curtis, P.D., R.L. Pooler, M.E. Richmond, L.A. Miller, G.F. Mattfeld, and F.W. Quimby. 2008. Physiological Effects of gonadotropin-releasing hormone immunocontraception in white-tailed deer. Human-Wildlife Conflicts 2:68-79.

Cooper, D.W. and C.A. Herbert. 2001. Genetics, biotechnology and population management of over-abundant mammalian wildlife in Australasia. Reproduction, Fertility and Development, 13:451-458.

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

Creel, S., B. Dantzer, W. Goymann, and D.R. Rubenstein. 2013. The ecology of stress: effects of the social environment. Functional Ecology 27:66-80.

Crist, M., et al. 2019. Science Framework for Conservation and Restoration of the Sagebrush Biome: Linking the Department of the Interior Secretarial Order 3336 to Long-Term Strategic Conservation Actions. Part 2. Management applications. Gen. Tech. Rep. RMRS-GTR-389. Fort Collins, CO: U.S Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Curtis, P.D., R.L. Pooler, M.E. Richmond, L.A. Miller, G.F. Mattfeld, and F.W Quimby. 2001. Comparative effects of GnRH and porcine zona pellucida (PZP) immunocontraceptive vaccines for controlling reproduction in white-tailed deer (Odocoileus virginianus). Reproduction (Cambridge, England) Supplement 60:131-141.

Dalmau, A., A. Velarde, P. Rodríguez, C. Pedernera, P. Llonch, E. Fàbrega, N. Casal, E. Mainau, M. Gispert, V. King, and N. Slootmans. 2015. Use of an anti-GnRF vaccine to suppress estrus in crossbred Iberian female pigs. Theriogenology 84:342-347.

Dalin, A.M., Ø. Andresen, and L. Malmgren. 2002. Immunization against GnRH in mature mares: antibody titres, ovarian function, hormonal levels and oestrous behaviour. Journal of Veterinary Medicine Series A 49:125-131.

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

Dong, F., D.C. Skinner, T. John Wu, and J. Ren. 2011. The Heart: A Novel Gonadotrophin-Releasing Hormone Target. Journal of Neuroendocrinology 23:456-463.

Donovan, C.E., T. Hazzard, A. Schmidt, J. LeMieux, F. Hathaway, and M.A. Kutzler. 2013. Effects of a commercial canine gonadotropin releasing hormone vaccine on estrus suppression and estrous behavior in mares. Animal Reproduction Science, 142:42-47.

Duncan, C.L., J.L. King, and P. Stapp. 2017. Effects of prolonged immunocontraception on the breeding behavior of American bison. Journal of Mammalogy 98:1272-1287.

Elhay, M., A. Newbold, A. Britton, P. Turley, K. Dowsett, and J. Walker. 2007. Suppression of behavioural and physiological oestrus in the mare by vaccination against GnRH. Australian Veterinary Journal 85:39-45.

Environmental Protection Agency (EPA). 2009a. Pesticide Fact Sheet: Mammalian Gonadotropin Releasing Hormone (GnRH), New Chemical, Nonfood Use, USEPA-OPP, Pesticides and Toxic Substances. US Environmental Protection Agency, Washington, DC

Environmental Protection Agency (EPA). 2009b. Memorandum on GonaCon ™ Immunocontraceptive Vaccine for Use in White-Tailed Deer. Section 3 Registration. US Environmental Protection Agency, Washington, DC.

Environmental Protection Agency (EPA). 2012. Porcine Zona Pellucida. Pesticide fact Sheet. Office of Chemical Safety and Pollution Prevention 7505P. 9 pages.

Environmental Protection Agency (EPA). 2013. Notice of pesticide registration for GonaCon-Equine. US Environmental Protection Agency, Washington, DC.

Environmental Protection Agency (EPA). 2015. Label and CSF Amendment. November 19, 2015 memo and attachment from Marianne Lewis to David Reinhold. US Environmental Protection Agency, Washington, DC.

Environmental Protection Agency (EPA). 2012. Porcine Zona Pellucida. Pesticide fact Sheet. Office of Chemical Safety and Pollution Prevention 7505P. 9 pages.

Feh, C. 2012. Delayed reversibility of PZP (porcine zona pellucida) in free-ranging Przewalski's horse mares. In International Wild Equid Conference. Vienna, Austria: University of Veterinary Medicine.

Fonner, R. and A.K. Bohara. 2017. Optimal control of wild horse populations with nonlethal methods. Land Economics 93:390-412.

