U.S. Department of the Interior
Bureau of Land Management

Pancake Complex Wild Horse Gather & Herd Management Plan

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Preliminary Environmental Assessment
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1.0 Introduction

This Environmental Assessment (EA) has been prepared to disclose and analyze the environmental effects of the Proposed Action and alternatives, which consist of establishing a Herd Management Area Plan (HMAP) (Appendix XIII) and gathering and removing excess wild horses from within and outside the Pancake and Sand Springs West Wild Horse Herd Management Areas (HMAs), and Jakes Wash Herd Area (HA), referred to as the Pancake Complex. The gather and removal of excess wild horses from the U.S. Forest Service's (USFS) Monte Cristo Wild Horse Territory (WHT) is also included in the Proposed Action and if approved, will be authorized under a separate USFS decision associated with this EA. The Monte Cristo WHT is managed in accordance with an Interagency Agreement between the BLM and the USFS and is included for informational purposes and cumulative impact analysis. Refer to Map 1, Appendix I which displays the HMAs and WHT included within the Complex.

The BLM proposes to immediately gather and remove excess wild horses in accordance with the Wild Free-Roaming Horses and Burros Act (WFRHBA) in an initial gather (and a follow-up gather or gathers if necessary) in order to achieve and maintain Appropriate Management Levels (AMLs), and to continue fertility control management. This EA will assist the Bureau of Land Management (BLM) Bristlecone and Tonopah Field Offices (FOs) in project planning, ensure compliance with the National Environmental Policy Act (NEPA)[1], and make a determination as to whether any significant effects could result from the analyzed actions. Following the requirements of NEPA (40 CFR 1501.5), this EA describes the potential impacts of a No Action Alternative and the Proposed Action for the Pancake Complex. If the BLM determines that the Proposed Action for the Complex is not expected to have significant impacts a Finding of No Significant Impact (FONSI) would be issued and a Decision Record would be prepared. If significant effects are anticipated, the BLM would prepare an Environmental Impact Statement.

This document is tiered to or conforms to the following documents:

- Ely Proposed Resource Management Plan and Final Environmental Impact Statement (2007 PRMP/FEIS)
- Ely District Record of Decision and Approved Resource Management Plan, as amended (2008 Ely RMP)
- The Tonopah Resource Management Plan dated October 1997 (Tonopah RMP)
- Humboldt National Forest Land and Resource Management Plan (LRMP) dated August 1986.

1.1 Background

The Pancake Complex is located approximately 30 miles southwest of Ely, Nevada, and 10 miles southeast of Eureka, Nevada, and 80 miles northwest of Tonopah, Nevada within White Pine and Nye Counties (Map 1 Appendix I) and lies within the Ely and Battle Mountain BLM Districts as well as the USFS Humboldt-Toiyabe National Forest. Table 1, below, displays the total acreage and established AML for each of the HMAs and WHT.

The 2008 Ely RMP combined two existing HMAs (Monte Cristo and Sand Springs East HMAs) into the Pancake HMA. The decision to combine all or portions of the two HMAs was due to the historical interchange of wild horses between the two HMAs and was also based on an in-depth analysis of habitat suitability and monitoring data as set forth in the 2007 PRMP/FEIS, which evaluated each HMA for five essential habitat components and herd characteristics: forage, water, cover, space, and reproductive viability. Through this analysis and the subsequent 2008 Ely RMP, the boundaries of the Pancake HMA

[1] BLM is using the NEPA regulations in effect as of July 1, 2024.

were established to ensure sufficient habitat for wild horses, and an AML was reviewed and set at a number range that would achieve a thriving natural ecological balance and rangeland health. The 2008 Ely RMP also returned the Jakes Wash HMA to HA status consistent with management action WH-5, which stated: "*Remove wild horses and drop herd management area status for those … as listed in Table 13.*" Removal of all excess wild horses from the Jakes Wash HA is needed at this time to implement the management direction from the 2008 Ely RMP and to prevent damage to the range resulting from the current overpopulation while achieving and maintaining a multiple-use relationship within the area.

The proposed wild horse gather of the Pancake Complex would be conducted in coordination and in conjunction with the Tonopah Field Office and Humboldt-Toiyabe National Forest, due to historic movement and continuing interchange of wild horses between the Pancake HMA (approximately 824,000 acres of public land), Sand Springs West HMA (approximately 157,436 acres of private/public land), Jakes Wash HA (approximately 153,663 acres of private/public land), and Monte Cristo WHT (approximately 93,640 acres of private/public land).

Since the passage of the WFRHBA, management knowledge regarding wild horse population levels has increased. For example, it has been determined that wild horses are capable of increasing their numbers by 15% to 25% annually, resulting in the doubling of wild horse populations about every 4 years (NRC 2013). This has resulted in the BLM shifting program emphasis beyond just establishing AML and conducting wild horse gathers to include a variety of management actions that further facilitate the achievement and maintenance of viable and stable wild horse populations and a thriving natural ecological balance. Management actions resulting from shifting program emphasis include increasing fertility control, adjusting sex ratio, and collecting genetic diversity baseline data to support genetic diversity assessments.

The AML is defined as the number of wild horses that can be sustained within a designated HMA which achieves and maintains a thriving natural ecological balance[2] in keeping with the multiple-use management concept for the area. The Pancake Complex currently has a cumulative AML range of 361-638 wild horses which has been established through land use plans, Final Multiple Use Decisions, and a Wild Horse Territory Management Plan. This population range was established at a level that would maintain healthy wild horses and rangelands over the long-term based on monitoring data collected over time as well as an in-depth analysis of habitat suitability.

The range of AML for the Pancake HMA is 240-493 wild horses and was established through prior decision-making processes then affirmed through the 2008 Ely RMP.

Under the 2008 Ely RMP, no wild horses are to be managed within the Jakes Wash HA based on analysis of habitat suitability and monitoring data; which indicates insufficient forage, water, space, cover, and reproductive viability to maintain healthy wild horses and rangelands over the long-term.

The Sand Springs West AML of 49 wild horses was established through a stipulated agreement (Consent Decision) between BLM, E. Wayne Hage, Colvin and Son Cattle Co., and Russell Ranches through the Department of the Interior Office of Hearings and Appeals, Hearings Division, and subsequently

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[2] 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 v. Clark, supra* at 594, the 'benchmark test' for determining the suitable number of wild horses on the public range is 'thriving 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 between WH&B populations, wildlife, livestock and vegetation, and to protect the range from the deterioration associated with overpopulation of wild horses and burros.'" *Animal Protection Institute of America v. BLM,* 109 IBLA 112, 115 (1989)).

confirmed in the Tonopah RMP. The Tonopah RMP stated that adjustments to AML would be based on monitoring and grazing allotment evaluations. At present, existing and historical monitoring data do not indicate that an increase or decrease of the existing AML is warranted. However, achieving and maintaining AML is critical for the conservation of rangeland resources and healthy wild horses. The wild horses from Sand Springs West HMA travel back and forth across the Pancake HMA boundary lines, mixing with the wild horses from the Pancake HMA. The population within these HMAs can fluctuate depending on the seasonal movement of these wild horses.

The Monte Cristo Wild & Free Roaming Horses Management Plan established a baseline AML of 72–120 wild horses, with an average of 96 head to be maintained. These numbers were based on proper use studies conducted on the natural horse concentration areas. The baseline AML was adjusted to 72–96 through the Humboldt National Forest Land & Resource Management Plan in 1986. Range conditions had not improved with the number of horses occupying the area. The population within this WHT can fluctuate depending on the seasonal movement of the wild horses.

Table 1. Herd Management Area, Acres, AML, and Estimated Population

Herd Management Area	Total Acres Private/Public land	Appropriate Management Level	2024 population estimate including net growth from foaling in 2023 and 2024
Pancake	824,000	240-493	1,092
Sand Springs West	157,436	49	156
Jakes Wash	153,663	0	102
Monte Cristo WHT	93,640	72-96	145
Total	**1,228,739**	**361-638**	**1,495**

The BLM conducted a population census flight in February 2023 to help confirm wild horse numbers within the Pancake Complex. Due to weather conditions during the flight, the wild horses that were observed had moved from higher elevations off the Monte Cristo Wild Horse Territory and into the Pancake HMA and Jakes Wash HA. A map of the recent flight survey can be found in Appendix XI. Based on past foaling rates and monitoring, the BLM assumes that foaling rates are approximately 20% per year.

Based upon all information available at this time, including the 2023 population census flight, the BLM has determined that there are at least 1,134 excess wild horses above the low end of AML exist within the Pancake Complex. All excess wild horses need to be removed in order to achieve the established AML, restore a thriving natural ecological balance (TNEB), and prevent degradation of rangeland resources. This assessment is based on factors including, but not limited to the following rationale:

- Pancake Complex estimated populations exceed the established AML range for the project area (Table 1).
- Excess wild horses are establishing populations outside of identified HMA and HA boundaries.
- Moderate, heavy, and severe utilization is evident on key forage species within Complex.
- Wild horses are contributing to not meeting Rangeland Health Standards throughout most of the Pancake HMA and in some cases are the sole contributor (See Appendix VII).
- Use by wild horses has caused damage to the water development at Young Florio Spring, Moody Spring, and has caused water source damage at Marilitti Spring.
- The BLM was required to conduct an emergency water trap gather in 2016 and 2018 due to a lack of water. The BLM gathered and removed 382 wild horses from the Pancake HMA.
- The BLM was required to conduct an emergency water trap gather in August 2020 in the Jakes Wash HA due to a lack of water. BLM gathered and removed 68 horses at that time.
- In 2022, the BLM conducted a gather and removed 2,030 excess wild horses. However, was unable to gather enough excess wild horses to reach low-end of AML for the Complex.

- Monitoring and historical information indicate that future emergency removals would likely be necessary due to lack of water and/or forage if gathers are not conducted to reduce the wild horse population to AML.

1.2 Purpose and Need
The BLM's purpose is to adopt and implement a Herd Management Area Plan (HMAP) consistent with the authority provided in 43 Code of Federal regulations 4700, restore and maintain Thriving Natural Ecological Balance (TNEB) by maintaining wild horse populations within the established AML ranges for the HMAs, and to reduce wild horse population growth rates to extend the time between gather events.

The BLM's need is to prevent undue or unnecessary degradation of the public lands associated with excess wild horses, and to restore a thriving natural ecological balance and multiple-use relationship on public lands, consistent with FLPMA and the WFRHBA.

1.3 Land Use Plan Conformance and Consistency with Other Authorities
The Proposed Action (Alternative A) and Alternatives B, C, and D are in conformance with the 2008 Ely District RMP.

- **Goal:** "Maintain and manage healthy, self-sustaining wild horse herds inside herd management areas within appropriate management levels to ensure a thriving natural ecological balance while preserving a multiple-use relationship with other uses and resources."
- **Objective:** "To maintain wild horse herds at appropriate management levels within herd management areas where sufficient habitat resources exist to sustain healthy populations at those levels."

The Proposed Action, (Alternative A) and Alternatives B, and C are in conformance with the Tonopah RMP and subsequent Record of Decision dated October 1997.

- **Objective**: "To manage wild horse and/or burro populations within Herd Management Areas at levels which will preserve and maintain a thriving natural ecological balance consistent with other multiple-use objectives."

The Proposed Action (Alternative A) and Alternatives B, C, and D are in conformance with the Humboldt National Forest Land and Resource Management Plan (LRMP) and subsequent Record of Decision dated August 1986.

- **Goal # 20**: "Manage the Cherry Springs, Monte Cristo, and Quinn Wild Horse Territories in accordance with the Wild Horse and Burro Act and the approved territory plans."
- **Standards and Guidelines:** "Manage wild free-roaming horses and burros to population levels compatible with the resource capabilities and needs."

The Proposed Action (Alternative A) and Alternatives B and C are in conformance with the Nevada and Northeastern California Greater Sage-grouse Approved Resource Management Plan Amendment dated September 2015.

- **Management Decision (MD) WHB 2**: "Manage herd management areas (HMAs) in GRSG habitat within established AML ranges to achieve and maintain GRSG habitat objectives (Table 2-2)."
- **MD WHB 7**: Develop or amend herd management area plans (HMAPs) to incorporate GRSG habitat objectives (Table 2-2) and management considerations for all HMAs within GRSG habitat, with emphasis placed on SFA and PHMAs outside of SFA."

1.4 Relationship to Statutes, Regulations, or other Plans
The Federal Land Policy and Management Act of 1976 (FLPMA) requires that an action under consideration be in conformance with the applicable BLM land use plan(s), and be consistent with other federal, state, and local laws and policies to the maximum extent possible.

The Proposed Action is also consistent with the WFRHBA, which mandates the Bureau to "*prevent the range from deterioration associated with overpopulation*", and "*remove excess horses in order to preserve and maintain a thriving natural ecological balance and multiple use relationships in that area".*

The WFRHBA at section 1333 (b)(1) states: "*The purpose of such inventory shall be to: make determinations as to whether and where an overpopulation exists and whether action should be taken to remove excess animals; determine appropriate management levels or wild free-roaming horses and burros on these areas of public land; and determine whether appropriate managements should be achieved by the removal or destruction of excess animals, or other options (such as sterilization, or natural control on population levels)*."

The Proposed Action is consistent with all applicable regulations at 43 CFR Part 4700:

- 43 CFR 4700.0-6 (a) 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).

- 43 CFR 4710.4 Management of wild horses and burros shall be undertaken with the objective of limiting the animals' distribution to herd areas. Management shall be at the minimum level necessary to attain the objectives identified in approved land use plans and herd management area plans.

- 43 CFR 4720.1 Upon examination of current information and a determination by the authorized officer that an excess of wild horses or burros exists, the authorized officer shall remove the excess animals immediately….

- 43 CFR 4720.2 Upon written request from a private landowner……the Authorized Officer shall remove stray wild horses and burros from private lands as soon as practicable.

- 43 CFR 4740.1 (a) Motor vehicles and aircraft may be used by the authorized officer in all phases of the administration of the Act, except that no motor vehicle or aircraft, other than helicopters, shall be used for the purpose of herding or chasing wild horses or burros for capture or destruction. All such use shall be conducted in a humane manner. (b) Before using helicopters or motor vehicles in the management of wild horses or burros, the authorized officer shall conduct a public hearing in the area where such use is to be made.

The Proposed Action is consistent with all applicable regulations at 36 CFR Part 222:

- 36 CFR 222.60 (a) Authority. The Chief, Forest Service, shall protect, manage, and control wild free-roaming horses and burros on lands of the National Forest System and shall maintain vigilance for the welfare of wild free-roaming horses and burros that wander or migrate from the National Forest System. If these animals also use lands administered by the Bureau of Land Management as a part of their habitat, the Chief, Forest Service, shall cooperate to the fullest extent with the Department of the Interior through the Bureau of Land Management in administering the animals.

- 36 CFR 222.61 (a) (1) Administer wild free-roaming horses and burros and their progeny on the

National Forest System in the areas where they now occur (wild horse and burro territory) to maintain a thriving ecological balance considering them an integral component of the multiple use resources, and regulating their population and accompanying need for forage and habitat in correlation with uses recognized under the Multiple-Use Sustained Yield Act of 1960 (70 Stat. 215; 16 U.S.C. 528-531)

- 36 CFR 222.64 (a) Prior to using helicopters in capture operations and/or using motor vehicles for the purpose of transporting captured animals, a public meeting will be held in the proximity of the territory where the capture operation is proposed. (b) Helicopters may be used in all phases of the administration of the Act including, but not limited to, inventory, observation, surveillance, and capture operations... (c) Fixed-wing aircraft may be used for inventory, observation, and surveillance purposes necessary in administering the Act… (d) Motor vehicles may be used in the administration of the Act except that such vehicles shall not be used for driving or chasing wild horses or burros in capture operations. Motor vehicles may also be used for the purpose of transporting captured animals…

- 36 CFR 222.66 Owners of land upon which wild free-roaming horses and burros have strayed from the National Forest System may request their removal by calling the nearest office of either the Forest Service or Federal Marshall.

- 36 CFR 222.69 (a) The Chief, Forest Service, shall, when he determines over-population of wild horses and burros exists and removal is required, take immediate necessary action to remove excess animals from that particular territory. Such action shall be taken until all excess animals have been removed so as to restore a thriving natural ecological balance to the range and protect the range from deterioration associated with over-population.

The Interior Board of Land Appeals (IBLA) in *Animal Protection Institute et al.*, 118 IBLA 63, 75 (1991) found that under the WFRHBA, the BLM is not required to wait until the range has sustained resource damage to reduce the size of the herd, instead proper range management dictates removal of excess animals before range conditions deteriorate in order to preserve and maintain a thriving natural ecological balance and multiple-use relationship in that area.

2.0 Description of Alternatives, Including Proposed Action

2.1 Introduction

This chapter of the EA describes the Proposed Action and Alternatives, including any that were considered but eliminated from detailed analysis. Alternatives analyzed in detail include the following:

- **No Action Alternative.** Under the No Action Alternative, continue existing management, a gather to remove excess wild horses would not occur. There would be no active management to control population growth rates, the size of the wild horse population or to bring the wild horse population to AML. A Herd Management Area Plan would not be implemented for the Pancake Complex.

- **Proposed Action (Alternative A).**

    - Implement HMAP with a management strategy which would include several population growth suppression methods.
    - Establish an AML range for Sand Springs West HMA of 28-49 wild horses.
    - Immediately gather and remove excess animals in order to reach low AML as expeditiously as possible through an initial gather, and if necessary, a follow-up gather or gathers, in order to achieve and maintain the population within AML range. Follow-up gathers to remove excess animals to achieve low AML shall be conducted as promptly as appropriate to allow sufficient time for the animals to settle after a helicopter gather and to provide for a safe, efficient, and effective follow-up gather operation. [3]
    - Apply fertility control methods (vaccines and/or intrauterine devices) to released mares.
    - Maintain a sex ratio adjustment of 60% male and 40% female.

- **Alternative B.** Alternative B is the same as Alternative A, but would release a small non-reproducing component of males (up to 138 geldings) that brings the population to mid-AML.

- **Alternative C.** Under Alternative C, Implement HMAP with management strategy, gather and remove excess animals to within the AML range without fertility control, sex ratio adjustments, or geldings.

- **Alternative D.** The BLM would capture 100% of the current population of excess wild horses from within and outside the Jakes Wash Herd Area, in an immediate gather and, if necessary, follow-up gather or gathers to capture animals missed or that evade capture during a prior gather. No wild horses gathered from the Jakes Wash HA would be released under this alternative. All of the animals gathered from the HA would be removed and transported to BLM off-range corrals where they would be prepared for adoption and/or sale to qualified individuals, or for off-range pastures.

2.2 Herd Management Area Plan

The HMAP is a plan for the management of wild horses within the Pancake Complex. The potential HMAPs are described in more detail in Appendix XIII, including management, monitoring, and implementation objectives. Potential future actions listed in the objectives of the HMAP would be reviewed prior to implementation to determine if additional NEPA documentation is required.

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[3] While the BLM's plan would be to immediately remove all excess animals above low AML and include enough mare fertility control treatments to slow population growth, it is possible that a single gather would not achieve this because of limitations such as on gather efficiency, logistics, space capacity for holding removed animals, or contractor availability. The result would be a need to conduct a follow-up gather or gathers to achieve low AML.