French, H., E. Peterson, R. Ambrosia, H. Bertschinger, M. Schulman, M. Crampton, R. Roth, P. Van Zyl, N. Cameron-Blake, M. Vandenplas, and D. Knobel. 2017. Porcine and recombinant zona pellucida vaccines as immunocontraceptives for donkeys in the Caribbean. Proceedings of the 8th International Wildlife Fertility Control Conference, Washington, D.C.

Garrott, R.A., and M.K. Oli. 2013. A Critical Crossroad for BLM's Wild Horse Program. Science 341:847-848.

Garza, F., D.L. Thompson, D.D. French, J.J. Wiest, R.L. St George, K.B. Ashley, L.S. Jones, P.S. Mitchell, and D.R. McNeill. 1986. Active immunization of intact mares against gonadotropin-releasing hormone: differential effects on secretion of luteinizing hormone and follicle-stimulating hormone. Biology of Reproduction 35:347-352.

Gionfriddo, J.P., A.J. Denicola, L.A. Miller, and K.A. Fagerstone. 2011a. Efficacy of GnRH immunocontraception of wild white-tailed deer in New Jersey. Wildlife Society Bulletin 35:142-148.

Gionfriddo, J.P., A.J. Denicola, L.A. Miller, and K.A. Fagerstone. 2011b. Health effects of GnRH immunocontraception of wild white-tailed deer in New Jersey. Wildlife Society Bulletin 35:149-160.

Goodloe, R.B., 1991. Immunocontraception, genetic management, and demography of feral horses on four eastern US barrier islands. UMI Dissertation Services.

Gray, ME. 2009a. The influence of reproduction and fertility manipulation on the social behavior of feral horses (Equus caballus). Dissertation. University of Nevada, Reno.

Gray, M.E. 2009b. An infanticide attempt by a free-roaming feral stallion (Equus caballus). Biology Letters 5:23-25.

Gray, M.E., D.S. Thain, E.Z. Cameron, and L.A. Miller. 2010. Multi-year fertility reduction in free-roaming feral horses with single-injection immunocontraceptive formulations. Wildlife Research 37:475-481.

Gray, M.E. and E.Z. Cameron. 2010. Does contraceptive treatment in wildlife result in side effects? A review of quantitative and anecdotal evidence. Reproduction 139:45-55.

Griffin, P.C., L.S. Ekernas, K.A. Schoenecker, and B.C. Lubow. 2020. Standard operating procedures for wild horse and burro double-observer aerial surveys. U.S. Geological Survey Techniques and Methods, book 2, chap. A16, 76 p.

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

Gupta, S., and V. Minhas. 2017. Wildlife population management: are contraceptive vaccines a feasible proposition? Frontiers in Bioscience, Scholar 9:357-374.

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

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

Hampton, J.O., T.H. Hyndman, A. Barnes, and T. Collins. 2015. Is wildlife fertility control always humane? Animals 5:1047-1071.

Heilmann, T.J., R.A. Garrott, L.L. Cadwell, and B.L. Tiller, 1998. Behavioral response of free-ranging elk treated with an immunocontraceptive vaccine. Journal of Wildlife Management 62: 243-250.

Herbert, C.A. and T.E. Trigg. 2005. Applications of GnRH in the control and management of fertility in female animals. Animal Reproduction Science, 88:141-153.

Hobbs, N.T., D.C. Bowden and D.L. Baker. 2000. Effects of Fertility Control on Populations of Ungulates: General, Stage-Structured Models. Journal of Wildlife Management 64:473-491.

Hsueh, A.J.W. and G.F. Erickson. 1979. Extrapituitary action of gonadotropin-releasing hormone: direct inhibition ovarian steroidogenesis. Science 204:854-855.

Imboden, I., F. Janett, D. Burger, M.A. Crowe, M. Hässig, and R. Thun. 2006. Influence of immunization against GnRH on reproductive cyclicity and estrous behavior in the mare. Theriogenology 66:1866-1875.

Janett, F., U. Lanker, H. Jörg, E. Meijerink, and R. Thun. 2009a. Suppression of reproductive cyclicity by active immunization against GnRH in the adult ewe. Schweizer Archiv fur Tierheilkunde 151:53-59.

Janett, F., R. Stump, D. Burger, and R. Thun. 2009b. Suppression of testicular function and sexual behavior by vaccination against GnRH (Equity™) in the adult stallion. Animal Reproduction Science 115:88-102.

Jones, M.M., and C.M.V. Nunez. 2019. Decreased female fidelity alters male behavior in a feral horse population managed with immunocontraception. Applied Animal Behaviour Science 214:34-41.

Jones, M.M., L. Proops, and C.M.V. Nunez. 2020. Rising up to the challenge of their rivals: mare infidelity intensifies stallion response to playback of aggressive conspecific vocalizations. Applied Animal Behaviour Science (in press): 104949.

Joonè, C.J., H.J. Bertschinger, S.K. Gupta, G.T. Fosgate, A.P. Arukha, V. Minhas, E. Dieterman, and M.L. Schulman. 2017a. Ovarian function and pregnancy outcome in pony mares following immunocontraception with native and recombinant porcine zona pellucida vaccines. Equine Veterinary Journal 49:189-195.

Joonè, C.J., H. French, D. Knobel, H.J. Bertschinger, and M.L. Schulman. 2017b. Ovarian suppression following PZP vaccination in pony mares and donkey jennies. Proceedings of the 8th International Wildlife Fertility Control Conference, Washington, D.C.

Joonè, C.J., M.L. Schulman, G.T. Fosgate, A.N. Claes, S.K. Gupta, A.E. Botha, A-M Human, and H.J. Bertschinger. 2017c. Serum anti-Müllerian hormone dynamics in mares following immunocontraception with anti-zona pellucida or -GnRH vaccines, Theriogenology (2017), doi: 10.1016/

Joonè, C.J., M.L. Schulman, and H.J. Bertschinger. 2017d. Ovarian dysfunction associated with zona pellucida-based immunocontraceptive vaccines. Theriogenology 89:329-337.

Kane, A.J. 2018. A review of contemporary contraceptives and sterilization techniques for feral horses. Human-Wildlife Interactions 12:111-116.

Kaur, K. and V. Prabha. 2014. Immunocontraceptives: new approaches to fertility control. BioMed Research International v. 2014, ArticleID 868196, 15 pp. http:/dx.doi.org/10.1155/2014/868196

Kean, R.P., A. Cahaner, A.E. Freeman, and S.J. Lamont. 1994. Direct and correlated responses to multitrait, divergent selection for immunocompetence. Poultry Science 73:18-32.

Killian, G., N.K. Diehl, L. Miller, J. Rhyan, and D. Thain. 2006. Long-term efficacy of three contraceptive approaches for population control of wild horses. In Proceedings-Vertebrate Pest Conference.

Killian, G., D. Thain, N.K. Diehl, J. Rhyan, and L. Miller. 2008. Four-year contraception rates of mares treated with single-injection porcine zona pellucida and GnRH vaccines and intrauterine devices. Wildlife Research 35:531-539.

Killian, G., T.J. Kreeger, J. Rhyan, K. Fagerstone, and L. Miller. 2009. Observations on the use of GonaConTM in captive female elk (Cervus elaphus). Journal of Wildlife Diseases 45:184-188.

Kirkpatrick, J.F. and J.W. Turner. 1991. Compensatory reproduction in feral horses. Journal of Wildlife Management 55:649-652.

Kirkpatrick, J.F., I.M.K. Liu, J.W. Turner, R. Naugle, and R. Keiper. 1992. Long-term effects of porcine zonae pellucidae immunocontraception on ovarian function in feral horses (Equus caballus). Journal of Reproduction and Fertility 94:437-444.

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

Kirkpatrick, J.F. and A. Turner. 2003. Absence of effects from immunocontraception on seasonal birth patterns and foal survival among barrier island wild horses. Journal of Applied Animal Welfare Science 6:301-308.

Kirkpatrick, J.F., A.T. Rutberg, and L. Coates-Markle. 2010. Immunocontraceptive reproductive control utilizing porcine zona pellucida (PZP) in federal wild horse populations, 3rd edition. P.M. Fazio, editor. Downloaded from http://www.einsten.net/pdf/110242569.pdf

Kirkpatrick, J.F., R.O. Lyda, and K. M. Frank. 2011. Contraceptive vaccines for wildlife: a review. American Journal of Reproductive Immunology 66:40-50.

Kirkpatrick, J.F., A.T. Rutberg, L. Coates-Markle, and P.M. Fazio. 2012. Immunocontraceptive Reproductive Control Utilizing Porcine Zona Pellucida (PZP) in Federal Wild Horse Populations. Science and Conservation Center, Billings, Montana.

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

Levy, J.K., J.A. Friary, L.A. Miller, S.J. Tucker, and K.A. Fagerstone. 2011. Long-term fertility control in female cats with GonaCon™, a GnRH immunocontraceptive. Theriogenology 76:1517-1525.