Table 2. Summary Comparison of the Impacts of Alternatives

Item	No Action	Alternative A (Proposed Action)	Alternative B	Alternative C
Population Management	AML for the Complex would remain at 361-638	Sand Springs West AML would be adjusted to reflect a range of 28-49 wild horses. This would allow the herd to grow over a four-year period at an average rate of 20% per year to reach high range of the AML without need for additional gathers to remove excess wild horses in the interim unless population growth suppression methods are utilized within the complex. The Complex would have an AML range of 336-638 wild horses. Excess wild horses would be removed to the low range of AML upon determination that excess animals are present. Once High-end of AML is reached follow-up gathers would occur to remove excess wild horses back down to low end of AML.	Same as Alternative A. Would include a portion of the population to be managed as geldings	Sand Springs West AML would not be adjusted to reflect an AML range. No population growth suppression methods would be utilized. Complex would be gathered once Wild Horses exceed High end of AML and an excess determination has been made.
Future Adjustments to AML	AML would be evaluated, as needed, following an in-depth analysis of resource conditions including actual use, utilization, available forage and water, range conditions, trend, and precipitation.			
Population Control Methods	Future gathers to remove excess wild horses would be implemented under all alternatives as outlined below.			
	Continue existing management, a gather to remove excess wild horses would not occur. There would be no active management to control population growth rates, the size of the wild horse population or to bring the wild horse population to AML	Additional population growth suppression methods would be utilized, adjusting sex ration in favor of males, implementing fertility control methods.	Same as Alternative A. Include managing a portion of the Complex as non-breeding population of geldings.	No population growth suppression would be utilized but area would be gathered once High-end of AML is reached and excess animals would be removed to achieve low-end of AML.

Item	No Action	Alternative A (Proposed Action)	Alternative B	Alternative C
Size of non-breeding population	No Geldings	No Geldings	138 wild horses would be managed as geldings	No Geldings
Desired Sex Ratio (immediately following gathers)	50/50 Male/Female	60/40 Male/Female	Same as Alternative A	No sex Ratio Adjustments
Total # Wild Horses Remain following Gathers	N/A	336 (low range AML)	336 (low Range AML)	361 (Low Range AML)
Selective Removal Criteria	No correction for potential future genetic loss would be implemented under this alternative.	Selective Removals would only be implemented once the HMA/WHT or Complex is within Appropriate Management Levels. Selection would be focused on returning animals with good conformation or size. See Appendix XIII.		Gate Cut Removal only (All horses capture would be removed to achieve low AML)
Genetic Diversity	The objective under all alternatives is to maintain genetic diversity within the herd (avoid inbreeding depression, i.e. maintain H at .344 (t or – 10%)			
	No correction for potential future genetic loss would be implemented under this alternative.	Under These alternatives, if future genetic sampling indicates a loss of 10%, 3-4 mares from similar HMAs would be introduced.		
Rangeland Health	Utilization by all herbivores is limited to 50% of current year's production for key grasses and 45% for key shrubs and forbs.			
Riparian Health	Maintain existing water developments until they outlive their useful life then remove them and readjust AML based on available water.	Existing water developments would be periodically maintained, and new water developments could be constructed as needed.		

2.3 No Action Alternative

Although the No Action Alternative does not comply with the WFRHBA and does not meet the purpose and need for the action in this EA, it is included as a basis for comparison with the Proposed Action and alternatives.

Under the No Action Alternative, a gather to remove excess wild horses would not occur. A Herd Management Area Plan would not be implemented for the Pancake Complex. There would be no active management to control the size of the wild horse population or to bring the wild horse population to AML. The current wild horse population would continue to increase at a rate of approximately 20% per year. Within five years, the wild horse population could exceed 3,000. Wild horses residing outside the HMAs would remain in areas not designated for management of wild horses and population numbers would continue to increase. The presence of increasing numbers of excess wild horses will continue to deteriorate rangelands within the Complex, public safety concerns will increase along heavily traveled road as well as private property issues, and an increase in emergency actions will be necessary to address the overpopulations of wild horses and limited water/forage resources.

2.4 Alternative A: Proposed Action Alternative

2.4.1 Population Management

The Proposed Action (Alternative A) would implement a management strategy which would incorporate a number of population growth suppression methods. Under this strategy (HMAP Table 2 and 3), Sand Springs West AML (Table 3) would be adjusted to a range of 28-49 wild horses. This would comply with the 1997 Tonopah RMP which states: "Excess horses and burros as determine by monitoring will be removed to a level from which it may take three years to again reach Appropriate Management Level. Wild horses across the Pancake Complex would be managed within the AML range of 336-638 wild horses. The BLM would immediately gather and remove excess wild horses both within and outside the Complex, which are currently estimated to number approximately 1,495 just within the Complex, to achieve and maintain AML and administer or booster population control measures to gathered and released horses over a period of multiple years from the initial gather. This would allow BLM to achieve management goals and objectives of attaining a herd size that is at the low range of AML, reducing population growth rates, and achieving a thriving natural ecological balance on the range as identified within the WFRHBA.

Table 3. Pancake Complex AML under Alternative A

	Total Acres Private/Public land	Appropriate Management Level
Pancake HMA	824,000	240-493
Sand Springs West HMA*	157,436	28-49*
Jakes Wash HA	153,663	0
Monte Cristo WHT	93,640	72-96
Total	**1,228,739**	**336-638**

It is expected that gather efficiencies and holding space during the initial gather may not allow for the removal of sufficient excess animals during the initial gather to reach low AML. Based on BLM's experience over the past few decades, there are a number of logistical and operational factors that can affect BLM's ability to achieve low AML with a single gather, including (but not limited to) that: gather efficiency is typically less than 80%, which reduces the likelihood that all excess animals can be removed in a single operation when the population significantly exceeds AML; the likely population undercount can result in additional excess wild horses being identified in a follow-up inventory even if the targeted numbers of estimated excess wild horses have been removed; the wild horses become more challenging to catch as the helicopter gather operation progresses and they learn to evade the helicopter, weather conditions may impeded achieving the targeted removal numbers, limited availability of contractors with the expertise needed to gather animals safely can impact the ability to continue with a gather until all excess animal have been removed. For this reason, if low AML cannot be achieved through a single initial gather, a follow-up gathers may be necessary to achieve low AML. The BLM and USFS would return to the Complex to remove the remaining excess horses in follow-up gathers as necessary. Follow-up gathers would be scheduled as expeditiously as feasible, considering all factors including logistics, contractor availability, space capacity at holding facilities, and funding. In both initial and follow-up gathers, BLM and USFS would aim to remove excess wild horses necessary to achieve and maintain the low range of AML, as well as to gather a sufficient number of wild horses to implement the population control component of the Proposed Action, which includes fertility control vaccines (PZP vaccines, GonaCon,-equine vaccine, flexible intrauterine devices) for wild horses remaining in the Complex. Removal of excess wild horses would be prioritized as follows: from areas where public health and safety issue have been identified; private land and non-HMA areas where resource degradation/deficiency has been identified; within HMAs from areas where resource degradation or habitat issues are most pressing; and where needed to reach and maintain low AML. Selective removal procedures would prioritize removal of younger excess wild horses within the Complex to keep the population from exceeding the high range of AML so that degraded range resources have sufficient opportunity for recovery, and allow older, less adoptable wild horses, to be released back to the Complex. BLM could begin implementing the population control components (PZP vaccines, GonaCon, and intrauterine devices) of this alternative as part of the initial gather and continue with increasing use of fertility controls in the follow-up gathers as the excess population is removed from the range. While in the temporary holding corral, horses would be identified for removal or release based on age, gender, and/or other characteristics. BLM may also apply fertility control treatments outside of removal operations, either through gather and release or other methods like darting. To help improve the efficacy and duration of fertility control vaccines, mares could be held for an additional 30 days and given a booster shot prior to release. It is expected that the number of fertile mares and stallions will always be a relatively large fraction (i.e., ~60% or more) of low AML, including those elusive animals that are never gathered and their offspring, fertile stallions, and mares whose reversible fertility control vaccines have become ineffective over time or whose intrauterine devices (IUDs) have fallen out.

Population inventories and routine resource/habitat monitoring would continue to be completed every two to three years to document current population levels, growth rates, and areas of continued resource concerns (horse concentrations, riparian impacts, over-utilization, etc.). Funding limitations and competing national priorities may impact the timing and ability to gather and conduct population control components of the Proposed Action.

The management objective for the Pancake Complex would be to manage the wild horse population within the AML range to achieve and maintain TNEB. BLM would achieve this through gathering and removing excess wild horses within the Complex to the low AML and also by applying population growth suppression measures to include:

- Administration of fertility control measures (i.e. PZP vaccines, GonaCon- equine vaccine or newly developed vaccine formulations, IUDs) to released mares.
- Adjustment of sex ratios to achieve a 60 % male to 40% female ratio.

The fertility control component of the Proposed Action would reduce the total number of wild horses that would otherwise be permanently removed from the range. Including some fertility control-treated mares in the herd at mid-AML herd size would allow for management of a total wild horse population within the Complex that would be larger than low AML, while still reducing population growth rates compared to those of an untreated herd and achieving a thriving natural ecological balance. Primary gather methods would include helicopter drive, bait, and water trapping. It is expected that not all horses would be able to be captured, as gather efficiencies rarely exceed 80-85% especially in larger Complexes. As a result of that and associated herd growth between gathers, it is expected that a proportion of wild horses (15-20%+) in the project area would not be captured or treated over the 10-year period of the Proposed Action.

As a part of periodic sampling to monitor wild horses' genetic diversity in the complex, hair follicle samples would be collected from a minimum of 25 horses in the released population from an HMA. Samples would be collected for analysis to assess the levels of observed heterozygosity, which is a measure of genetic diversity (BLM 2010), within the Complex and may be analyzed to determine relatedness to established breeds and other wild horse herds. Mares identified for release would be aged, microchipped and freeze-marked for identification prior to being released to help identify the animals for future treatments/boosters and assess the efficacy of fertility control treatments.

2.4.2. Population Growth Suppression Methods

The Proposed Action would include population growth suppression methods such as fertility control vaccines, flexible IUDs, and sex ratio adjustment in the herd. In cases where a booster vaccine is required, mares could be held for approximately 30 days and given a booster shot prior to release. During gather operations to remove excess wild horses, in separate gathers where horses will not be removed, or other methods like darting, BLM would treat/ retreat mares with fertility control to help meet herd management objectives. Since release of the 2013 National Research Council (NRC) Report, the BLM has supported field trials of potential sterilization methods that may be used in WHB management, but inclusion of any particular method for population management is not contingent on completion of any given research project. The use of any new fertility control method would conform to current best management practices as coordinated with the BLM National Wild Horse and Burro Program.

Mares that are selected for treatment would be treated with fertility control treatments (PZP vaccines [ZonaStat-H, PZP-22], GonaCon equine vaccine or most current formulation, flexible IUDs) to prevent pregnancy in the following year(s). Detailed analysis on population growth suppression methods are discussed further in Appendix II, VI and XII.

2.4.2.1. PZP

Porcine Zona Pellucida (PZP) Vaccine

Immunocontraceptive Porcine Zona Pellucida (PZP) vaccines are currently being used on over 75 areas managed for wild horses by the National Park Service, US Forest Service, and the Bureau of Land Management and its use is appropriate for free-ranging wild horse herds. Taking into consideration available literature on the subject, the National Research Council concluded in their 2013 report that PZP vaccine was one of the preferred available methods for contraception in wild horses and burros (NRC 2013). PZP vaccine use can reduce or eliminate the need for gathers and removals (Turner et al. 1997). PZP vaccines meet most of the criteria that the National Research Council (2013) used to identify promising fertility control methods, in terms of delivery method, availability, efficacy, and side effects. It has been used extensively in wild horses (NRC 2013), and in a population of feral burros in territory of the US (Turner et al. 1996). PZP vaccine can be relatively inexpensive, meets BLM requirements for safety to mares and the environment, and is commercially produced as ZonaStat-H, an EPA-registered product (EPA 2012, SCC 2015), or as PZP-22, which is a formulation of PZP in polymer pellets that can lead to a longer immune response (Turner et al. 2002, Rutberg et al. 2017, Carey et al. 2019). It can easily be remotely administered (dart-delivered) in the field, but only where mares are relatively approachable.

Under the Proposed Action, mares being treated for the first time would receive a liquid primer dose along with time release pellets. BLM would return to the HMA as needed to re-apply PZP-22 and/or

ZonaStat-H and initiate new treatments in order to maintain contraceptive effectiveness in controlling population growth rates. Application methods could be by hand in a working chute during gathers, or through field darting if mares in some portions of the Complex prove to be approachable. Both forms of PZP can safely be reapplied as necessary to control the population growth rate. Even with repeated booster treatments of PZP, it is expected that most, if not all, mares would return to fertility, and not all mares would be treated or receive boosters within the Complex due to the sheer numbers of the population, the large size of the Complex, and logistics of wild horse gathers. Once the population is at AML and population growth seems to be stabilized, BLM could use population planning software (PopEquus, USGS Fort Collins Science Centre, https://rconnect.usgs.gov/popequus/) to determine the required frequency of re-treating mares with PZP or other fertility control methods.

2.4.2.2. Gonadotropin Releasing Hormone (GnRH) Vaccine, GonaCon

The immune-contraceptive GonaCon-Equine vaccine meets most of the criteria that the National Research Council of the National Academy of Sciences (NRC 2013) used to identify the most promising fertility control methods, in terms of delivery method, availability, efficacy, and side effects. GonaCon-Equine is approved for use by authorized federal, state, tribal, public, and private personnel, for application to wild and feral equids in the United States (EPA 2013, 2015). Its use is appropriate for free-ranging wild horse herds. Taking into consideration available literature on the subject, the National Research Council concluded in their 2013 report that GonaCon-B (which is produced under the trade name GonaCon-Equine for use in feral horses and burros) was one of the most preferable available methods for contraception in wild horses and burros (NRC 2013). GonaCon-Equine has been used on feral horses in Theodore Roosevelt National Park (Baker et al. 2023) and on a small number of wild horses in the Water Canyon area within the Antelope Complex (DOI-BLM-NV-L020-2015-0014-EA). Gona-Con is currently being administered in Oregon, Idaho, and Nevada as well in numerous HMAs. GonaCon-Equine can be remotely administered in the field in cases where mares are relatively approachable, using a customized pneumatic dart (McCann et al. 2017). Use of remotely delivered (dart-delivered) vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached within 50 meters or less (BLM 2010).

As with other contraceptives applied to wild horses, the long-term goal of GonaCon-Equine use is to reduce or eliminate the need for gathers and removals (NRC 2013). GonaCon-Equine 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. Its categorization as a pesticide is consistent with regulatory framework for controlling overpopulated vertebrate animals, and in no way is meant to convey that the vaccine is lethal; the intended effect of the vaccine is as a contraceptive. GonaCon is produced as a pharmaceutical-grade vaccine, including aseptic manufacturing technique to deliver a sterile vaccine product (Miller et al. 2013). If stored at 4° C, the shelf life is 6 months (Miller et al 2013).

Miller et al. (2013) reviewed the vaccine environmental safety and toxicity. When advisories on the product label (EPA 2015) are followed, the product is safe for users and the environment (EPA 2009b). EPA waived a number of tests prior to registering the vaccine, because GonaCon was deemed to pose low risks to the environment, so long as the product label is followed (Wang-Cahill et al.2023).

Under the Proposed Action, the BLM would return to the Complex as needed to re-apply GonaCon-Equine and initiate new treatments in order to maintain contraceptive effectiveness in controlling population growth rates. Booster dose effects may lead to increased effectiveness of contraception, which is generally the intent. GonaCon-Equine can safely be reapplied as necessary to control the population growth rate. Even with one booster treatment of GonaCon-Equine, it is expected that most, if not all, mares would return to fertility at some point, as a study of boostered mares shows a gradual return to fertility over time (Baker et al. 2023), although the average duration of effect after booster doses has not yet been quantified. It is unknown what would be the expected rate for the return to fertility rate in mares boosted more than once with GonaCon-Equine has not been quantified. Once the herd size in the project area is at AML and population growth seems to be stabilized, BLM would make a determination as to the required frequency of new mare treatments and mare re-treatments with GonaCon or other fertility control methods, to maintain the number of horses within AML.

2.4.2.3. Intrauterine Devices (IUDs)
IUDs are considered a temporary fertility control method that does not generally cause future sterility issues (Daels and Hughes 1995). It is expected that flexible IUDs would only be inserted in non-pregnant (open) mares, and only by a veterinarian. Wild mares receiving IUDs would be checked for pregnancy prior to insertion of an IUD. Based on promising results from pasture-based studies in domestic mares, BLM has begun to use IUDs to control fertility as a wild horse and burro fertility control method on the range. The initial management application used Y-shaped silicone IUDs (EPA 2020) in mares from the Swasey HMA, in Utah. The BLM has supported and continues to support research into the development and testing of effective and safe IUDs for use in wild horse mares (Baldrighi et al. 2017, Holyoak et al. 2021). However, existing literature on the use of IUDs in horses allows for inferences about expected effects of any management alternatives that might include use of IUDs and support the apparent safety and efficacy of some types of IUDs for use in horses (see section 3.3).

Soft IUDs may cause relatively less discomfort than hard IUDs (Daels and Hughes 1995). The 2013 National Research Council of the National Academy of Science (NRC) report considered IUDs and suggested that research should test whether IUDs cause uterine inflammation and should also test how well IUDs stay in mares that live and breed with fertile stallions. Since that report, researchers tested a Y-shaped silicone IUD to determine retention rates and assess effects on uterine health; retention rates were greater than 75% for an 18-month period, and mares returned to good uterine health and reproductive capacity after removal of the IUDs (Holyoak et al. in press). Also, the University of Massachusetts has developed a magnetic IUD that has been effective at preventing estrus in non-breeding domestic mares (Gradil et al. 2019). The overall results for flexible IUDs (Gradil 2019, Joonè et al. 2021, Holyoak et al. 2021) are consistent with results from an earlier study (Daels and Hughes 1995), which used O-shaped silicone IUDs.

2.4.2.5 Sex Ratio Adjustment
Sex ratio adjustment, leading to a reduced fraction of mares in the herd, can be considered a form of contraceptive management, insofar as it can reduce the realized per-capita growth rate in a herd. By reducing the proportion of breeding females in a population (as a fraction of the total number of animals present), the technique leads to fewer foals being born, relative to the total herd size. Sex ratio is typically adjusted in such a way that 60 percent of the horses are male. In the absence of other fertility control treatments, this 60:40 sex ratio alone can temporarily reduce population growth rates from approximately 20% to approximately 15% (Bartholow 2004). While such a decrease in growth rate may not appear to be large or long-lasting, the net result can be that fewer foals are born, at least for a few years – this can extend the time between gathers, and reduce impacts on-range, and costs off-range.

2.5 Alternative B
Alternative B is similar to Alternative A except that it includes a gelding component. This alternative would include selective removal of excess wild horses to low end AML, population growth control using mare fertility control treatments (PZP vaccines, GonaCon or most current vaccine formulation, IUDs) gelding and sex ratio adjustments. In addition to bringing the wild horse population to low AML, up to 138 gelded horses – that would otherwise be excess animals permanently removed from the range and sent to off-range corrals for adoption/sales or off-range pastures – may be returned to the range and managed as a non-breeding population of geldings, so long as the geldings do not result in the population exceeding mid-range AML.

2.5.1. Gelding

In order to reduce the total number of excess wild horses that would otherwise be permanently removed from the Complex, a portion of the male population would be managed as geldings. The procedures to be followed for gelding of stallions are detailed in the Gelding Standard Operating Procedures (SOPs) in Appendix III.

Gelding Procedure

BLM routinely gelds all excess male horses that are captured and removed from the range prior to their adoption, sale, or shipment to Off-Range Pastures (ORPs). The gelding procedure for excess wild horses removed from the range would be conducted at temporary (field) or off range corrals by licensed veterinarians and follows industry standards. Under Alternative B, in addition to returning the population of wild horses to low AML, up to 138 geldings could be returned to resume their free-roaming behaviors on the public range instead of being permanently removed from the Complex, which could bring the population to mid-AML. Geldings have been released on BLM lands as a part of herd management in many areas, including the Barren Valley complex in Oregon (BLM 2011), the Challis HMA in Idaho (BLM 2012), and the Conger HMA in Utah (BLM 2016). By including some geldings in the population and having a slightly skewed sex ratio with more males than females overall, the anticipated result would be a reduction in per-capita population growth rates while allowing for management of a larger total wild horse population on the range. Stallions that would otherwise be permanently removed as excess wild horses would be selected for gelding and release. No animals which appear to be distressed, injured, or in poor health or condition would be selected for gelding. Stallions would not be gelded within 72 hours of capture. The surgery would be performed at a BLM-managed holding center by a veterinarian using general anesthesia and appropriate surgical techniques (see Gelding SOPs in Appendix III).

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

Any males that have an inguinal or scrotal hernias would be removed from the population, sent to a BLM prep corral facility and be treated surgically as indicated if possible or euthanized if they have a poor prognosis for recovery according to BLM policy (WO PIM 2021-007). Horses with only one descended testicle may be removed from the population and managed at a BLM prep corral facility according to BLM policy or anesthetized with the intent to locate the undescended testicle for castration. If an undescended testicle cannot be located, the animal may be recovered and removed from the population if no surgical exploration has started. Once surgical exploration has started those that cannot be completely castrated would be euthanized prior to recovering them from anesthesia according to BLM policy. All animals would be rechecked by a veterinarian the day following surgery. Those that have excessive swelling, are reluctant to move, or show signs of any other complications would be held in captivity and treated accordingly as they normally would in a BLM facility. Once released to the wild no further veterinary interventions are possible.

Selected stallions would be shipped to an off-range corral, gelded, and returned to the range within 30 days. Gelded animals would be monitored periodically for complications for approximately 7-10 days following release. This monitoring may be completed either through aerial recon if available, or field observations from major roads and trails. The goal of this monitoring is to detect complications if they are occurring and determine if the horses are freely moving about the Complex. All adults would have been freeze-marked at the first gather to facilitate posttreatment and routine field monitoring. Post-gather monitoring would be used to document whether geldings form bachelor bands or intermix with the breeding population as expected. Other periodic observations of the long-term outcomes of gelding could be recorded during routine resource monitoring work. Such observations would include but not be limited to band size, social interactions with other geldings and harem bands, distribution within their habitat, forage utilization, and activities around key water sources. Periodic population inventories and future gather statistics may contribute to BLM's ongoing considerations about managing a portion of the herd as non-breeding animals, as an effective approach to slowing the annual population growth rate by replacing breeding mares with sterilized animals, when used in conjunction with other population control techniques. Management of a gelding population would allow for management at mid-AML, instead of gathering and removing excess animals to low AML.

By itself, it is unlikely that gelding would allow the BLM to achieve its horse and burro population management objectives since a single fertile stallion is capable of impregnating multiple mares, and stallions other than the dominant harem stallion may also breed with some mares. Adequate reduction of female horse fertility rates would be expected to result only if a large proportion of male horses in the population are sterile, because of their social behavior (Garrott and Siniff 1992). Therefore, to be fully effective, use of gelding (alone) to control population growth requires that either the entire male population be gathered and treated (which is not practical and is not being considered here) or that some percentage of the female wild horses in the population be gathered and treated. If the mare treatment is not of a permanent nature (e.g., application of PZP vaccine, GonaCon, IUDs) the mares may need to be gathered and retreated on a periodic basis.

2.6 Alternative C

Under this alternative, implement an HMAP with management strategy, gather and remove excess animals to within the AML range without fertility control, sex ratio adjustments, geldings or an AML range for Sand Springs West (HMAP Table 2).

2.7 Alternative D

The BLM would capture 100% of the current population of excess wild horses from within and outside the Jakes Wash Herd Area, in an immediate gather and, if necessary, follow-up gather or gathers to capture animals missed or that evade capture during a prior gather. No wild horses gathered from the Jakes Wash HA would be released under this alternative. All of the animals gathered from the HA would be removed and transported to BLM off-range corrals where they would be prepared for adoption and/or sale to qualified individuals, or for off-range pastures.

2.8 Management Actions Common to Alternatives A, B, C and D

The primary gather techniques would be the helicopter-drive and water/bait trapping. The use of roping from horseback could also be used when necessary. Multiple, temporary gather sites (traps) would be used to gather wild horses both from within and outside the Complex. In addition to public lands, private property may be utilized for gather sites and temporary holding facilities (with the landowner's permission) if necessary, to ensure accessibility and/or based on prior disturbance. Use of private land would be subject to Standard Operating Procedures (SOPs) (Appendix IV) and to the written approval/authorization of the landowner.

Any trapping activities would be scheduled in locations and during time periods that would be most effective to gather sufficient numbers of animals to achieve management goals for the areas being gathered. The most efficient gather technique would be chosen as determined by the gather needs of the specific area.

Temporary trap and holding sites would be no larger than 0.5 acres. Temporary holding sites could be in place for up to 60 days depending on length of gather. Bait or water trapping sites could remain in place up to one year. The exact location of the trap sites and holding sites are determined by the contractor in coordination with the BLM, based on site-specific factors, and may not be determined until immediately prior to the gather because the location of the animals on the landscape is variable and unpredictable.

Trap and holding sites are often located in previously disturbed areas, but if a new site needs to be used, the BLM will conduct a cultural inventory prior to using such a site. If cultural resources are encountered, the location of the gather/holding site would be adjusted to avoid all cultural resources.

No trap or holding sites would be set up on Greater sage-grouse leks, known populations of sensitive species, in riparian areas, in cultural resource sites, sacred sites, paleontological sites, Wilderness Study Areas (WSAs) or congressionally designated Wilderness Areas. All gather sites, holding facilities, and camping areas on public lands would be recorded with Global Positioning System equipment, given to the BLM Battle Mountain and Ely District Invasive, Non-native Weed Coordinators, and then assigned for monitoring and any necessary treatment during the next several years for invasive, non-native weeds. All gather and handling activities (including gather site selections) would be conducted in accordance with SOPs in Appendix VI.

Activities in listed species habitat would be subject to Section 7 consultation under the Endangered Species Act with the level of consultation to be determined based upon the project site-specific proposed action. BLM would complete consultation prior to implementation of any specific action which may have an effect on a listed species.

Wildlife Stipulations (Common to all Alternatives, except No Action Alternative)

- If gather operations were to be conducted during the migratory bird breeding season (March 1 – July 31) a nest clearance survey would be conducted by BLM Biologist at trap, corral, and staging areas.
- Trap sites and corrals would not be located in active pygmy rabbit habitat or other sensitive habitat.
- Greater sage-grouse Required Design Features that are identified in Appendix X would be applied in Greater sage-grouse habitat.
- Corrals would not be constructed within 1 mile of an active or pending lek.
- Prior to gathers, BLM would coordinate with NDOW regarding locations of staging areas to address Greater sage-grouse concerns. The following timing restrictions would be adhered to the best of BLM's abilities while not impeding gather operations:
    - Helicopter and water trapping gather would not occur during the lek timing restriction of March 1 – May 15 to protect breeding Greater sage-grouse.
    - Helicopter gathers would not occur during the nesting timing restriction of April 1 – June 30 within 4 miles of an active or pending lek.
    - Water trapping operations would not occur during nesting timing restriction April 1 – June 30 within 1 mile of an active or pending lek.
    - Water trapping operations would not occur at springs and seeps during brood-rearing timing restriction of May 1 – September 15 without a timing waiver.

2.7.1. Helicopter Drive Trapping

The BLM would utilize a contractor to perform the gather activities in cooperation with the BLM. The contractor would be required to conduct all helicopter operations in a safe manner and in compliance with Federal Aviation Administration (FAA) regulations including 14 CFR § 91.119. Helicopter landings would not be allowed in wilderness except in the case of an emergency. For safety purposes, any public observers must be located a minimum of 1,000 from the areas where the helicopter may be herding animals or flying over.

Helicopter-drive trapping may be needed to meet management objectives to capture the highest percentage of wild horses possible. The appropriate gather method would be determined by the BLM based on the location, accessibility of the animals, local terrain, vegetative cover, and available sources of water and forage. Roping from horseback could also be used when necessary. Based on wild horse watering locations in this area, it is estimated that multiple trap sites may be used during trapping activities.

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

The BLM may find it necessary to issue a temporary closure and restriction order, in order to ensure that gather operations will be effective and to protect the safety of the contractors, employees, public and the wild horses during gather operations. Any such closures will comply with the public notification process outlined in the BLM's regulations at 43 C.F.R. § 8364.1. The BLM will limit any such closures to the appropriate area needed to conduct gather operations and may move the closed/restricted area from capture site to capture site to ensure access to public lands when operations are not occurring near the capture site or temporary holding corrals. Where possible, closed areas may be open to traffic when directed by a pilot car.

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

2.7.2. Bait/Water Trapping

Bait and/or water trapping would be used as appropriate to gather wild horses efficiently and effectively. Bait and water trapping may be utilized when wild horses are in an area where there is a limited resource (such as food or water). The use of bait and water trapping, though effective in specific areas and circumstances, is not timely, cost-effective, or practical as the primary or sole gather method for the Complex. However, water or bait trapping could be used as a supplementary approach to achieve the desired goals of the BLM in portions of the Complex. Bait and/or water trapping generally require a longer window of time for success than helicopter drive trapping. Although the trap would be set in a high probability area for capturing excess wild horses residing within the area and at the most effective time periods, time is required for the horses to acclimate to the trap and/or decide to access the water/bait.

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

Gathering excess horses using bait/water trapping could occur at any time of the year and traps would remain in place until the target numbers of animals are removed. As the proposed bait and/or water trapping in this area is a lower stress approach to gathering wild horses, such trapping can continue into the foaling season without harming the mares or foals. Due to the nature of the bait and water trap method, wild horses are reluctant to approach the trap site when there is too much activity. Therefore, only essential gather operations personnel are able to be at the trap site during gather operations and there is generally no public observation allowed. The BLM may issue a closure and restriction order in accordance with 43 C.F.R. § 8364.1 in order to ensure that the gather is effective and to protect wild horse and public safety.

2.7.3. Gather-related Temporary Holding Facilities (Corrals)
Wild horses that are gathered would be transported from the gather sites to a temporary holding corral. At the temporary holding corral wild horses would be sorted into different pens. Mares would be identified for fertility control and treated at the corrals. The horses would be provided good quality hay and water. At the temporary holding facility, a veterinarian, when present, would provide recommendations to the BLM regarding care and treatment of recently captured wild horses. Any animals affected by a chronic or incurable disease, injury, lameness, or serious physical defect (such as severe tooth loss or wear, club foot, and other severe congenital abnormalities) would be humanely euthanized using methods acceptable to the American Veterinary Medical Association (AVMA).

Herd health and characteristics data would be collected as part of continued monitoring of the wild horse herds. Genetic diversity baseline data would be collected to monitor the genetic diversity of the wild horses within the combined project area. Additional samples may be collected to analyze ancestry.

Gathered wild horses would be transported to BLM off-range corrals where they would be prepared for adoption and/or sale to qualified individuals or transfer to off-range pastures or other disposition authorized by the WFRHBA.

2.7.4. Transport, Off-range Corrals, and Adoption Preparation
All gathered wild horses would be removed and transported to Off-Range Corrals (ORC, formerly short-term holding facility) where they would be inspected by facility staff (and if needed by a contract veterinarian) to observe health conditions and ensure that the animals are being humanely cared for. Wild horses removed from the range would be transported to the receiving ORC in a goose-neck stock trailer or straight-deck semi-tractor trailers. Trucks and trailers used to haul the wild horses would be inspected prior to use to ensure wild horses can be safely transported. Wild horses would be segregated by age and sex when possible and loaded into separate compartments. Mares and their un-weaned foals may be shipped together. Transportation of recently captured wild horses is limited to a maximum of 10 hours.

Upon arrival, recently captured wild horses are off-loaded by compartment and placed in holding pens where they are provided good quality hay and water. Most wild horses begin to eat and drink immediately and adjust rapidly to their new situation. At the ORC, a veterinarian provides recommendations to the BLM regarding care, treatment, and if necessary, euthanasia of the recently captured wild horses. 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 AVMA. Wild horses in very thin condition, or animals with injuries, are sorted and placed in hospital pens, fed separately, and/or treated for their injuries. Recently captured animals in very thin condition may have difficulty transitioning to feed. Some of these animals may be in such poor condition that it is unlikely they would have survived if left on the range. Similarly, some females may lose their pregnancies. Certain management techniques would be taken to help females make a quiet, low stress transition to captivity and domestic feed to minimize the risk of miscarriage or death.

After recently captured wild horses have transitioned to their new environment, they are prepared for adoption, sale, or transport to off-range pastures. Preparation involves freeze marking the animals with a unique identification number, vaccination against common diseases, castration, microchipping, and de-worming. At ORC facilities, a minimum of 700 square feet of space is provided per animal. Mortality at ORCs averages approximately 5% per year (GAO, 2008), and includes animals euthanized due to pre-existing conditions; animals in extremely poor condition; animals that are injured and would not recover; animals which are unable to transition to feed; and animals which are seriously injured or accidentally die during sorting, handling, or preparation. ORCs may be BLM-owned or contracted private facilities.

2.7.5. Adoption

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

2.7.6. Sale with Limitations

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

2.7.7. Off-Range Pastures

When shipping wild horses for adoption, sale, or Off-Range Pastures (ORPs), the animals may be transported for up to a maximum of 24 hours. Immediately prior to transportation, and after every 24 hours of transportation, animals are off-loaded and provided a minimum of 8 hours on the-ground rest. During the rest period, each animal is provided access to unlimited amounts of clean water and two pounds of good quality hay per 100 pounds of body weight with adequate space to allow all animals to eat at one time. 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.

2.7.8. Euthanasia or Sale without Limitations

Under the WFRHBA, healthy excess wild horses can be euthanized or sold without limitation if there is no adoption demand for the animals. However, while euthanasia and sale without limitation are allowed under the statute, for several decades Congress has prohibited the use of appropriated funds for this purpose. If Congress were to lift the current appropriations restrictions, then it is possible that excess horses removed from the Complex could potentially be euthanized or sold without limitation consistent with the provisions of the WFRHBA.

Any old, sick, or lame horses unable to maintain an acceptable body condition (greater than or equal to a Henneke BCS of 3) or with serious physical defects would be humanely euthanized either before gather activities begin or during the gather operations as well as within off-range corrals. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy (Washington Office Instruction Memorandum (WO IM) 2015-070 or most current edition). Conditions requiring humane euthanasia occur infrequently and are described in more detail in Washington Office Instruction Memorandum 2015-070.

2.7.9. Public Viewing Opportunities

Opportunities for public observation of the gather activities on public lands would be provided, when and where feasible, consistent with WO IM No. 2013-058 or other current policy and the Visitation Protocol and Ground Rules for Helicopter WH&B Gathers within Nevada (Appendix V). As part of public viewing of the gather operations, BLM will establish observation locations that reduce safety risks to the public during helicopter gathers (e.g., from helicopter-related debris or from the rare helicopter crash landing, or from the potential path of gathered wild horses), to the wild horses (e.g., by ensuring observers would not be in the line of vision of wild horses being moved to the gather site), and to contractors and BLM employees who must remain focused on the gather operations and the health and well-being of the wild horses. As feasible, observation locations would be located near gather or holding sites, although safety, gather efficiency, terrain, and land status factor into how close observation locations will be. All observation locations would be subject to the same cultural resource requirements as gather and holding sites.

During water/bait trapping operations, spectators and viewers would be prohibited as it would impact the contractor's ability to capture wild horses. Only essential gather operation personnel would be allowed at the trap site during operations.

Alternatives Considered but Eliminated from further Consideration

The following alternatives to the helicopter drive and bait/water trapping method for the removal of wild horses to reach the established AML were considered but eliminated from detailed analysis for the reasons stated below.

2.8.1. Exclusively Field Darting Horses with ZonaStat-H (Native PZP) or GonaCon-Equine

This alternative was eliminated from further consideration as the sole method of applying fertility control vaccine due to the difficulties inherent in darting wild horses in the project area. Field darting of wild horses works in small areas with good access where animals are acclimated to the presence of people who come to watch and photograph them. The size of the Complex is very large (1,228,739 acres) and many areas do not have access. The presence of water sources on both private and public lands inside and outside the Complex would make it almost impossible to restrict wild horse access to be able to dart horses consistently. Horse behavior limits their approachability/accessibility, so that the number of mares expected to be treatable via darting would be insufficient to control growth. BLM would have difficulties keeping records of animals that have been treated due to common and similar colors and patterns. This formulation of PZP also requires a booster given every year following treatment to maintain the highest level of efficacy. Annual darting of wild horses in large areas can be very difficult to replicate and would be unreliable. For these reasons, this alternative was determined to not be an effective or feasible method by itself for applying population controls to wild horses from the Complex. Darting is included as a potential tool for use under the Proposed Action in areas that may be deemed suitable in the future, and to be implemented in concert with the other methods detailed in the Proposed Action.

2.8.2. Control of Wild Horse Numbers by Fertility Control Treatment Only (No Removals)

An alternative to gather a significant portion of the existing population (95%) and implement fertility control treatments only, without removal of excess wild horses was modeled using a three-year gather/treatment interval over an 11-year period, in the *PopEquus* (1.0.2) software. Based on this modeling, this alternative would not result in attainment of the AML range for the Complex and the wild horse population would reach a projected population size of 3,245 using GonaCon-Equine (or 6,149 using PZP-22), adding to the current wild horse overpopulation, albeit at a slower rate of growth than an approach with no fertility control. Over the 10-year period modeled, 6,594 wild horses would need to be gathered if GonaCon-Equine is used (or 9,286 if PZP-22 is used), to allow for injection of vaccines for population control. It is important to understand that in these scenarios, the same wild horse may be gathered multiple times during the 10-year period. See Appendix VI for population modeling.

This alternative would not bring the wild horse population to within the established AML range, would allow the wild horse population to continue to grow even further in excess of AML, and would allow resource concerns to further escalate. Implementation of this alternative would result in high gather and fertility control costs without achieving a thriving natural ecological balance or resource management objectives. This alternative would not meet the purpose and need and therefore was eliminated from further consideration.

2.8.3. Chemical Immobilization

Chemical immobilization as a method of capturing wild horses is not 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 at scale and it would be impractical to use given the size of the Complex, access limitations and approachability of the horses.

2.8.4. Use of Wrangler on Horseback Drive-trapping

Use of wranglers on horseback drive-trapping to remove excess wild horses can be somewhat effective on a small scale but due to the number of horses 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 often outrun and outlast domestic horses carrying riders. Helicopter assisted roping is typically only used if necessary and when the wild horses are in close proximity to the gather site. For these reasons, this method was eliminated from further consideration.

2.8.5. Designate the HMAs to be Managed Principally for Wild Horse Herds Under 43 C.F.R. 4710.3-2.

The HMAs are designated in the Land Use Planning process for the long-term management of wild horses in conjunction with other multiple uses. The (BLM) Bristlecone and Tonopah Field Office and Humboldt-Toiyabe National Forest do not administer any designated Wild Horse or Burro Ranges, which under 43 C.F.R. 4710.3-2 are "to be managed principally, but not necessarily exclusively, for wild horse or burro herds." There are currently only four designated Wild Horse or Burro Ranges on public lands and authority to designate such ranges resides with the Secretary of Interior or Nevada State Director. This alternative would involve no removal of wild horses and would instead address excess wild horse numbers through removal or reduction of livestock within the HMAs. In essence, this alternative would exchange use by livestock for use by wild horses. Because this alternative would mean converting the HMAs to wild horse Ranges and modifying the existing multiple use relationships established through the land-use planning process, it would first require an amendment to the RMP, which is outside the scope of this analysis. Further, this alternative was not brought forward for analysis because it is inconsistent with the 2008 Ely RMP, the 1997 Tonopah RMP and the WFRHBA which directs the Secretary to immediately remove excess wild horses where necessary to ensure a thriving natural ecological balance and multiple use relationship. This alternative is also inconsistent with the BLM's multiple use management mission under FLPMA. Changes to or the elimination of livestock grazing cannot be made through a wild horse gather decision. Furthermore, even with significantly reduced levels of livestock grazing within the gather area relative to the permitted levels authorized in the 2008 Ely RMP, there is insufficient habitat for the current population of wild horses, as confirmed by monitoring data. As a result, this alternative was not analyzed in detail.