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

Lubow, B. 2020. Statistical analysis for 2019 surveys of wild burro abundance in the Lake Mead Complex, NV. Report to the BLM.

Lundgren, E.J., D. Ramp, WJ. Ripple, and A.D. Wallach. Introduced megafauna are rewilding the Anthropocene. Ecography 41:857-866.

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

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

Mask, T.A., K.A. Schoenecker, A.J. Kane, J.I.Ransom, and J.E. Bruemmer. 2015. Serum antibody immunoreactivity to equine zona protein after SpayVac vaccination. Theriogenology, 84:261-267.

Miller, L.A., J.P. Gionfriddo, K.A. Fagerstone, J.C. Rhyan, and G.J. Killian. 2008. The Single-Shot GnRH Immunocontraceptive Vaccine (GonaCon™) in White-Tailed Deer: Comparison of Several GnRH Preparations. American Journal of Reproductive Immunology 60:214-223.

Miller, L.A., K.A. Fagerstone, and D.C. Eckery. 2013. Twenty years of immunocontraceptive research: lessons learned. Journal of Zoo and Wildlife Medicine 44:S84-S96.

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

National Park Service (NPS). 2008. Environmental Assessment of Alternatives for Managing the Feral Horses of Assateague Island National Seashore. NPS Assateague Island National Seashore.

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

Nettles, V. F. 1997. Potential consequences and problems with wildlife contraceptives. Reproduction, Fertility and Development 9, 137–143.

Nolan, M.B., H.J. Bertschinger, and M.L. Schulman. 2018a. Antibody response and safety of a novel recombinant Zona Pellucida vaccine formulation in mares. Journal of Equine Veterinary Science 66:97.

Nolan, M.B., H.J. Bertschinger, M. Crampton, and M.L. Schulman. 2018b. Serum anti-Müllerian hormone following Zona Pellucida immunocontraceptive vaccination of mares. Journal of Equine Veterinary Science 66:105.

Nolan, M.B., H.J. Bertschinger, R.Roth, M. Crampton, I.S. Martins, G.T. Fosgate, T.A. Stout, and M.L. Schulman. 2018c. Ovarian function following immunocontraceptive vaccination of mares using native porcine and recombinant zona pellucida vaccines formulated with a non-Freund's adjuvant and anti-GnRH vaccines. Theriogenology 120:111-116.

Nuñez, C.M.V., J.S. Adelman, C. Mason, and D.I. Rubenstein. 2009. Immunocontraception decreases group fidelity in a feral horse population during the non-breeding season. Applied Animal Behaviour Science 117:74-83.

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

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

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

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

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

Powell, D.M. and S.L. Monfort. 2001. Assessment: effects of porcine zona pellucida immunocontraception on estrous cyclicity in feral horses. Journal of Applied Animal Welfare Science 4:271-284.

Powers, J.G., D.L. Baker, T.L. Davis, M.M. Conner, A.H. Lothridge, and T.M. Nett. 2011. Effects of gonadotropin-releasing hormone immunization on reproductive function and behavior in captive female Rocky Mountain elk (Cervus elaphus nelsoni). Biology of Reproduction 85:1152-1160.

Powers, J.G., D.L. Baker, M.G. Ackerman, J.E. Bruemmer, T.R. Spraker, M.M. Conner, and T.M. Nett. 2012. Passive transfer of maternal GnRH antibodies does not affect reproductive development in elk (Cervus elaphus nelson) calves. Theriogenology 78:830-841.

Powers, J.G., D.L. Baker, R.J. Monello, T.J. Spraker, T.M. Nett, J.P. Gionfriddo, and M.A. Wild. 2013. Effects of gonadotropin-releasing hormone immunization on reproductive function and behavior in captive female Rocky Mountain elk (Cervus elaphus nelsoni). Journal of Zoo and Wildlife Medicine meeting abstracts S147.

Ransom, J.I. and B.S. Cade. 2009. Quantifying equid behavior: A research ethogram for free-roaming feral horses. U.S. Geological Survey Techniques and Methods Report 2-A9.

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

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

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

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

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

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

Roelle, J.E., and J.I. Ransom. 2009. Injection-site reactions in wild horses (Equus caballus) receiving an immunocontraceptive vaccine: U.S. Geological Survey Scientific Investigations Report 2009–5038.

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

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

Roelle, J.E., S.S. Germaine, A.J. Kane, and B.S. Cade. 2017. Efficacy of SpayVac ® as a contraceptive in feral horses. Wildlife Society Bulletin 41:107-115.