2.8.6. Raising the Appropriate Management Levels for Wild Horses

Increasing the AML is not consistent with current monitoring results or with the Ely and Tonopah RMPs. Monitoring and other historical data collected within the Complex 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 above the current AML to reverse downward trends, promote improvement of rangeland health and ensure safety and health of wild horses. 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. Raising the

AML where there are known resource degradation issues associated with an overpopulation of wild horses does not meet the Purpose and Need to Restore a TNEB or meet Rangeland Health Standards.

2.8.7. Remove or Reduce Livestock Within the HMAs

This alternative would involve no removal of wild horses and would instead address excess wild horse numbers through removal or reduction of livestock within the HMAs. In essence, this alternative would simply exchange use by livestock for use by wild horses. This alternative was not brought forward for analysis because it is inconsistent with the Ely and Tonopah RMP, and the WFRHBA which directs the Secretary to immediately remove excess wild horses.

Additionally, the proposal to reduce livestock would not meet the Purpose and Need for action identified in Section 1.2. Eliminating or reducing livestock grazing in order to shift forage use to wild horses would not be in conformance with the existing land use plans and is contrary to the BLM's multiple-use mission as outlined in FLPMA and would be inconsistent with the WFRHBA and PRIA. It was Congress' intent to manage wild horses and burros as one of the many uses of the public lands, not a single use. Therefore, the BLM is required to manage wild horses and burros in a manner designed to achieve a thriving natural ecological balance between wild horse and burro populations, wildlife, domestic livestock, vegetation, and other uses. Information about the Congress' intent is found in the Senate Conference Report (92-242) which accompanies the 1971 WFRHBA (Senate Bill 1116): "*The principal goal of this legislation is to provide for the protection of the animals from man and not the single use management of areas for the benefit of wild free-roaming horses and burros. It is the intent of the committee that the wild free-roaming horses and burros be specifically incorporated as a component of the multiple-use plans governing the use of the public lands.*"

Furthermore, simply re-allocating livestock Animal Unit Months (AUMs) to increase the wild horse AMLs would not achieve a thriving natural ecological balance. Wild horses are unlike livestock which can be confined to specific pastures, limited to specific periods of use, and specific seasons-of-use to minimize impacts to vegetation during the critical growing season and to riparian zones during the summer months. Wild horses are present year-round and their impacts to rangeland resources cannot be controlled through the establishment of a grazing system, such as for livestock. Thus, impacts from wild horses can only be addressed by limiting their numbers to a level that does not adversely impact rangeland resources and other multiple uses.

Livestock grazing can only be reduced or eliminated through provisions identified within regulations at 43 CFR Part 4100 and must be consistent with multiple use allocations set forth in LUP/RMPs. Such changes to livestock grazing cannot be made through a wild horse gather decision and are only possible if BLM first revises the LUPs to allocate livestock forage to wild horses and to eliminate or reduce livestock grazing. Because this alternative is inconsistent with the Ely and Tonopah RMPs, it would first require an amendment to the RMP, which is outside the scope of this EA.

2.8.8. Wild Horse 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. The alternative of using natural controls to achieve a desirable AML has not been shown to be feasible in the past (NRC 2013).

Survival rates for wild horses on western USA public lands are high (Ransom et al. 2016). None of the significant natural predators from native ranges of the wild equids in Europe, Asia, and Africa — wolves, brown bears, and African lions — exist on the wild horse ranges in the western United States (mountain lions are known to predate on horses, primarily foals, in a few herds, but predation contributes to biologically meaningful population limitation in only a handful of herds). In some cases, adult annual survival rates exceed 95%.

Many horse herds grow at sustained high rates of 15-25% per year and are not a self-regulating species (NRC 2013). The NAS report (NRC 2013) concluded that the primary way that equid populations self-limit is through increased competition for forage at higher densities, which results in smaller quantities of forage available per animal, poorer body condition, and decreased natality and survival. It also concluded that the effect of this would be 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 wild horse populations which would continue to exceed the carrying capacity of the range resulting in a catastrophic mortality of wild horses in the Complex, and irreparable damage to rangeland resources. While some members of the public have advocated "letting nature take its course", allowing horses to die of dehydration and starvation would be inhumane treatment and would be contrary to the WFRHBA, which mandates removal of excess wild horses. The damage to rangeland resources that results from excess numbers of wild horses is also contrary to the WFRHBA, which mandates the Bureau 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*".

The BLM's regulations at 43 CFR § 4700.0-6 (a) state, "Wild horses shall be managed as self- sustaining populations of healthy animals in balance with other uses and the productive capacity of their habitat." As the vegetative and water resources are over utilized and degraded to the point of no recovery as a result of the wild horse overpopulation, wild horses would start showing signs of malnutrition and starvation. The weaker animals, generally the older animals, and the mares and foals, would be the first to be impacted. It is likely that a majority of these animals would die from starvation and dehydration which could lead to a catastrophic die off. The resultant population could be heavily skewed towards the stronger stallions which could contribute to social disruption in the Complex. Competition between wildlife and wild horses for forage and water resources would be severe. Wild horses can be aggressive around water sources, and some wildlife may not be able to compete, which could lead to the death of individual animals. Wildlife habitat conditions would deteriorate as wild horse numbers above AML reduce herbaceous vegetative cover, damage springs and increase erosion, and could result in irreversible damage to the range. This degree of resource impact would likely lead to management of wild horses at a greatly reduced level if BLM is able to manage for wild horses at all on the Complex in the future after a catastrophic die off and irreversible habitat damage. 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 from within and outside the Complex and to reduce the wild horse population growth rates to manage wild horses within established AML ranges.

2.8.9. Gathering the Complex to Upper Range of AML

Under this Alternative, a gather would be conducted to gather and remove enough wild horses to achieve the upper range of the AML (638 in the Pancake Complex). A post-gather population size at the upper range of the AML would result in AML being exceeded following the next foaling season. This would be unacceptable for several reasons. The AML represents "that 'optimum number' of wild horses which results in a thriving natural ecological balance and avoids a deterioration of the range." *Animal Protection Institute*, 109 IBLA 112, 119 (1989). The Interior Board of Land Appeals has also held that "Proper range management dictates removal of horses before the herd size causes damage to the rangeland. Thus, the optimum number of horses is somewhere below the number that would cause resource damage" *Animal Protection Institute*, 118 IBLA 63, 75 (1991).

The upper level of the AML established for the Pancake Complex represents the maximum population for which thriving natural ecological balance would be maintained. The lower level represents the number of animals that should remain in the complex immediately following a wild horse gather that brings the population back to AML in order to allow for a periodic gather cycle and to prevent the population from exceeding the established AML between gathers.

Additionally, gathering only to the upper range of AML, would result in the need to follow up with another gather by the next year and could result in continued overutilization of vegetation resources and damage to important wildlife habitats. Frequent gathers could increase the stress to wild horses, as individuals and as entire herds. Moreover, this alternative would not meet the Purpose and Need for this EA. For these reasons, this alternative was eliminated from further consideration.

3.0 Affected Environment/Environmental Effects

3.1 Identification of Issues

Internal scoping was conducted by an interdisciplinary (ID) team on April 15, 2024, that analyzed the potential consequences of the Proposed Action and alternatives. Potential impacts to the following resources/concerns were evaluated in accordance with criteria listed in the NEPA Handbook H-1790-1 (2008) page 41, to determine if detailed analysis was required. Consideration of some of these items is to ensure compliance with laws, statutes or Executive Orders that impose certain requirements upon all Federal actions. Other items are relevant to the management of public lands in general, and to the Ely and Battle Mountain Districts BLM in particular.

Table 4. summarizes which of the supplemental authorities of the human environment and other resources of concern within the project area are present, not present, or not affected by the Proposed Action.

Table 4. Resources of Concern

Resource/Concern	Issue(s) Analyzed? (Y/N)	Rationale for Dismissal from Detailed Analysis or Issue(s) Requiring Detailed Analysis
Air Quality	N	The air quality status for the project analysis area in White Pine and Nye Counties is termed "unclassifiable" by the State of Nevada. No data is collected in White Pine County or in areas outside of Pahrump in southeastern Nye County due to the expectation that annual particulate matter would not exceed national standards. The proposed action or alternatives would not affect air quality in White Pine or Nye Counties, as it is a temporary action.
Areas of Critical Environmental Concern (ACEC)	N	Not present in the designated HMA boundaries. Honeymoon Hill ACEC is present in Jakes Wash HA, but the 2008 Ely RMP already says that Jakes Wash HA will not be managed for Wild Horses and Burros based on the habitat suitability evaluation and analysis. See Ely Proposed Resource Management Plan/Final Environmental Impact Statement (November 2007) table 3.8-2 and page 4.8-2.
Cultural Resources	N	In accordance with the SOPs for Gather and Handling Activities in Appendix V (BLM/SHPO Protocol), gather facilities would likely be placed in previously disturbed areas. Should new, previously undisturbed gather sites or holding facility locations be required, appropriate Class III cultural resource inventories would be conducted to avoid placing gather facilities in areas with cultural resources and to ensure that measures are taken to avoid any cultural resource impacts.
Forest Health	N	Project has a negligible impact directly, indirectly and cumulatively to forest health. Detailed analysis not required.
Migratory Birds	Y	Effects to resource are analyzed in this EA.
Livestock Grazing	Y	Effects to resource are analyzed in this EA.
Native American Religious and other Concerns	N	No potential traditional religious or cultural sites of importance have been identified in the project according to the Ely District RMP Ethnographic Report. Tribal consultation has not identified any issues.
Wastes, Hazardous or Solid	N	No hazardous or solid wastes exist in the designated HMA boundaries, nor would any be introduced.
Water Quality, Drinking/Ground	N	The proposed action or alternatives would not affect drinking or groundwater quality. The project design would avoid surface water and riparian systems and no water wells would be

Resource/Concern	Issue(s) Analyzed? (Y/N)	Rationale for Dismissal from Detailed Analysis or Issue(s) Requiring Detailed Analysis
		affected.
Environmental Justice and Socioeconomics	N	The Proposed Action would not have disproportionately high or adverse effects on low income or minority populations. Health and environmental statutes would not be compromised. The Proposed Action would not disproportionately impact social or economic values.
Floodplains	N	The project analysis area was not included on FEMA flood maps.
Farmlands, Prime and Unique	N	Resource not present.
Species Threatened, Endangered or Proposed for listing under the Endangered Species Act.	N	The Railroad Valley springfish (*Crenichthys nevadae) is a Federally Threatened species and* is found in two springs on the Duckwater Shoshone Reservation. The gather would take place entirely on BLM land and would therefore not affect this species.
Wetlands/Riparian Zones	Y	Effects to resource are analyzed in this EA.
Non-native Invasive and Noxious Species	Y	Effects to resource are analyzed in this EA.
Wilderness/WSA	Y	Effects to resource are analyzed in this EA.
Fire / Fuels	Y	Effects to resource are analyzed in this EA.
Lands with Wilderness Characteristics	N	6 BLM LWC inventory units (NV-040:131E,131E4, 131F, 148-1, 148-2,158-2) are contiguous with USFS Wilderness. Impacts to Wilderness Character are same as those analyzed under Wilderness and WSA.
Recreation	N	Temporary impacts to dispersed recreation in the area would be negligible. Detailed analysis is not necessary.
Visual Resource Management	N	There will be no impacts to visual resources.
Human Health and Safety	N	Risks have been assessed to mitigate any safety hazards in the form of safety plans and risk management worksheets.
Wild and Scenic Rivers	N	Not Present.
Special Status Plant and Animal Species	Y	Effects to resource are analyzed in this EA.
Fish and Wildlife	Y	Effects to resource are analyzed in this EA.
Paleontology	N	There are Mollusks and Brachiopods/corals identified within the Jakes Wash HA. All known paleontology would be avoided during the gather operations; therefore, no effects are expected from the Proposed Action
Wild Horses	Y	Effects to resource are analyzed in this EA.
Soils Resources	Y	Effects to resource are analyzed in this EA.
Water Resources (Water Rights)	N	The Proposed Action and Alternatives would not affect water resources or water rights. Project design would avoid surface water and riparian systems. Permitted or pending water uses would not be affected.
Mineral Resources	N	There would be no modifications to mineral resources through the Proposed Action.
Vegetation Resources	Y	Effects to resource are analyzed in this EA.

3.2. General Setting

The Pancake Complex is within the Great Basin physiographic region, characterized by a high, rolling plateau underlain by basalt flows covered with a thin loess and alluvial mantle. On many of the low hills and ridges that are scattered throughout the area, the soils are underlain by bedrock. Elevations within the Complex range from approximately 5,000 feet to 11,000 feet. Annual precipitation ranges from approximately 5 inches or less on some of the valley bottoms to 20 inches on the mountain peaks. Most of this precipitation comes during the winter and spring months in the form of snow, supplemented by localized thunderstorms during the summer months. Temperatures range from greater than 90 degrees to 98 degrees Fahrenheit in the summer months to minus 20 degrees in the winter. The area is also utilized by domestic livestock and numerous wildlife species.

3.3. Wild Horses

Affected Environment

In January 2022, the BLM conducted a wild horse gather in the Pancake Complex. During the gather 2054 excess wild horses were captured. Six stallions were released, and 18 mares were treated and released back into the Pancake Complex. The mares that were treated and released during the 2022 gather had been captured, treated, and released during prior gathers.

<u>Pancake HMA</u>

The 1987 Egan RMP originally designated the Monte Cristo and Sand Springs East HMAs for the long-term management of wild horses. These HMAs were later combined into the Pancake HMA in the 2008 Ely RMP due to the interchange between the two HMAs. The HMA is nearly identical in size and shape to the original Herd Areas representing where wild horses were located in 1971. Some fences exist within the HMA but do not restrict wild horse movement as they are open ended drift fences. Currently, management of HMAs and wild horse populations within the Ely District is guided by the Ely District RMP. The AML range for the Pancake HMA is 240-493 wild horses. The current estimated population is 1,092 wild horses.

Water available for use by wild horses within the Pancake HMA is limited to a few perennial sources. Ike Spring, Moody Spring and Indian Spring tend to produce water year-round. As water supplies become depleted at other smaller water sources, wild horses tend to concentrate around these primary water sources causing negative effects to riparian resources. These water sources are monitored throughout the summer to make sure water is available for wild horses. The Young Florio Spring water development has been damaged by excess numbers of wild horses as they search for water. During the summer months this spring only produces a trickle of water. This water development has been fixed several times with repairs to the pipeline. Following each repair, the wild horses have damaged the water development by pawing and breaking the pipeline. Young Florio Well is an ephemeral water source which, depending on the year's precipitation level in the area, may or may not produce water and during summer months helps relieve pressure from Young Florio Spring. However, it is not a reliable source of perennial water. At Martiletti Spring, a development of pipeline and trough system installed in 2015 has helped contain the water that the spring produces, however the flow changes seasonally and all but dries up in the hot summer months. Moody Spring had a fence exclosure put around the spring to protect the spring source while allowing the water to seep out and fill a catch pond below it. In 2016 and 2018 an emergency gather took place at Moody and Martilletti Springs to reduce the number of horses that were relying on these drying up water sources. Wild horses also rely on springs located on the Forest Service lands within and outside the Monte Cristo Wild Horse Territory. The remaining springs within the Pancake HMA might have water in early spring depending on precipitation but are not reliable perennial water sources.
In 2012 two water developments (Guzzlers) were constructed in the Big Sand Springs Valley of the Pancake HMA. These water developments were constructed to help with distribution of wild horses throughout the area and relieve pressure from heavily used springs in the area. The duration of available

water is dependent on the precipitation, and how many animals are using the developments.

BLM recognizes that when wild horse density is low relative to available resources, horses can have some positive ecological effects, but these positive effects do not outweigh degradation that can result when horse numbers and impacts are high relative to available natural resources (See Appendix XII). Rangeland resources have been and are currently being impacted within the Pancake HMA due to the over-population of wild horses. Rangeland Health Standards have found wild horses are contributing factors for not meeting these Standards. Resource monitoring data for the South Sand Springs Valley Use Area – an area that has not been grazed by cattle for the past 20 years -- has found wild horses and drought as the contributing factors for not meeting the Standards.

Utilization data was collected for the Pancake HMA in April 2023. The key forage species monitored at that time include: Indian ricegrass (*Achnatherum hymenoides*), winterfat (*Krascheninnikovia lanata*), Squirreltail grass (*Elymus elymoides*) and Needleandthread grass (*Hesperostipa comata*). Current monitoring data collected using Range Utilization Key Forage Plant Method over the last three years has indicated Moderate (41-60%) and Heavy (61-80%) utilization directly attributable to wild horses. Use pattern mapping in April 2023 shows wild horse utilization as 5% slight (1-20%), 17% light (21-40%), 42% moderate (41-60%), 18% heavy (61-80%), 11% severe (81-100%).

<u>Jakes Wash HA</u>
The Egan RMP (1987 Ely District) designated the Jakes Wash Herd Management Area for the long-term management of wild horses. However, based on monitoring and analysis, the 2008 Ely RMP changed direction. Management action WH-5 states: “remove wild horses and drop herd management area status for those as listed in Table 13.” Jakes Wash was accordingly dropped from HMA status and returned to HA status (i.e., to manage “0” wild horses) with this management action. The management action to manage for no wild horses within the Jakes Wash HA reflects the habitat suitability evaluation based on multi-tiered analysis from the Ely Proposed Resource Management Plan/Final Environmental Impact Statement (November 2007) table 3.8-2 and page 4.8-2. The components and herd characteristics assessed were forage, water, cover, space, and reproductive viability. If one or more of these components were missing, or there was no potential for maintenance of genetic diversity, the HMA was considered unsuitable for wild horse management. The Jakes Wash HA has inadequate forage, water, space, and cover for long-term management of wild horses. The estimated population in Jakes Wash HA is 102 wild horses.

Water available for use by wild horses within the Jakes Wash HA is very limited. Two springs located in the southern end and three stock watering ponds provide the only available water in the northern and central portions of the HA. These ponds are filled with winter/spring runoff or water released from the nearby Illipah reservoir by the water right holder and tend to go dry in mid- to late summer. As these ponds and reservoirs dry up wild horses leave the HA boundary in search of water. During the summer months wild horses can be found outside HA boundaries on US Forest Service lands which are not managed as a Wild Horse Territory. Water is also available for use by wild horses when livestock operators pump three stock-water wells (with privately held water rights) in the southern end of the HA, but that is only for a few months each year when livestock are present.

Utilization data was collected for Jakes Wash HA in March 2023. Use pattern mapping shows wild horse utilization as 0% slight (1-20%), 25% light (21-40%), 50% moderate (41-60%), 17% heavy (61-80%), 8% severe (81-100%) or lost due to flooding within the area.

<u>Sand Springs West HMA</u>
The Sand Springs West HMA is administered by the Battle Mountain District, Tonopah Field Office. It is bordered to the northeast by the Pancake HMA, split only by the Battle Mountain and Ely District boundary. Wild horses in the Sand Springs West HMA commonly move back and forth to the Pancake

HMA seeking available forage and water.

The Sand Springs West AML of 49 wild horses was initially established through a stipulated agreement (Consent Decision) between BLM, E. Wayne Hage, Colvin and Son Cattle Co., and Russell Ranches through the Department of the Interior Office of Hearings and Appeals, Hearings Division, and was affirmed in the Tonopah Resource Management Plan (RMP) approved October 6, 1997. The RMP objectives state "*to manage wild horse and/or burro populations within Herd Management Areas at levels which will preserve and maintain a thriving natural ecological balance consistent with other multiple-use objectives*" and "*to manage wild horses and/or burros at appropriate management levels (AML) or interim herd size (IHS) for each HMA* . . . ." The current estimated population is 156 wild horses.

Water in the Sand Springs West HMA is limited to man-made water-haul sites developed for grazing livestock. One site (Etcheverria Well) has a small reservoir that seasonally holds run-off water which is available to wild horses. This water accumulates from winter precipitation and snow melt, only to dry up during the hot summer months. Water is available to wild horses temporarily at water haul sites while domestic livestock are grazing; however, they are not reliable sources. Some water hauls sites have small depressions or tanks that may temporarily hold water from natural precipitation; however, they are not consistent or dependable sources. No known natural springs occur on the HMA except along Nevada State Highway 6, at which horses are rarely observed. Many of the wild horses from the Sand Springs West HMA travel into the Pancake HMA administered by BLM in the Ely District or to areas outside of the Sand Springs West HMA in search of water sources. Concentrations of wild horses and cattle around the limited water sources during the summer months increases competition with wildlife for water resources and negatively affect the associated range resources.

Forage quality and quantity on the Sand Springs West HMA is generally poor due to a majority of sandy and volcanic soils and little precipitation. Drought is a common occurrence throughout Nevada and the Great Basin; the Sand Springs West HMA is no different. Drought conditions during the period of March through June can substantially reduce annual production of forage, as well as have detrimental effects on vegetative health, especially under heavy or repeated grazing. As water becomes scarcer in the summer months, even less forage would be available as wild horses will travel shorter distances from the available water. With the current excess population of wild horses, severe range degradation may occur. Overall wild horse herd and individual health may also be in at risk if AML is not achieved and maintained.

The general vegetation trend for key species from 1981 to 2020 is declining among Indian ricegrass, Winterfat, and Squirreltail grass at most key areas. There are some areas that have increases in cheatgrass (*Bromus tectorum*) and Yellow rabbitbrush (*Chrysothamnus viscidiflorus*) indicating overgrazed rangelands. Galleta grass (*Pleuraphis jamesii*) generally shows a stable to slight increase in trend. These decreases in key species are due in most part to grazing by cattle and wild horses. Wild horses can spread nonnative plant species, including cheatgrass, and may limit the effectiveness of habitat restoration projects (Beever et al. 2003, Couvreur et al. 2004, Jessop and Anderson 2007, Loydi and Zalba 2009, King et al. 2019).

Utilization data was collected in April 2023 on key forage species including Indian ricegrass, Winterfat, and Squirreltail at 15 Key Areas (KAs) within the Sand Springs West HMA. Many of these KAs were primarily utilized by wild horses, though signs of cattle utilization were also apparent at many sites. Numerous sites and many roads throughout the HMA showed extensive wild horse trailing and stud piles. Utilization data was documented for the previous year (2023). Use pattern mapping in April 2023 shows wild horse utilization as 23% slight (1-20%), 23% light (21-40%), 30% moderate (41-60%), 13% heavy (61-80%), 15% severe (81-100%). In general, utilization was lower on benches, likely due to limited availability of water. Several sites were dominated by Yellow rabbitbrush, an indication of historic overutilization. While some new growth of both grasses and shrubs was observed at most KAs, plant vigor for those individual plants exhibiting heavy to severe utilization was lower than would otherwise be expected. Cheatgrass was dominant at five of the KAs. Push outs (shallow water ponds for animal watering) in valley bottoms were all dry or nearly dry.

Body condition scores of horses observed in the Sand Springs West HMA in 2023 ranged from a Henneke body condition score (BCS) of 2 (very thin/emaciated) to 4 (moderately thin).

Monte Cristo WHT

The Monte Cristo Wild & Free Roaming Horses Management Plan established a baseline AML of 72–120 wild horses, with an average of 96 head to be maintained. These numbers were based on proper use studies conducted on the natural horse concentration areas. The baseline AML was adjusted to 72–96 through the Humboldt National Forest Land & Resource Management Plan in 1986. Range conditions have not improved given the number of horses occupying the area. The current estimated population is 145 wild horses. The population within this HMA can fluctuate depending on the seasonal movement of the wild horses.

Water available for use by wild horses within the Monte Cristo WHT is very limited. There are no active streams; however, several seeps and springs can be found across the territory. Pinyon-juniper is abundant and in some instances affecting water flow. In addition, when water is present these vegetation communities experience heavy utilization by wild horses.

Utilization data was collected within the riparian zones within the Treasure Hill portion of the Monte Cristo WHT during July and September 2023. The key forage species was Nebraska Sedge. Early season monitoring location showed moderate use (1 to 20%) and late season monitoring locations showed heavy use (21 to 40%). No data was collected in the Blackrock portion of the territory.

Pancake Complex

Population inventory flights have been conducted in the Complex every two to three years. These population inventory flights have provided information pertaining to population numbers, foaling rates, distribution, and herd health. A population inventory was conducted March 2021 utilizing a direct count method and 2,703 wild horses were observed throughout the project area. Wild horse body condition scores (BCS) within the Complex currently range from a score of 2-5 (Very thin/emaciated – Moderate) based on the Henneke Body Condition Chart and some animals at time of gather may have a lower BCS of 2-3 (Very thin – Thin). Genetic baseline data would be collected to monitor the genetic diversity of the wild horses within the project area. Samples may also be taken for ancestral analysis.

Standards determination documents and rangeland health evaluations have identified wild horses as a contributing factor for non-achievement of some standards for rangeland health and management objectives. The achievement or non-achievement of standards for rangeland health are summarized in Appendix VII. These standard determination documents, evaluations, and write-ups are available at the Bristlecone and Tonopah Field Offices.

Population Modeling

Population modeling was completed for the proposed action and alternatives to analyze how the alternatives would affect the wild horse populations. Analysis included removal of excess wild horses with no fertility control, as compared to alternatives which consider removal of excess wild horses with fertility control and sex ratio adjustments. The No Action (no removal) Alternative was also modeled (Appendix VI). The primary objective of the modeling was to identify if any of the alternatives "crash" the population or cause extremely low population numbers or growth rates. The results of population modeling show that minimum population levels and growth rates would be within reasonable levels and adverse impacts to the population would not be likely under Alternatives A, B, and C. Graphic and tabular results are displayed in detail in Appendix VI.

Genetic Diversity

During the 2022 gather in the Complex, the BLM collected genetic samples for analysis by E. Gus Cothran and Rytis Juras. The BLM received those results on April 22, 2024. In summary, the genetic variability of this herd is near average. The herd ancestry likely includes some Spanish component based upon this data and the 2001 data. Similarity levels show no clear ancestral relationships. The analysis found that current variability levels are good for this herd and no immediate action is recommended. The analysis recommended that long term monitoring should be continued, and re-sampling of the herd should be done by 2028 to check for changes in variation.

The Sand Springs East HMA, which became part of the Pancake HMA, was sampled for genetic diversity in the past. Results from nearby HMAs are also informative and indicate that genetic diversity is expected to be high within the Pancake complex. Based on samples from the Sand Springs East HMA, Cothran (2009) noted that, "Genetic variability of this herd is high. The values related to allelic diversity in particular suggest a herd with highly mixed ancestry...No action is needed at this time due to the high variability and relatively high AML." Future genetic sampling and monitoring would be facilitated by gather operations. If necessary, animals would be introduced into the Complex to increase heterozygosity.

Because of history, context, and periodic introductions, wild horses that live in the Pancake Complex should not be considered as truly isolated populations (NRC 2013). Rather, managed herds of wild horses should be considered as components of interacting metapopulations, connected by interchange of individuals and genes due to both natural and human-facilitated movements. These animals are part of a larger metapopulation (NRC 2013) that has demographic and genetic connections with other BLM-managed herds in Nevada, Utah, and beyond. This conclusion is also supported by multiple analyses in Cothran et al. (2024). Wild horse herds in the larger metapopulation have a background of diverse domestic breed heritage, probably caused by natural and intentional movements of animals between herds. At low AML, the herd size of wild horses in the Pancake complex would be 361; even if half of the mares are infertile at any one point, that number, along with interchange from nearby herds, should allow for a low rate of loss of observed heterozygosity. Under the proposed action, hair follicle samples would be collected during gathers, from at least 25 animals, to assess the levels of genetic diversity of the herds. Analysis would determine whether management is maintaining acceptable genetic diversity (and avoiding excessive risk of inbreeding depression).

Under all action alternatives, wild horse introductions from other HMAs could be used if needed, to augment observed heterozygosity, which is a measure of genetic diversity, the result of which would be to reduce the risk of inbreeding-related health effects. Introducing a small number of fertile animals every generation (about every 8-10 years) is a standard management technique that can alleviate potential inbreeding concerns (BLM 2010).

The 2013 National Academies of Sciences report included other evidence that shows that wild horses in the Pancake HMA (i.e. when it was Sand Springs East HMA) and in herds very close to the Complex are not genetically unusual, with respect to other wild horse herds. Specifically, Appendix F of the 2013 NRC report is a table showing the estimated 'fixation index' (Fst) values between 183 pairs of samples from wild horse herds. Fst is a measure of genetic differentiation, in this case as estimated by the pattern of microsatellite allelic diversity analyzed by Dr. Cothran's laboratory. Low values of Fst indicate that a given pair of sampled herds has a shared genetic background. The lower the Fst value, the more genetically similar are the two sampled herds. Values of Fst under approximately 0.05 indicate virtually no differentiation. Values of 0.10 indicate very little differentiation. Only if values are above about 0.15 are any two sampled subpopulations considered to have evidence of elevated differentiation (Frankham et al 2010). Pairwise Fst values for Sand Springs East HA were less than 0.05 with over 120 other sample sets. These results, along with new analyses in Cothran et al. (2024), suggest that herds in and near the Pancake complex were extremely similar to one-third to two-thirds of other BLM-managed herds, supporting the interpretation that Pancake Complex horses are components in a highly connected metapopulation that includes horse herds in many other HMAs.

Environmental Effects

No Action Alternative
Under the No Action Alternative, no population growth suppression action or wild horse removals (gathers) would take place. A HMAP would not be implemented for the Pancake Complex. The population of the wild horses within the Pancake Complex would continue to grow at the national average rate of increase seen in the majority of HMAs of 20 to 25% per year.

The wild horse population levels would not achieve AML or a thriving natural ecological balance, and excess concentrations of wild horses would continue to impact site specific areas throughout the Complex at this time. The animals would not be subject to the individual direct or indirect impacts as a result of a trapping operation. Over the short-term, individual animals in the herd would be subject to increased stress and possible death as a result of increased competition for water and/or forage as the population continues to grow even further in excess of the land's capacity to meet the wild horses' habitat needs. The areas currently experiencing heavy to severe utilization by wild horses would increase over time and degradation could become irreversible in areas where ecological thresholds are passed.

This alternative would be expected to result in increasing damage to rangeland resources throughout the Complex. Trampling and trailing damage by wild horses in/around riparian and impacts to rangeland resources would also be expected to increase, resulting in larger, more extensive areas of poor range condition, some of which might be unable to recover even after removal of excess horses. Competition for the available water and forage among wild horses, domestic livestock, and native wildlife would continue and further increase.

Wild horses are a long-lived species with survival rates estimated between 80 and 97% and may be the determinant of wild horse population increases (Garrott and Taylor 1990, Ransom et al. 2016). Predation and disease have not substantially regulated wild horse population levels within or outside the project area. Throughout the HMAs few predators exist to control wild horse populations. Some mountain lion predation occurs but does not appear to be substantial, as evidenced by the continued high growth rates in the herds. Coyotes are not prone to prey on wild horses unless the horses are young, or extremely weak. Other predators such as wolf or bear do not inhabit the area in high enough numbers to cause an effect on horse growth rates. Being a non-self-regulating species (NRC 2013), there would be a steady increase in wild horse numbers for the foreseeable future, which would continue to exceed the carrying capacity of the range. Individual wild horses would be at risk of death by starvation and lack of water as the population continues to grow annually. The wild horses would compete for the available water and forage resources, affecting mares and foals most severely. Social stress would increase. Fighting among stud horses would increase as well as injuries and death to all age classes of animals as the studs protect their position at scarce water sources. Significant loss of the wild horses in the Complex due to starvation or lack of water would have obvious consequences to the long-term viability of the herd. Allowing wild horses to die of dehydration and starvation would be inhumane treatment and would be contrary to the WFRHBA, which mandates removal of excess wild horses.

The damage to rangeland resources that results from excess numbers of wild horses is also contrary to the WFRHBA, which mandates the Bureau 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." Once the vegetative and water resources are at critically low levels due to excessive utilization by an overpopulation of wild horses, the weaker animals, generally the older animals and the mares and foals, are the first to be impacted. It is likely that a majority of these animals would die from starvation and dehydration. The resultant population would be extremely skewed towards the stronger stallions which would lead to significant social disruption in the Complex. By managing the public lands in this way, the vegetative and water resources would be impacted first and to the point that they have limited potential for recovery, as is already occurring in some areas hardest hit by the excess wild horses. As a result, the No Action Alternative, by delaying the removal of excess horses from specific areas that are most impacted at this time, would not ensure healthy rangelands that would allow for the management of a healthy wild horse population, and would not promote a thriving natural ecological balance.

As populations increase beyond the capacity of the habitat, more bands of horses would also leave the boundaries of the Complex in search of forage and water, thereby increasing impacts to rangeland resources outside the HMA boundaries as well. This alternative would result in increasing numbers of wild horses in areas not designated for their use and would not achieve and thriving natural ecological balance.

Proposed Action

The Proposed Action would implement a management strategy (HMAP Table 2) which would incorporate a number of population growth suppression methods. Sand Springs West AML (Table 3) would be adjusted to a range of 28-49 wild horses. This is based off This would comply with the 1997 Tonopah RMP which states: "Excess horses and burros as determine by monitoring will be removed to a level from which it may take three years to again reach Appropriate Management Level. Wild horses across the Pancake Complex would be managed within the AML range of 336-638 wild horses. By decrease the existing overpopulation of wild horses in the course of successive helicopter drive trap and bait and water trapping operations over a period of ten years. Stallions would be selected for release with the objective of establishing a 60% male ratio out of the low-range AML herd size on the range. Any mares that would be returned to the range would be treated with fertility control (PZP vaccines, GonaCon, IUDs). The target population when the objectives of this alternative are reached is to manage a total population at approximately mid-range AML, or roughly 500 wild horses. The Proposed Action would not reduce all of the associated impacts to the wild horses and rangeland resources as quickly as the other alternatives because the herd would be maintained near mid-AML as opposed to low AML. Over the short-term, individuals in the herd would still be subject to increased stress and possible death as a result of continued competition for water and forage until the project area's population can be reduced to the AML range. The areas experiencing heavy and severe utilization levels by wild horses would likely still be subject to some excessive use and impacts to rangeland resources, those being concentrated trailing, riparian trampling, increased bare ground, etc. These impacts would be expected to continue until the project area's population can be reduced to the AML range and concentration of horses can be reduced.

Removal of excess wild horses would improve herd health. Decreased competition for forage and water resources would reduce stress and promote healthier animals. This removal of excess animals coupled with anticipated reduced reproduction (population growth rate) as a result of fertility control should result in improved health and condition of mares and foals as the actual population comes into line with the population level that can be sustained with available forage and water resources, and would allow for healthy range conditions (and healthy animals) over the longer-term. Additionally, reduced population growth rates would be expected to extend the time interval between large gathers and reduce disturbance to individual animals as well as to the herd social structure over the foreseeable future.
Bringing the wild horse population size back to low AML (which could increase to mid-range AML with the addition of some geldings) and slowing its growth rate once that level has been achieved would reduce damage to the range from the current overpopulation of wild horses and allow vegetation resources to start recovering, without the need for additional gathers in the interim. As a result, there would be fewer disturbances to individual animals and the herd, and a more stable wild horse social structure would be provided. Managing a self-sustaining population that includes some component of geldings would also allow BLM to manage the wild horse population at the mid-range of AML once the low AML has been achieved, without adversely impacting rangeland resources as a result of a more rapid population growth in excess of AML.

Impacts to individual animals may occur as a result of handling stress associated with the gathering, processing, and transportation of animals. The intensity of these impacts varies by individual animal and is indicated by behaviors ranging from nervous agitation to physical distress. Mortality to individual animals from these impacts is infrequent but does occur in 0.5% to 1% of wild horses gathered in a given gather (Scasta 2019, along with new analyses in Cothran et al. (2024),). Other impacts to individual wild horses include separation of members of individual bands of wild horses and removal of animals from the population.

Indirect impacts can occur after the initial stress event, and may include increased social displacement or increased conflict between stallions. These impacts are known to occur intermittently during wild horse gather operations. Traumatic injuries may occur; however, typical injuries involve bruises from biting and/or kicking, which do not break the skin.

Stallions selected for release would be released to increase the post-gather sex ratio to approximately 60% stallions, out of the low AML overall herd size. Stallions would be selected to maintain a diverse age structure, herd characteristics and body type (conformation). It is expected that releasing additional stallions to reach the targeted sex ratio of 60% males would result in smaller band sizes, larger bachelor groups, and some increased competition for mares (see Appendix XII). With more stallions involved in breeding it should result in a slightly higher genetic effective population size (Ne) relative to total herd size.

Alternative B
Alternative B is similar to Alternative A except that it includes a gelding component. This alternative would include selective removal of excess wild horses to low end AML, population growth control using mare fertility control treatments (PZP vaccines, GonaCon or most current vaccine formulation, IUDs) gelding and sex ratio adjustments. In addition to bring the wild horse population to low AML, up to 138 gelded horses may be returned to the range and managed as a non-breeding population of geldings, Some gelded horses that would otherwise be excess animals permanently removed from the range and sent to ORC for adoption/sales or ORP, may be returned to the range and managed as a nonbreeding population of geldings so long as the geldings do not result in the population exceeding mid-range AML

Gelding
Castration (the surgical removal of the testicles, also called gelding or neutering) is a well-established surgical procedure for the sterilization of domestic and wild horses. The procedure rarely leads to serious complications and seldom requires postoperative veterinary care. Gelding adult male horses results in reduced production of testosterone which directly influences reproductive behaviors. Although 20-30% of domestic horses, whether castrated pre- or post-puberty, continued to show stallion-like behavior (Line et al. 1985), it is assumed that free roaming wild horse geldings would exhibit reduced aggression toward other horses and reduced reproductive behaviors. Gelding of domestic horses most commonly takes place before or shortly after sexual maturity, and age-at-gelding can affect the degree to which stallion-like behavior is expressed later in life.

Though castration (gelding) is a common surgical procedure, minor complications are not uncommon after surgery, and it is not always possible to predict when postoperative complications would occur. fortunately, the most common complications are almost always self-limiting, resolving with time and exercise. Individual impacts to the stallions during and following the gelding process should be minimal and would mostly involve localized swelling and bleeding. A small amount of bleeding is normal and generally subsides quickly, within 2-4 hours following the procedure. Some localized swelling of the prepuce and scrotal area is normal and may begin between one to 5 days after the procedure. Swelling should be minimized through the daily movements (exercise) of the horse during travel to and from foraging and watering areas. Most cases of minor swelling should be back to normal within 5-7 days, more serious cases of moderate to severe swelling are also self-limiting and resolve with exercise after one to 2 weeks. Serious complications (eviscerations, anesthetic reaction, injuries during handling, etc.) that result in euthanasia or mortality during and following surgery are rare and vary according to the population of horses being treated. Normally one would expect serious complications in less than 5% of horses operated under general anesthesia, but in some populations these rates can be as high as 12% (Shoemaker 2004). These complications are generally noted within 3 or 4 hours of surgery but may occur any time within the first 7 days following surgery. If they occur, they would be treated in the same manner as at BLM facilities.