Rubenstein, D.I. 1981. Behavioural ecology of island feral horses. Equine Veterinary Journal 13:27-34.

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

Scasta, J.D. 2020. Mortality and operational attributes relative to feral horse and burro capture techniques based on publicly available data from 2010-2019. Journal of Equine Veterinary Science, 102893.

Sacco, A.G., M.G. Subramanian, and E.C. Yurewicz. 1981. Passage of zona antibodies via placenta and milk following active immunization of female mice with porcine zonae pellucidae. Journal of Reproductive Immunology 3:313-322.

Sarker, N., M. Tsudzuki, M. Nishibori, and Y. Yamamoto. 1999. Direct and correlated response to divergent selection for serum immunoglobulin M and G levels in chickens. Poultry Science 78:1-7.

Schaut, R.G., M.T. Brewer, J.M. Hostetter, K. Mendoza, J.E. Vela-Ramirez, S.M. Kelly, J.K. Jackman, G. Dell'Anna, J.M. Howard, B. Narasimhan, and W. Zhou. 2018. A single dose polyanhydride-based vaccine platform promotes and maintains anti-GnRH antibody titers. Vaccine 36:1016-1023.

Schulman, M.L., A.E. Botha, S.B. Muenscher, C.H. Annandale, A.J. Guthrie, and H.J. Bertschinger. 2013. Reversibility of the effects of GnRH-vaccination used to suppress reproductive function in mares. Equine Veterinary Journal 45:111-113.

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

Shumake, S.A. and G. Killian. 1997. White-tailed deer activity, contraception, and estrous cycling. Great Plains Wildlife Damage Control Workshop Proceedings, Paper 376.

Skinner, S.M., Mills, T., Kirchick, H.J. and Dunbar, B.S., 1984. Immunization with Zona Pellucida Proteins Results in Abnormal Ovarian Follicular Differentiation and Inhibition of Gonadotropin-induced Steroid Secretion. Endocrinology, 115:2418-2432.

Stout, T.A.E., J.A. Turkstra, R.H. Meloen, and B. Colenbrander. 2003. The efficacy of GnRH vaccines in controlling reproductive function in horses. Abstract of presentation from symposium, "Managing African elephants: act or let die? Utrecht University, Utrecht, Netherlands.

Turner, J.W., I.K.M. Liu, and J.F. Kirkpatrick. 1996. Remotely delivered immunocontraception in free-roaming feral burros (Equus asinus). Journal of Reproduction and Fertility 107:31-35.

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

Turner, J.W., I.K. Liu, D.R. Flanagan, K.S. Bynum, and A.T. Rutberg. 2002. Porcine zona pellucida (PZP) immunocontraception of wild horses (Equus caballus) in Nevada: a 10 year study. Reproduction Supplement 60:177-186.

Turner, J.W., and J.F. Kirkpatrick. 2002. Effects of immunocontraception on population, longevity and body condition in wild mares (Equus caballus). Reproduction (Cambridge, England) Supplement, 60, pp.187-195.

Turner, J.W., I.K. Liu, D.R. Flanagan, A.T. Rutberg, and J.F. Kirkpatrick. 2007. Immunocontraception in wild horses: one inoculation provides two years of infertility. Journal of Wildlife Management 71:662-667.

Turner, J.W, A.T. Rutberg, R.E. Naugle, M.A. Kaur, D.R.Flanagan, H.J. Bertschinger, and I.K.M. Liu. 2008. Controlled-release components of PZP contraceptive vaccine extend duration of infertility. Wildlife Research 35:555-562.

US Fish and Wildlife Service (USFWS). 2015. Endangered and Threatened Wildlife and Plants; 90-day findings on 31 petitions. Federal Register 80 (126):37568-37579.

Wang-Cahill, F., J. Warren, T. Hall, J. O'Hare, A. Lemay, E. Ruell, and R. Wimberly. In press. Use of GonaCon in wildlife management. Chapter 24 in USDA-APHIS, Human health and ecological risk assessment for the use of wildlife damage management methods by APHIS-Wildlife Services. USDA APHIS, Fort Collins, Colorado.

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

Yao, Z., W. Si, W. Tian, J. Ye, R. Zhu, X. Li, S. Ki, Q. Zheng, Y. Liu, and F. Fang. 2018. Effect of active immunization using a novel GnRH vaccine on reproductive function in rats. Theriogenology 111:1-8. https://doi.org/10.1016/j.theriogenology.2018.01.013

Zoo Montana. 2000. Wildlife Fertility Control: Fact and Fancy. Zoo Montana Science and Conservation Biology Program, Billings, Montana.