By including some geldings in the population and having a slightly skewed sex ratio with more males than females overall, the result would be that there would be a relatively lower number of breeding females in the population and, hence, a lower per-capita growth rate. The surgery would be performed by a veterinarian using general anesthesia and appropriate surgical techniques. The final determination of which specific animals would be gelded for release would be based on the professional opinion of the attending veterinarian in consultation with the Authorized Officer (see Gelding SOPs in Appendix III). When gelding procedures are done in the field, geldings would be released near a water source, when possible, approximately 24 to 48 hours following surgery. When the procedures are performed at a BLM-managed facility, selected stallions would be shipped to the facility, gelded, held in a separate pen to minimize risk for disease, and returned to the range within 30 days.

Gelded animals would be monitored periodically for complications for approximately 7-10 days post-surgery and release. This monitoring would be completed either through aerial recon if available or field observations from major roads and trails. It is not anticipated that all the geldings would be observed but the goal is to detect complications if they are occurring and determine if the horses are freely moving about the HMA. Once released, anecdotal information suggests that the geldings would form bachelor bands. Periodic observations of the long term outcomes of gelding would be recorded during routine resource monitoring work. Such observations could include but not be limited to band size, social interactions with other geldings and harem bands, distribution within their habitat, forage utilization and activities around key water sources. Periodic population inventories and future gather statistics would assist BLM to determine if managing a portion of the herd as non-breeding animals is an effective approach to slowing the annual population growth rate and extending the gather cycle when used in conjunction with other population control techniques, while allowing more horses to remain on the range.

Surgical sterilization techniques, while not reversible, may provide reproductive control on horses without the need for any additional handling of the horses as required in the administration of chemical contraception techniques. See Appendix XII for a more detailed analysis on gelding effects.

Alternative C
Much like the Proposed Action and Alternative B this action would address the need to remove excess wild horses while bringing the population on the range to the low AML. This action would address attainment and maintenance of a thriving natural ecological balance through the gather and removal of excess animals only. Direct impacts to the wild horse population would be the decreased population to low AML resulting in reduced competition for scarce resources within the HMA such as water, forage, and space. Improved body condition should be experienced in the short term by the remaining wild horse population in the Complex. There would be increased opportunities for wild horses to utilize higher quality habitat related to a reduction in competition in these areas and to lessened pressure on the habitat itself. Reduced wild horse densities should result in less competition between bands resulting in fewer injuries and a reduced risk of disease outbreak.

This alternative would directly impact the BLM's Wild Horse Program's off range corrals and off-range pasture facilities. Due to national WHB program constraints, the available funding and space at these facilities may be needed for other higher priority removals. This action would not address population control on the range by reducing population growth and would not slow population growth over the long term or result in greater intervals between gathers or fewer excess wild horses being removed and sent to short term holding and long-term pasture facilities.

Under Action Alternative C, impacts to the population growth rate should be moderately higher than with Alternatives A and B and so the population would increase at a higher rate resulting in more frequent gathers and many more animals being removed over time.

Alternative D
This action would address attainment and maintenance of a thriving natural ecological balance within the Jakes Wash HA. It may take multiple gathers to remove all the horses from the Jakes Wash HA since gather efficiencies are less than 100% and some horses will evade capture or hide where they cannot be seen from the helicopter. It is expected that resources would eventually return from a degraded state as horses are removed. There would be increased opportunities for any remaining wild horses there (pending capture and removal of all excess horses) to utilize higher quality habitat related to a reduction in competition in these areas and to lessened pressure on the habitat itself. Reduced wild horse densities should result in less competition between bands resulting in fewer injuries and a reduced risk of disease outbreak in the short term.

Effects Common to the Proposed Action and Alternative B
Fertility Control BLMs Use of Contraception in Wild Horse Management

Expanding the use of population growth suppression to slow population growth rates and reduce the number of animals removed from the range and sent to Off-Range Pastures (ORPs) is a BLM priority. The WFRHBA of 1971 specifically provides for contraception and sterilization (section 3.b.1) as viable management approaches. No finding of excess animals is required for BLM to pursue contraception in wild horses or wild burros. Contraception has been shown to be a cost effective and humane treatment to slow increases in wild horse populations or, when used with other techniques, to reduce horse population size (Bartholow 2004, de Seve and Boyles-Griffin 2013). All fertility control methods in wild animals are associated with potential risks and benefits, including effects of handling, frequency of handling, physiological effects, behavioral effects, and reduced population growth rates (Hampton et al. 2015). Contraception by itself does not remove excess horses from an HMA's population, so if a wild horse population is in excess of AML, then contraception alone would result in some continuing environmental effects of horse overpopulation (ie. Appendix VI). Successful contraception reduces future reproduction. Limiting future population increases of horses could limit increases in environmental damage from higher densities of horses than currently exist. Horses are long-lived, potentially reaching 20 years of age or more in the wild and, if the population is above AML, treated horses returned to the HMA may continue exerting negative environmental effects, as described in the PZP Direct Effects and GnRH Direct effects sections in Appendix XII, throughout their life span. In contrast, if horses above AML are removed when horses are gathered, that leads to an immediate decrease in the severity of ongoing detrimental environmental effects throughout their lifespan, as described above. See Appendix XII for a more detailed analysis on fertility control effects.

Effects Common to the Proposed Action and Alternatives B, C and D

Over the past 35 years, various impacts to wild horses as a result of gather activities have been observed. Under the Proposed Action, potential impacts to wild horses would be both direct and indirect, occurring to both individual horses and the population as a whole.

Helicopter Drive Trapping

The BLM has been conducting wild horse gathers since the mid-1970s and has been using helicopters for such gathers since the late 1970's. During this time, methods and procedures have been identified and refined to minimize stress and impacts to wild horses during gather implementation. Published reviews of agency practice during gathers and subsequent holding operations confirm that BLM follows guidelines to minimize those impacts and ensure humane animal care and high standards of welfare (GAO 2008, AAEP 2011, Greene et al. 2013, Scasta 2019). Refer to Appendix II, III, and IV for information on the methods that are utilized to reduce injury or stress to wild horses and burros during gathers. The Comprehensive Animal Welfare Policy (CAWP) would be implemented to ensure a safe and humane gather occurs and would minimize potential stress and injury to wild horses.

In any given gather, gather-related mortality averages only about one half of one percent (0.5%), which is very low when handling wild animals. Approximately, another six-tenths of one percent (0.6%) of the captured animals, on average, are humanely euthanized due to pre-existing conditions and in accordance with BLM policy (GAO 2008, Scasta 2019). These data affirm that the use of helicopters and motorized vehicles has proven to be a safe, humane, effective, and practical means for the gather and removal of excess wild horses (and burros) from the public lands. The BLM also avoids gathering wild horses by helicopter during the 6 weeks prior to and following the expected peak of the foaling season (i.e., from March 1 through June 30).

Individual, direct impacts to wild horses include the handling stress associated with the roundup, capture, sorting, handling, and transportation of the animals. The intensity of these impacts varies by individual, and is indicated by behaviors ranging from nervous agitation to physical distress. When being herded to trap site corrals by the helicopter, injuries sustained by wild horses may include bruises, scrapes, or cuts to feet, legs, face, or body from rocks, brush or tree limbs. Rarely, wild horses will encounter barbed wire fences and will receive wire cuts. These injuries are very rarely fatal and are treated on-site until a veterinarian can examine the animal and determine if additional treatment is indicated.

Other injuries may occur after a horse has been captured and is either within the trap site corral, the temporary holding corral, during transport between facilities, or during sorting and handling. Occasionally, horses may sustain a spinal injury or a fractured limb but based on prior gather statistics, serious injuries requiring humane euthanasia occur in less than 1 horse per every 100 captured. Similar injuries could be sustained if wild horses were captured through bait and/or water trapping, as the animals still need to be sorted, aged, transported, and otherwise handled following their capture. These injuries can result from kicks and bites, or from collisions with corral panels or gates.

To minimize the potential for injuries from fighting, the animals are transported from the trap site to the temporary (or short-term) holding facility where they are sorted as quickly and safely as possible, then moved into large holding pens where they are provided with hay and water. Fatalities and injuries due to gathers are few, with direct gather related mortality averaging less then 1%. Most injuries are a result of the horse's temperament, meaning they do not remain calm and lash out more frequently.

Gathering wild horses during the summer months can potentially cause heat stress. Gathering wild horses during the fall/winter months reduces risk of heat stress, although this can occur during any gather, especially in older or weaker animals. Adherence to the SOPs 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' exposure to dust.

Indirect individual impacts are those which occur to individual wild horses after the initial event. These may include miscarriages in mares, increased social displacement, and conflict in studs. These impacts, like direct individual impacts, are known to occur intermittently during wild horse gather operations. An example of an indirect individual impact would be the brief 1-2 minute skirmish between older studs which ends when one stud retreats. Injuries typically involve a bite or kick with bruises which do not break the skin. Like direct individual impacts, the frequency of these impacts varies with the population and the individual. Observations following capture indicate the rate of miscarriage varies but can occur in about 1 to 5% of the captured mares, particularly if the mares are in very thin body condition or in poor health. A few foals may be orphaned during a gather. This can occur if the mare rejects the foal, the foal becomes separated from its mother and cannot be matched up following sorting, the mare dies or must be humanely euthanized during the gather, the foal is ill or weak and needs immediate care that requires removal from the mother, or the mother does not produce enough milk to support the foal. On occasion, foals are gathered that were previously orphaned on the range (prior to the gather) because the mother rejected it or died. These foals are usually in poor condition. Every effort is made to provide appropriate care to orphan foals. Veterinarians may administer electrolyte solutions or orphan foals may be fed milk replacer as needed to support their nutritional needs. Orphan foals may be placed in a foster home in order to receive additional care. Despite these efforts, some orphan foals may die or be humanely euthanized as an act of mercy if the prognosis for survival is very poor.

Through the capture and sorting process, wild horses are examined for health, injury, and other defects. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy. BLM Euthanasia Policy IM-2021-007 is used as a guide to determine if animals meet the criteria and should be euthanized (refer to CAWP). Animals that are euthanized for non-gather related reasons include those with old injuries (broken or deformed limbs) that cause lameness or prevent the animal from being able to maintain an acceptable body condition (greater than or equal to BCS 3); old animals that have serious dental abnormalities or severely worn teeth and are not expected to maintain an acceptable body condition, and wild horses that have serious physical defects such as club feet, severe limb deformities, or sway back. Some of these conditions have a causal genetic component such that the animals should not be returned to the range; this prevents suffering and avoids amplifying the incidence of the deleterious gene in the wild population.

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

It is not expected that genetic diversity would be adversely affected by the Proposed Action. Available indications are that these populations contain high levels of genetic diversity at this time. The AML range of 361-638 in the Complex should provide for acceptable rates of genetic diversity maintenance (BLM 2010). If at any time in the future the genetic diversity in the Pancake Complex is determined to be relatively low, then a large number of other HMAs could be used as sources for fertile wild horses that could be transported into the area of concern to augment local genetic diversity levels.

By maintaining wild horse population size within the AML range, there would be a lower density of wild horses across the Complex, reducing competition for resources and allowing the wild horses that remain to use their preferred habitat. Maintaining population size near the established AML would be expected to improve forage quantity and quality and promote healthy, self-sustaining populations of wild horses in a thriving natural ecological balance and multiple use relationship on the public lands in the area. Deterioration of the range associated with wild horse overpopulation would be reduced. Managing wild horse populations in balance with the available habitat and other multiple uses would lessen the potential for individual animals or the herd to be affected by drought, and would avoid or minimize the need for emergency gathers. All this would reduce stress to the animals and increase the success of these herds over the long-term.

Water/Bait Trapping

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

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

When actively trapping wild horses, the trap would be checked on a daily basis. Wild horses would be either removed immediately or fed and watered for up to several days prior to transport to a holding facility. Existing roads would be used to access the trap sites.

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

Impacts to individual animals would be similar to those for helicopter gathers and could occur as a result of stress associated with the gather, capture, processing, and transportation of animals. The intensity of these impacts would vary by individual and would be indicated by behaviors ranging from nervous agitation to physical distress. Mortality of individual horses from these activities is rare but can occur. Other impacts to individual wild horses include separation of members of individual bands and removal of animals from the population.

Indirect impacts can occur to horses after the initial stress event and could include increased social displacement or increased conflict between studs. These impacts are known to occur intermittently during wild horse gather operations. Traumatic injuries could occur and typically involve bruises caused by biting and/or kicking. Horses may potentially strike or kick gates, panels or the working chute while in corrals or trap which may cause injuries. These impacts, like direct individual impacts, are known to occur intermittently during wild horse gather operations. Since handling, sorting and transportation of horses would be similar to those activities under Helicopter drive trapping, the direct and indirect impacts would be expected to be similar as well. Past gather data shows that euthanasia, injuries and death rates for both types of gathers are similar (also see Appendix XII).

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

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

During the preparation process, potential impacts to wild horses are similar to those that can occur during transport. Injury or mortality during the preparation process is low but can occur.

Mortality at off-range corrals (ORCs) facilities averages approximately 5% (GAO-09-77, Page 51), which includes animals euthanized due to a pre-existing condition, animals in extremely poor condition, animals that are injured and would not recover, animals that are unable to transition to feed; and animals that die accidentally during sorting, handling, or preparation.

Off-Range Pastures (ORPs), known formerly as long-term holding 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 and with the forage, water, and shelter necessary to sustain them in good condition. Mares and sterilized stallions (geldings) are segregated into separate pastures except at one facility where geldings and mares coexist. About 37,000 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 western and midwestern states. The establishment of ORPs is subject to a separate NEPA and decision-making process. Located mainly in mid or tall grass prairie regions of the United States, these ORPs are highly productive grasslands compared to 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 ORP, less than one percent is age 0-4 years, 49 percent are age 5-10 years, and about 51 percent are age 11+ years.

Potential impacts to wild horses from transport to adoption, sale or off-range pastures (ORP) are similar to those previously described. One difference is when shipping wild horses for adoption, sale or ORPs, animals may be transported for up to a maximum of 24 hours. Immediately prior to transportation, and after every 24 hours of transportation, animals are offloaded and provided a minimum of 8 hours on-the-ground rest. During the rest period, each animal is provided access to unlimited amounts of water and two pounds of good quality hay per 100 pounds of body weight with adequate space to allow all animals to eat at one time.

A small percentage of the animals may be humanely euthanized if they are in very poor condition due to age or other factors. Horses residing on ORP facilities live longer, on the average, than wild horses residing on public rangelands, and the 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 Remaining or Released Back into the Complex following Gather

The wild horses that are not captured may be temporarily disturbed and may move into another area during the gather operations. With the exception of changes to herd demographics and their direct population, wide impacts from a gather have proven, over the last 20 years, to be temporary in nature with most if not all impacts disappearing within hours to several days of when wild horses are released back into the HMAs.

No observable effects associated with these impacts would be expected within one month of release, except for a heightened awareness of human presence, and possible changes in specific band composition. There is the potential for the horses that have been desensitized to vehicles and human activities to return to areas where they were gathered if released back into HMAs. The wild horses that remain in the Complex following the gather would maintain their social structure and herd demographics (age and sex ratios) as the proposed gathers would mainly be targeting specific individual or bands of horses. No observable effects to the remaining population from the gather would be expected.

Cumulative Effects

Cumulative Effects of the No Action Alternative

Under the No Action Alternative, the wild horse population within the Pancake Complex combined could exceed 4,718 in two years. Continued and expanded movement outside the HMAs would be expected as greater numbers of horses search for food and water for survival, thus impacting larger areas of public lands and threatening public safety as wild horses cross highways in search of forage. Heavy to Severe utilization of the available forage would continue to be expected and the water available for use would become increasingly limited. Ecological plant communities would continue to be damaged to the extent that they would no longer be sustainable, and the wild horse population would be expected to crash; this result would be expedited under drought conditions. As wild horse populations continue to increase within and outside the Complex, rangeland degradation intensifies on public lands. Also as wild horse populations increase, concerns regarding public safety along highways increase as well as conflicts with private land. Wild horses that reside along highways would continue to come on to the highways in many areas during the evenings or early mornings looking for forage and salt along the pavement, posing a hazard to motorists.

Emergency removals could be expected in order to prevent individual animals from suffering or death as a result of insufficient forage and water. These emergency removals are occurring annually and would be expected to increase as the wild horse population grows. During emergency conditions, competition for the available forage and water increases. This competition generally impacts the oldest and youngest horses as well as lactating mares 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 when emergency conditions arise, the overall population could be affected by severely skewed sex ratios towards stallions as they are generally the strongest and healthiest portion of the population. An altered age structure would also be expected.

Cumulative impacts of the no action alternative would result in foregoing the opportunity to improve rangeland health and to properly manage wild horses 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.

Cumulative Effects of the Proposed Action

In the future, application of population growth suppression techniques (i.e. PZP, PZP-22, GonaCon, and Gelding) and adjustment in sex ratios would be expected to slow total population growth rates, and to result in fewer gathers with less frequent disturbance to individual wild horses and the herd's social structure. However, return of wild horses back into the Complex could lead to decreased ability to effectively gather horses in the future as released horses learn to evade gather operations. The effect may be reduced gather effectiveness and the ability to capture a smaller portion of the population with each consecutive operation.

Cumulative Effects of the Proposed Action and Alternatives B, C, and D

A gather would ultimately benefit wild horses and rangeland resources. During gather operations, wild horses would be provided adequate feed and water at temporary and short-term holding. Removal of excess wild horses would allow for reduced competition for the remaining resources left on the range. Removal of excess wild horses would ensure that individual animals do not perish due to starvation, dehydration, or other health concerns related to insufficient feed and water and extreme dust conditions. Additionally, a gather would remove excess wild horses while they remain in adequate health to transition to feed.

The cumulative effects associated with the capture and removal of excess wild horses include gather-related mortality, which averages approximately 1% of the captured animals but could be higher based on the circumstances of individual gathers. (Scasta, 2020). Mortality averages about 5% per year associated with transportation, ORCs, adoption or sale with limitations and about 8% per year associated with ORPs. These rates are comparable to natural mortality on the range ranging from about 5-8% per year for foals (animals under age 1), about 5% per year for horses ages 1-15, and 5-100% for animals age 16 and older (Stephen Jenkins, 1996, Garrott and Taylor, 1990). In situations where forage and/or water are limited, mortality rates in the wild increase, with the greatest impact to young foals, nursing mares and older horses. 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 mare, 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 for which there is no adoption demand is authorized under the WFRHBA, Congress prohibited the use of appropriated funds between 1987 and 2004 and again in 2010 to present for this purpose. If Congress were to lift the current appropriations restrictions, then it is possible that excess horses removed from the Complex could potentially be euthanized or sold without limitation consistent with the provisions of the WFRHBA.

The other cumulative effects which would be expected when incrementally adding either of the Action Alternatives to the cumulative study area would include continued improvement of upland and riparian vegetation conditions, which would in turn benefit permitted livestock, native wildlife, and wild horse population as forage (habitat) quality and quantity is improved over the current level. Benefits from a reduced wild horse population would include fewer animals competing for limited forage and water resources. Cumulatively, there should be more stable wild horse populations, healthier rangelands, healthier 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 within the established AML range would achieve a thriving natural ecological balance and multiple use relationship on public lands in the area.

3.4. Riparian/Wetland Areas and Surface Water Quality

Affected Environment

Riparian areas occupy a small but unique position on the landscape in the Complex. Riparian areas are important to water quality, water quantity, and forage. Riparian sites provide habitat needs for many species and support greater numbers and diversity of wildlife than any other habitat type in the western United States. Riparian areas at high elevations support cottonwood and aspen woodlands. Small riparian areas and their associated plant species occur throughout the HMAs near seeps, springs, and along sections of perennial drainages. Many of these areas support limited riparian habitat (forage) and water flows. At the present time, wild horse use of the majority of these areas is averaging heavy to severe use. Trampling and trailing damage by wild horses is evident at most locations; soil compaction and surface and rill erosion are evident. Some of the spring sources within the HMAs are minimally functioning because of factors such as over utilization and trampling effects. The current over population of wild horses is contributing to resource damage and decline in functionality of spring sources.

Environmental Effects

No Action Alternative – With the No Action Alternative, wild horse populations would continue to increase within the HMAs and to expand beyond the HMA boundaries. Increased horse use within and outside the HMAs would present additional adverse impacts to riparian resources and their associated surface waters. Over the longer-term, as native plant health continues to deteriorate and plants are lost, soil erosion would increase. An opportunity to make progress toward achieving and maintaining riparian areas in properly functioning condition would be foregone as ever increasing numbers of wild horses continue to trample and degrade other riparian areas, springs and associated water sources. Riparian areas that are currently in a Functional at Risk with a Downward Trend state would be expected to decline to a

Non-Functional state over time.

Proposed Action – To avoid the direct impacts potentially associated with the gather operation, temporary gather sites and holding/processing facilities would not be located within riparian areas. The amount of trampling/trailing would be reduced. Utilization of the available forage within the riparian areas would also be expected to be reduced to within allowable levels. Over the longer-term, continued management of wild horses within the established AML 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 that would result in some associated improvements in water quality. The alternative would make progress towards achieving and maintaining proper functioning condition at riparian areas. There would also be reduced competition among wildlife, wild horses, and domestic livestock for the available water. An opportunity to make progress toward achieving and maintain riparian areas in properly functioning condition would be foregone until reaching the mid-range of AML.

Alternative B – Initial impacts would be similar to the Proposed Action.

Alternative C – Initial impacts would be similar to the Proposed Action.

Alternative D- Initial impacts would be similar to the Proposed Action, except that continued gathering efforts over the 10-year period aimed at capturing 100% of the current wild horse population would improve the rate and extent of damaged riparian recovery for the Jakes Wash HA.

Cumulative Impacts

Cumulative Impacts of the Proposed Action and Alternatives B, C and D
Impacts to riparian/wetland areas and surface water quality within the Pancake Complex have resulted from past and present actions such as grazing, road construction and maintenance, agriculture, off-highway vehicle (OHV) use and recreation, mining and processing activities, aggregate operations, public land management activities, and wildland fire.

Impacts to riparian/wetland areas and surface water quality from Reasonably Foreseeable Future Actions (RFFAs) would be similar to those described above for past and present actions, as these activities are expected to continue into the future. Direct cumulative impacts to riparian/wetland areas and surface water quality would be marginal because part of the Proposed Action is to avoid riparian/wetland areas during the present and future horse gathers. However, the long-term incremental impact to these resources from the proposed action would be positive as the number of horses are decreased with this gather and over time with subsequent gathers. This would result in improved surface water quality and reestablishment of riparian areas exhibiting increased stability and vigor.

Cumulative Impacts of the No Action Alternative
Under the No Action Alternative, no incremental gather-associated impacts would occur to riparian/wetland areas and surface water quality, thus declining conditions would continue as horse populations increase.

3.5. Wildlife, Including Migratory Birds

Affected Environment
The Pancake Complex provides habitat for many species of wildlife, including large mammals like mule deer, pronghorn antelope, Rocky Mountain elk, and desert bighorn sheep. Yearlong habitat for mule deer occurs throughout the Complex. A couple of small areas of crucial winter range occurs in the east-central

and southeast portions of the Pancake HMA. The majority of the complex outside of the White Pine Range is yearlong pronghorn antelope habitat. The eastern boundary of the complex is Rocky Mountain elk yearlong habitat. There is occupied desert bighorn sheep habitat in the central-eastern portion of the Pancake HMA in the Duckwater Hills.

Predominant habitat types within the Complex which are likely to support migratory birds include: aspen, mountain riparian, mountain shrub, sagebrush, pinyon/juniper, salt desert scrub, playa and cliffs/talus habitat types. There are small inclusions of coniferous forest and mountain mahogany habitat types included in the upper elevations of the Pancake Range.

The migratory bird nesting season is from March 1 through July 31 (including raptors). No surface disturbing activity (staging, trapping, or corrals) can be conducted during this time period without a nesting bird survey of the proposed project area.

Environmental Effects

No Action Alternative – Wildlife would not be disturbed or displaced by gather operations under the no action alternative. However, competition between wildlife and wild horses for forage and water resources would continue and may get worse as wild horse numbers continue to increase above AML. As competition increases, some wildlife species may not be able to compete successfully, potentially leading to increased stress and possible dislocation or death of native wildlife species over the long-term.

Proposed Action – Individual animals of all species may be disturbed or displaced during gather operations. Large mammals and some birds may run or fly (flush from the nest) during helicopter operations, but animals should return to normal activities post disturbance. Small mammals, birds, and reptiles would be displaced at staging areas and slower moving animals may be adherently killed. Overall, there would be no impact to animal populations as a result of gather operations.

The use of previously disturbed areas would reduce impacts to migratory birds. Any new staging, corral, and trap sites with vegetation would be surveyed for nesting birds, if gather operations were to occur during the migratory bird breeding season.

Removing wild horses would result in decreased competition between wild horses and wildlife for available forage and water resources as soon as the gather is completed. Over the long-term, both riparian and upland habitat conditions (forage quantity and quality) for wildlife would improve.

Alternative B – Impacts from this alternative would be similar to the Proposed Action, however it does not include management of nonreproducing portion of the population. This Alterative would be less effective at improving wildlife habitat than Alternative D, and slightly less effective than Alternative A.

Alternative C – Impacts from this alternative would be the similar to the Proposed Action. Overall, this alternative would be the least effective at improving habitat conditions for wildlife because there would be no fertility control, sex ratio adjustments, or gelding management. This Alternative would be less effective at improving wildlife habitat conditions than Alternative D, and slightly less effective than Alternatives A and B.

Alternative D – Impacts from this alternative would be similar to the Proposed Action. This alternative would be the most effective at improving habitat conditions for wildlife, with the capturing of all horses and zero release within the Jakes Wash HA. This alternative provides the best opportunity for breeding, nesting and foraging habitat to recover over the long-term within the Jakes Wash HA.

Cumulative Impacts

Cumulative Impacts of the Proposed Action and Alternatives B, C and D
Impacts to wildlife habitat within the Pancake Herd Area have resulted from past and present actions such as livestock grazing, road construction and maintenance, agriculture, OHV use and recreation, Powerlines and other right-of-way actions, and wild horses. The cumulative impacts from the Proposed Action, in addition to past, present and reasonably foreseeable future actions would be beneficial for all wildlife and their habitat. With a reduction of horse numbers, habitat within the HA and surrounding area would have the opportunity to improve. Impacts to vegetation at riparian areas would be reduced, allowing them to slowly recover with time. Breeding, forage, nesting, and security habitat for all species would improve over time.

Cumulative Impacts of the No Action Alternative
The cumulative impacts from the No Action Alternative, in addition to past, present and reasonably foreseeable future actions would result in continual degradation of habitat for all wildlife. Horses would continue to be above AML and compete for resources with other wildlife and livestock. Breeding, foraging, nesting and security habitat for all species would continue to degrade.

3.6. Special Status Plant and Animal Species

Affected Environment
Appendix IX identifies numerous BLM special status species that may potentially occur within the Pancake Complex, including several bat, reptile, raptor and other bird species.

According to the 2015 Greater sage-grouse Land Use Plan Amendments (LUPA; 2022 maintenance action), portions of the Pancake Complex contains Other Habitat (OHMA), General Habitat (GHMA), and Priority Habitat Management Areas (PHMA; Appendix X). Greater sage-grouse use the majority of the Pancake HMA throughout the year for all of their seasonal habitat needs. These needs include breeding (i.e., strutting grounds or leks), nesting and early brood-rearing, late brood-rearing or summer, and winter habitat. Greater sage-grouse require a herbaceous understory of forbs and grass to provide nest concealment, as well as to provide a diet of forbs and insects for the adults and their chicks. Riparian areas are frequently used by greater sage-grouse for late brood-rearing habitat.

The Complex contains large portions of the Butte/Buck/White Pine greater sage-grouse population management unit (PMU), with minor portions of the Monitor and Quinn PMUs. There are approximately 19 known active and pending greater sage-grouse leks within the gather area, with several that have hit a soft or hard trigger in 2023 according to USGS Targeted Annual Warning System (TAWS; Prochazka et al. 2023) Additionally, the gather area overlaps six lek clusters in which three have reached a hard trigger in 2023 (Prochazka et al. 2023). In 2020, an Adaptive Management Response Team determined that wild horses were one of the casual factors for the Butte/Buck/White Pine PMU for hitting a soft trigger at that time (State of Nevada Sagebrush Ecosystem Program, 2020). The presence of wild horses is associated with a reduced degree of greater sage-grouse lekking behavior (Muñoz et al. 2020). Moreover, increasing densities of wild horses, measured as a percentage above AML, are associated with decreasing greater sage-grouse population sizes, measured by lek counts (Coates 2021). In northwest Nevada, Behnke et al. (2023) found that Greater sage-grouse nesting rates were marginally higher in areas with wild horses, but Behnke et al. (2022) found that Greater sage-grouse in areas with feral horses had elevated corticosterone levels, especially under drought conditions. Behnke et al. (2022) also found that high corticosterone levels were associated with low Greater sage-grouse nesting success rates. In Wyoming, Hennig et al (2023) found a high degree of spatial overlap between wild horses and Greater sage-grouse in summer. Most recently, Beck et al. (2024) demonstrated significant declines in Greater sage-grouse survival rates associated with wild horse densities, with greater wild horse densities above AML causing greater declines in sag-grouse survival at several life stages.

Areas within the Complex provide aquatic and riparian habitat for three aquatic BLM Sensitive Species, the Railroad Valley springfish, which is found in Big and Little Warm Springs adjacent to the Pancake HMA, on Duckwater Shoshone Reservation lands. The Railroad Valley tui chub (*Gila bicolor* ssp. 7), grated tyronia *(Tryonia clathrata)*, Duckwater pyrg *(Pyrgulopsis aloba)*, southern Duckwater pyrg *(Pyrgulopsis anatina)*, Big Warm Springs pyrg *(Pyrgulopsis papillata)*, and Warm Springs pyrg *(Pyrgulopsis villacampae)* can also be found within the Pancake Complex.

There is potential pygmy rabbit habitat within the Complex as well as documented sightings within the Pancake and Sand Springs West HMAs and Jakes Wash HA. Pygmy rabbits predominately inhabit tall sagebrush with deep friable soils for burrowing.

Other terrestrial species include the Railroad Valley skipper *(Hesperia uncas fulvapalla)*,

There are several BLM sensitive plant species that have been found within or adjacent to the Pancake Complex. These are the Blaine pincushion *(Sclerocactus blainei)*, rock violet *(Viola lithion)*, Eastwood milkweed *(Asclepias eastwoodiana)*, Currant milkvetch *(Astragalus uncialis)*, Needle Mountains milkvetch *(Astragalus eurylobus)*, and Railroad Valley globemallow *(Sphaeralcea caespitosa var. williamsiae)*.

Environmental Effects
No Action Alternative – Individual animals would not be disturbed or displaced because gather operations would not occur under the No Action Alternative. However, habitat conditions for all special status animal species would continue to deteriorate as wild horse numbers above the established AMLs further reduce herbaceous vegetative cover and trample riparian areas, springs, and stream banks. Sensitive plant species would be more likely to be grazed and trampled under the no action alternative because there would be more wild horses in the HMAs.

Proposed Action – Individual raptors and birds may be disturbed during helicopter gather operations; however, birds should return to normal activities. Staging, corral and trapping locations would be surveyed for nests if operations take place during the breeding season, minimizing impacts to species. BLM would not locate any trap sites, holding corrals, or staging areas where sensitive animal and plant species are known to occur, so there would be no impact from the placement of facilities.

BLM would not locate trap sites, holding corrals, or staging areas in areas used for Greater sage-grouse strutting grounds and pygmy rabbit habitat would not be used for trap sites or staging areas. Additionally, the BLM would apply the Greater sage-grouse timing restrictions identified in the Proposed Action would to the greatest extent possible to minimize impacts to breeding, nesting and brood-rearing birds. In order to minimize impacts to Greater sage grouse during the late brood-rearing season, the BLM would review any water bait trapping sites on natural water sources for use. BLM would coordinate with NDOW if the gather could not meet any of these stipulations. Greater sage-grouse may be temporarily disturbed during winter gather operations.

Under the Proposed Action, the removal of excess wild horses would cause habitat conditions to improve for all special status species; however, this alternative does not remove all horses. This alternative would be more effective at improving special status species' habitat than Alternative D.

Alternative B – Impacts from this alternative would be similar to the Proposed Action, however it does not include management of nonreproducing portion of the population. This Alterative would be less effective at improving special status species' habitat than Alternative D, and slightly less effective than Alternative A.

Alternative C – Impacts from this alternative would be the similar to the Proposed Action. Overall, this alternative would be the least effective at improving habitat conditions for special status species because there would be no fertility control, sex ratio adjustments, or gelding management. This Alternative would be less effective at improving habitat conditions than Alternative D, and slightly less effective than Alternatives A and B.

Alternative D – Impacts from this alternative would be similar to the Proposed Action. This alternative would be the most effective at improving habitat conditions for special status species, with the capturing of all horses and zero release. This alternative provides the best opportunity for breeding, nesting and foraging habitat to recover over the long-term within the Jakes Wash HA.

Cumulative Impacts

Cumulative Impacts of the Proposed Action and Alternatives B, C and D
Impacts to special status species' habitat within the Pancake Herd Area have resulted from past and present actions such as livestock grazing, road construction and maintenance, agriculture, OHV use and recreation, powerlines and other right-of-way actions, and wild horses. The cumulative impacts from the Proposed Action, in addition to past, present and reasonably foreseeable future actions would be beneficial for all wildlife and their habitat. With a reduction of horse numbers, habitat within the Complex and surrounding area would have the opportunity to improve. Impacts to vegetation at riparian areas would be reduced, allowing them to slowly recover with time. Breeding, forage, nesting, and security habitat for all species would improve over time.

Cumulative Impacts of the No Action Alternative
The cumulative impacts from the No Action Alternative, in addition to past, present and reasonably foreseeable future actions would result in continual degradation of habitat for all special status species. Horses would continue to be above AML and compete for resources with other wildlife and livestock. Breeding, foraging, nesting, and security habitat for all species would continue to degrade.

3.7. Livestock Grazing

Affected Environment
The Pancake Complex includes portions of several livestock grazing allotments. Permitted livestock grazing use in the HMAs, HA, and WHT include both cattle and sheep. Some livestock grazing occurs during all seasons. Livestock grazing also occurs in areas immediately adjacent to the Complex.

Table 5 summarizes grazing use by grazing allotments across associated horse management units of the Pancake Complex. The kind of livestock, season of use and permitted use in Animal Unit Months (AUM) is described alongside the percentage of the allotment within the HMA, HA, or WHT and the percent of the permitted use that has been used across a ten-year average from 2014 to 2023. An AUM is the amount of forage necessary for the sustenance of one cow or its equivalent for a period of 1 month (4100.0-5 of the CFRs).

Table 5. Pancake Complex

HMA/WHT	Allotment	Season of Use	% of Allot-ment in HMA/WHT	Permitted Use	Ten Year Average AUM Use	Percent Actual Use of Permit
Pancake HMA	Duckwater	Cattle and Sheep 3/1 to 2/28	100%	23,667	6,858	29%

HMA/WHT	Allotment	Season of Use	% of Allot-ment in HMA/WHT	Permitted Use	Ten Year Average AUM Use	Percent Actual Use of Permit
Pancake HMA	Monte Cristo	Cattle 6/21 to 9/18	100%	1,129	74	7%
Pancake HMA	Pancake Black Point	Cattle 6/01 to 2/28	17%	609	588	97%
Pancake HMA	Six Mile	Cattle 4/15 to 10/31; Sheep 11/1 to 4/15	96%	1,209	552	46%
Pancake HMA	South Pan-cake	Sheep 11/1 to 4/15	100%	1,155	832	72%
Pancake HMA	Newark	Cattle and Sheep 3/1 to 2/28	15%	9,709	3,069	32%
Sand Springs West HMA	Sand Springs	Cattle 3/1 to 2/28; Sheep 11/1 to 3/31	100%	7,843	5,624	72%
Monte Cristo WHT	Blackrock	Cattle 6/21 to 9/30	73%	540	504	90%
Monte Cristo WHT	Treasure Hill	Cattle 6/16 to 10/15	63%	2,198	2,010	93%
Monte Cristo WHT	Illipah	Cattle 6/16 to 10/15	2%	895	823	99%
Monte Cristo WHT	Tom Plain	Cattle 6/11 to 10/10	17%	2,647	2,089	80%
Jakes Wash HA	Badger Spring	Sheep 4/15 to 11/30	90%	1,411	243	17%
Jakes Wash HA	Giroux Wash	Cattle 4/01 to 12/15; Sheep 4/01 to 11/01	61%	5,326	436	8%
Jakes Wash HA	Indian Jake	Cattle 3/15 to 6/15; 10/15 to 1/15	100%	2,948	1160	39%
Jakes Wash HA	Tom Plain	Cattle 3/1 to 6/15; 10/01 to 2/28	42%	5,192	2211	43%

Over the past ten years, actual livestock use has generally been less than what is permitted for each of the grazing allotments within the Pancake HMA, Jakes Wash HA, and the Sand Springs West HMA. This has been in part due to droughts, competition with wild horses for forage, and the needs of the livestock operations, among others. Permitted livestock grazing use has also generally been reduced from historical grazing levels over the past decades in a majority of the allotments. A portion of the Duckwater allotment in Sand Springs valley has been in temporary non-use for cattle grazing since 2001 due to drought and non-achievement of rangeland health standards. Allotments continue to be evaluated for achievement of the rangeland health standards, and adjustments to livestock grazing are implemented as appropriate, as grazing term permits are renewed or through annual coordination between BLM and grazing permit holders. Adjustments can include livestock stocking levels, seasons of use, grazing rotations, utilization standards, and other management practices to better control livestock distribution.

In the past, the BLM, Bristlecone Field Office combined the Land Health Assessment, Evaluation Report and the Determination Document into a single document called a Standard Determination Document (SDDs) to evaluate and assess livestock grazing management practices to determine whether those practices are conforming to the standards and guidelines for rangeland health, as required by 43 C.F.R. Subpart 4180. In addition to livestock grazing, these SDDs provide insights into whether wild horses and other factors are contributing to non-attainment of land health standards. A summary of SDDs which have been completed within the Pancake Complex can be found in Appendix VII.

Livestock impact vegetation resources through consumption of forage species and trampling. Under improper livestock management there is potential for degradation. Livestock grazing is limited to certain use levels on forage species, AUMs, and seasons of use as described in the terms and conditions of grazing permits, which are designed to be sustainable and prevent resource degradation.

Environmental Effects

No Action Alternative – Under the No Action Alternative, there would be continued competition with excess numbers of wild horses for limited water and forage resources. Uncontrolled wild horse population growth would lead to degradation of rangelands and forage resources which would reduce the respective grazing allotment potential to support livestock grazing. As wild horse numbers continue to increase, livestock grazing within the HMAs may necessitate reductions to slow the deterioration of the range to the greatest extent possible.

Proposed Action – Past experience has shown that wild horse gather operations have few direct impacts to cattle and sheep grazing. Livestock located near gather activities would be temporarily disturbed or displaced by the helicopter and the increased vehicle traffic during the gather operation. Typically, livestock would move back into the area once gather operations cease. Under the Proposed Action, competition between livestock and wild horses for water and forage resources would be reduced over time. Forage availability and quality would improve over time as the wild horse population is incrementally brought to low or mid AML. These effects would be extended by population growth control measures.

Alternative B –Impacts would be similar to those of the Proposed Action, but to a lesser extent.

Alternative C – Impacts would be similar to those of the Proposed Action, but to a lesser extent.

Alternative D - Impacts under Alternative D would be similar to those in the Proposed Action until all wild horses are removed from the Jakes Wash HA, at which point competition for forage and water resources would cease. The Pancake HMA, Sand Springs West HMA, and Monte Cristo Wild Horse Territory would experience impacts similar to those of the no action alternative.

Cumulative Impacts

The incremental cumulative effects of different population levels and different reproductive rates of wild horse populations over time would have varying effects on livestock grazing and their shared use of resources.

Cumulative Impacts of the No Action Alternative

Under the no action alternative, wild horse populations would continue to increase. This continually increasing competition for available forage and water resources would lead to increased resource utilization and increased likelihood of rangeland degradation. Where site-specific vegetation management objectives and Standards for Rangeland Health are not being achieved, they would likely continue to not achieve the standard. Where standards are being achieved, it is possible they would change to not achieving the standard. Opportunities to improve rangeland health, by bringing the wild horse population to AML and reducing resource competition and utilization, would be lost.

Cumulative Impacts of the Proposed Action and Alternatives B, C and D
Under the Proposed Action, wild horse populations would be maintained at or near AML for the longest amount of time, compared to the alternatives. This would reduce excess pressure from wild horses on the shared forage and water resources. Over time this would likely aid in the increased potential for achievement of the Standards of Rangeland Health and allow for the perpetuity of livestock grazing. The cumulative effects of Alternatives B and C would be similar to the Proposed Action, but they would not be as long lasting because the reproductive rates of the wild horse would not be reduced or controlled indefinitely.

Under Alternative D, all unallocated horse use and competition with livestock for resources would cease in the Jakes Wash HA. Site conditions should experience a short-term period of improvement and a long-term increase in potential for attainment of achieving the Standards for Rangeland Health. It is possible for horses to emigrate from adjacent areas and reestablish populations in the future.

3.8. Wilderness

Affected Environment
The Pancake HMA contains a portion of the Park Range Wilderness Study Area (WSA). The Park Range WSA is a jumbled mass of volcanic rock covered by a thin layer of soil which supports a surprisingly dense forest. There are dozens of wetland meadows above 8,000 feet that support a rich and diverse mixture of wildlife. Pockets of aspen attract deer, foxes and rabbits. At lower elevations, in the sagebrush semi-desert you may encounter antelope, coyote and jackrabbits.

The White Pine Peak Research Natural Area (RNA) is also located in the southwest portion of this wilderness. Research natural areas are part of a nationwide network of ecological areas set aside for both research and education. The Forest Service and other agencies establish these areas to typify certain types of important forest, shrubland, grassland, aquatic, geological, alpine, or similar environments with unique characteristics of scientific interest. These areas contain important ecological and scientific values and are managed for minimum human disturbance.

Currant Mountain Wilderness encompasses 47,357 acres in the western half of the Ely Ranger District in the White Pine Range and includes portions of the Blackrock and Currant Creek allotments. The Currant Mountain Wilderness is readily accessible on the eastern side via the White River and Currant Creek roads. Access to the western slope is much more difficult, requiring high clearance 4x4 vehicles or ATV's. This area is dominated by the limestone massif (mountainous mass) that comprises the mountain range and is home to desert bighorn sheep, elk, mule deer, cougar, and bobcats. There are no formal trails in existence any longer in this wilderness due to flood events washing out the drainages where trails once occurred.

The White Pine Range Wilderness (40,013 acres) is located on the western side of the White Pine Range south of Highway 50, approximately 55 miles west of Ely, Nevada. This area is on the west edge of the White Pine Range, just north of the Currant Mountain Wilderness. Access is difficult from the west slope as the area is divided into three sections by rough roads open to motorized vehicles. There are no trails within the area, but a non-motorized route goes through Cathedral Canyon on the north edge of the area. Rocky ridges, rolling hills, and varied vegetation can be experienced throughout the wilderness. Many springs attract wildlife and mixed conifers can be found on the higher ridges.

Environmental Effects
No Action Alternative – No direct impacts to wilderness values would occur. However, impacts to wilderness values of naturalness could be threatened through the continued population growth of wild horses. The Wilderness/WSA currently receives slight-moderate use by wild horses during certain times of the year. Increasing wild horse populations would be expected to further degrade the condition of vegetation and soil resources. The sight of heavy horse trails, trampled vegetation and areas of high erosion would continue to detract from the wilderness experience within the WSA.

Proposed Action – Impacts to opportunities for solitude could occur during gather operations due to the possible noise of the helicopter and increased vehicle traffic around the Wilderness/WSA.

Those impacts would cease when the gather was completed. No surface impacts within the Wilderness/WSA are anticipated to occur during the gather since all gather sites and holding facilities would be placed outside wilderness. However, wilderness values of naturalness would remain at or near the current condition. Under the Proposed Action wilderness values would likely see more improvement over time since wild horse population would be gathered in increments and growth rates would be less under this alternative.

Alternative B – Impacts would be similar to the Proposed Action, however, wilderness values of naturalness after the gather would be enhanced by a reduction in wild horse numbers as a result of an improved ecological condition of the plant communities and other natural resources.

Alternative C – Impacts would be the same as described for the Proposed Action.

Alternative D – Impacts to solitude would be slightly greater than all alternatives due to time needed for gather operations to gather 100% of population. Over time, this alternative would have the greatest beneficial impact to naturalness in the Jakes Wash HA.

Cumulative Impacts

Impacts to Wilderness/WSA from past actions such as road development/improvement, grazing, range improvements, recreation and OHV use have been accounted for within the designation of the Wilderness its boundary and USFS and BLM Wilderness management plans and WSA interim management plan. Impacts from present and future actions are similar and should be limited to outside of the Wilderness/WSA boundary. Horse gather operations have occurred in the past and would likely continue into the reasonably foreseeable future. Impacts of these operations usually have temporary negative impacts to solitude during operations but have long term beneficial effects to naturalness.

The cumulative impacts from the No Action Alternative, in addition to past, present, and reasonably foreseeable future actions would have no temporary negative impacts to solitude during operations but would have negative impacts to naturalness.

Impacts of Alternative A - Proposed Action - The cumulative impacts from the Proposed Action, in addition to past, present and reasonably foreseeable future actions would have temporary negative impacts to solitude during operations but would have beneficial impacts to naturalness.

Impacts of Alternative B – Cumulative impacts are similar to those described in the Proposed Action.

Impacts of Alternative C - Cumulative impacts are similar to those described in the Proposed Action.

Impacts of Alternative D - Cumulative impacts are similar to those described in the Proposed Action.

3.9. Noxious Weeds and Invasive Non-Native Species

Affected Environment

Noxious and invasive species introduction and proliferation are a growing concern among local and regional interests. Noxious and invasive weeds are known to exist on public lands within the administrative boundaries of the Tonopah and Bristlecone FO's (Appendix VIII). Noxious and invasive weed species are aggressive, typically nonnative, ecologically damaging, undesirable plants, which severely threaten native rangeland, biodiversity, decrease forage quality, wildlife habitat, and ecosystems. Because of their aggressive nature, noxious and invasive weeds can readily spread into established plant communities primarily through ground disturbing activities. In addition, new populations can become established when the seeds hitchhike on equipment, vehicles, and people. The following noxious and invasive weed species are known to exist within the Complex or along drainages and roadways leading to the project area:

Table 6. Noxious and Invasive Weeds

Scientific Name	Common Name
Acroptilon repens	Russian knapweed
Carduus nutans	Musk thistle
Centaurea stoebe	Spotted knapweed
Centaurea squarrosa	Squarrose knapweed
Cirsium vulgare	Bull thistle
Conium maculatum	Poison hemlock
Hyoscyamus niger	Black henbane
Lepidium draba	Hoary cress
Lepidium latifolium	Tall whitetop
Onopordum acanthium	Scotch thistle
Tamarix spp.	Salt cedar
Bromus tectorum	Cheatgrass
Salsola iberica	Russian thistle

These species occur in a variety of habitats including roadside areas, rights-of-way, wetland meadows, and as well as undisturbed upland rangelands.

Environmental Effects

No Action Alternative – No impacts from the gather would occur. However, the wild horse populations would remain over AMLs and the impacts to native vegetation from wild horse over-grazing and/or trampling especially around water sources would increase exponentially and impacts to the present plant communities could lead to an expansion of noxious and invasive species.

Proposed Action and Alternatives B, C and D

The proposed gather may spread existing noxious and/or invasive species. This could occur if vehicles drive through infestations and spread seed into previously weed-free areas or arrives already carrying seeds attached to the vehicle or equipment. This is especially a concern as the gather crew moves from valley to valley. The contractor, together with the contracting officer's representative or project inspector (COR/PI), would examine proposed gather sites and holding corrals for noxious and invasive weed populations prior to construction. If noxious weeds are found, the location of the facilities would be moved. Any equipment or vehicles exposed to weed infestations or arriving on site carrying dirt, mud, or plant debris would be cleaned before moving into or within the project area. All gather sites, holding facilities, and camping areas on public lands would be monitored for weeds during the next several years. Despite short-term risks, over the long term the reduction in wild horse numbers and the subsequent recovery of the native vegetation would result in fewer disturbed sites that would be susceptible for non-native plant species to invade.

Cumulative Impacts

Cumulative Impacts of the Proposed Action and Alternatives B, C and D
The cumulative impacts of the proposed gather could increase the existing noxious and invasive weed populations through vehicle traffic, foot traffic, gather sites, camp sites, and temporary holding and processing sites, however through awareness and location scouting the risks of spreading the populations can be reduced. New weed species could be introduced without proper inspection and washing, if necessary, of equipment and vehicles. Best Management Practices should be followed to reduce the risks.

Cumulative Impacts of the No Action Alternative
Under the No Action Alternative, the cumulative impacts are reduced but still exist. By not gathering to AML the overall rangeland health would decrease thus allowing the opportunity for established noxious and invasive weed populations to expand and establish. Seeds can be carried on the horse's lower legs among their hair and fall off in other locations and establish as seedlings. There is a direct correlation to rangeland health and noxious and invasive weed population percentage.

3.10. Vegetation

Affected Environment
The vegetative plant communities within the Complex have developed on many different soil types with several kinds of parent materials under varying climatic conditions through time. The vegetation is diverse with desert shrub/sagebrush/grass plant communities dominating the lower elevations while sagebrush/mountain shrub/grass/pinyon-juniper/mountain mahogany plant communities dominate the benches and higher elevation sites.

The Pancake HMA is dominated by Inter-Mountain Basins Big Sagebrush Shrubland, Great Basin Pinyon-Juniper Woodland, and Inter-Mountain Basins Mixed Salt Desert Scrub, but is also includes Great Basin Xeric Mixed Sagebrush Shrubland, Inter-Mountain Basins Greasewood Flat and others. Some dominant species of these vegetation types include Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), pinyon-juniper (*Pinus monophylla* - *Juniperus osteosperma*), winterfat (*Krascheninnikovia lanata*), shadscale (*Atriplex confertifolia*), black sagebrush (*Artemisia nova*), and black greasewood (*Sarcobatus vermiculatus*) plant communities. To a lesser extent, this HMA also includes vegetation communities dominated by mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), mountain mahogany (*Cercocarpus ledifolius*), and mixed conifers.

The Monte Cristo WHT is dominated by Inter-Mountain Basins Big Sagebrush Shrubland, Great Basin Pinyon-Juniper Woodland, Mixed Sagebrush Shrubland, and Mountain Mahogany. Some dominant species of these vegetation types include pinyon-juniper (*Pinus monophylla* - *Juniperus osteosperma*), mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), low sage (*Artemisia arbuscula*), black sagebrush (*Artemisia nova*), basin big sagebrush (*Artemisia tridentata ssp. tridentata*), and mountain mahogany (*Cercocarpus ledifolius*) plant communities. To a lesser extent, this WHT also includes vegetation communities dominated Inter-Mountain Basins Mixed Salt Desert Scrub.

The Jakes Wash HA primarily has four vegetative types. Salt desert shrub and winterfat plant communities occur in the lower valley and wash, while sagebrush/perennial grass communities and pinyon/juniper woodlands dominate the benches and higher elevation sites. A unique ecological site is present in the valley bottom. This is a Silty Clay 8-10" ecological site (028BY071NV) with western wheatgrass (*Elymus trachycaulus*) or thickspike wheatgrass (*Elymus lanceolatus*) and Nuttall saltbush

(*Atriplex nuttallii*). The extensive areas of winterfat occur throughout the valley bottom, in fragile silty soils, where native perennial grasses are lacking due to historical overgrazing by livestock and wild horses.

The Sand Springs West HMA is dominated by Inter-Mountain Basins Big Sagebrush Shrubland with Great Basin Pinyon-Juniper, Great Basin Xeric Mixed Sagebrush Shrubland, and Inter-Mountain Basins Mixed Salt Desert Scrub. These include Wyoming big sagebrush, basin big sagebrush (*Artemisia tridentata ssp. tridentata*), pinyon-juniper, black sagebrush, and winterfat plant communities. This HMA also has small areas of greasewood.

Rangeland Health Standards were assessed (Appendix VII) on a scale of livestock grazing allotments which also overlap with the Pancake Complex (Table 3, Section 3.7). The majority of the Pancake Complex is not meeting one or more of the Rangeland Health Standards. The non-achievement of Standards is directly and indirectly related to vegetation as it affects the hydrologic cycle, soil health, wildlife habitat quality, and etc. Current and historical livestock grazing management, wild horses, drought, lack of wildfire, insects, invasive species, and road construction have been attributable factors to not meeting Standards. The causal factors listed above have caused shifts in the vegetation communities such as increases in shrub dominance, reduced native vegetation cover, increases in invasive species spread, and the reduction of native perennial grasses.

Environmental Effects
No Action Alternative – Under the no action alternative, no direct impacts to vegetation resources from gather related activities would occur. Wild horse populations would remain over appropriate management levels and populations levels would continue to grow. The impacts to vegetation through consumption or trampling would increase proportionally to wild horse population levels and deteriorations in plant health, reproduction, diversity, and composition would be expected. As plants deteriorate, they would not be able to reproduce or recover. By reducing opportunities for photosynthetic processes through grazing the plants would be more susceptible to other stressors such as drought. Although, overgrazing can singularly lead to plant mortality, it is a more likely outcome when compounded by multiple negating factors. Loss of desirable forage species will lead to increases in less desirable species and it will continue to shift vegetative communities away from the site's potential. Over time forage resources would become less available, impacting wild horse herd health, and wild horses would be more susceptible to disease and drought.

Proposed Action- The proposed action is expected to have an effect on vegetative resources including trampling of vegetation by wild horses at gather sites and holding locations; and crushing of vegetation by vehicles, temporary corrals and holding facilities. Gather corrals and holding facility locations are usually placed in previously disturbed sites (e.g. gravel pits) which are easily accessible to livestock trailers and standard equipment and that use existing roads. These disturbed areas would be less than one acre in size. No new roads would be created. These impacts are temporary, and vegetation is expected to recover within the next growing season. Noxious and invasive species are analyzed in Section 3.9.

Achieving and maintaining the established AML would benefit the vegetation by reducing the grazing pressure on the forage resources. Forage utilization would be reduced. The impacts to vegetation by grazing or trampling based on the reduction in wild horse numbers to AML would result in maintaining or improving vegetation health and vigor, diversity, and composition by allowing the plants to maintain and continue photosynthetic processes to initiate regrowth and reproduction.

Alternative B- Impacts would be similar to those of the Proposed Action but to a lesser extent.

Alternative C- Impacts would be similar to those of the Proposed Action but to a lesser extent.

Alternative D – Under Alternative D, the Pancake HMA, Sand Springs West HMA, and the Monte Cristo Wild Horse Territory would experience impacts similar to those of the no action alternative. Wild horse removal in Jakes Wash HA would impact vegetation resources similarly to the Proposed Action, but once all horses were removed from the HA the recovery of vegetation would be faster and future wild horse impacts to vegetation would be absent.

Cumulative Impacts
The incremental cumulative effects of different population levels and different reproductive rates of wild horse populations over time would have varying effects on the vegetative communities they rely on for forage, the vegetative communities they travel through and seasonally occupy, and the vegetative communities around areas of water.

Cumulative Impacts of the No Action Alternative
Under the no action alternative, wild horse populations would continue to increase leading to greater resource use and consumption. As vegetative forage resources become degraded and more scarce, wild horses are likely to emigrate outside of the herd management areas and have impacts to vegetation resources in new areas. Alongside vegetative resources, soil resources would also be expected to be degraded which would have negative effects and feedback on the vegetative communities. Where site-specific vegetation management objectives and Standards for Rangeland Health are not being achieved, they would likely continue not being achieved. Where standards are being achieved, it is possible they would transition to not being achieved. Opportunities to improve rangeland health and that of the vegetation, by bringing the wild horse population to AML and reducing vegetation utilization and trampling, would be lost.

Cumulative Impacts of the Proposed Action and Alternatives B, C and D
Under the Proposed Action, wild horse populations would be maintained at or near AML for the longest amount of time, compared to the alternatives. This would reduce excess pressure on the vegetative resources. Over time this would likely improve plant health, reproduction, diversity, and composition. The cumulative effects of Alternatives B and C would be similar to the Proposed Action, but they would not be as long lasting because the reproductive rates of the wild horse would not be reduced or controlled to the same extent. Under Alternative D, impacts to vegetation from horses in Jakes Wash HA would cease. This could lead to achieving Standards of Rangeland Health that are not currently achieved. It is possible for horses to emigrate from adjacent areas and reestablish populations in the future.

3.11. Soils/Watershed

Affected Environment
Soils within the Complex are typical of the Great Basin and vary with elevation. Soils range in depth from very shallow (below 20 inches to bedrock) to deep (greater than 60 inches to bedrock) and are typically gravelly, sandy and/or silt loams. Soils that are located on low hill slopes, upland terraces, and fan piedmont remnants are typically shallow to deep over bedrock or indurated lime hardpan. They are highly calcareous and medium textured with gravel. Soils on mountain slopes are also calcareous and range from shallow to deep over limestone. Some of the mountain soils have high rock fragment content, and support pinyon and juniper trees. Mountain soils typically have gravelly to very gravelly loam textures. Soils on floodplains and fan skirts are deep, have silt textures, and are highly calcareous.

Environmental Effects
No Action Alternative- Soils and watersheds would continue to have horse use and as horse populations increase heavy trailing and trampling around water sources and to foraging areas would occur. Watershed objectives would not be met due to increased horse populations over time.

Proposed Action- Project implementation would stay on existing roads, washes and horse trail areas, and would disturb relatively small areas used for gathering and holding operations. Horses may be concentrated for a limited period of time in traps. Potential for soil compaction would occur but would be minimal and temporary and is not expected to adversely impact soil or hydrologic function. Soils and watersheds would remain at or near the current condition. However, soils and watersheds would likely see improvement over time since wild horse population would be gathered in increments and growth rates would be less under this alternative.

Alternative B- Impacts would be similar to the Proposed Action; however, long term impacts may improve the area due to less soil compaction from trailing.

Alternative C- Impacts would be similar to those described for the Proposed Action.

Alternative D - Initial impacts would be similar to the Proposed Action, except that continued gathering efforts over the 10-year period aimed at capturing 100% of the current wild horse population would reduce to a greater extent the compaction effects from trailing over Alternatives A, B and C. This would promote the return of soil structure and water holding capacity in a shorter time period which in turn would increase plant community vitality and stability over time.

Cumulative Impacts

Cumulative Impacts of the Proposed Action and Alternatives B, C and D

Impacts to soils/watersheds within the Pancake Complex have resulted from past and present actions such as grazing, road construction and maintenance, OHV use and recreation, mining and processing activities, aggregate operations, public land management activities, and wildland fire.

Impacts to soils/watersheds from RFFAs would be similar to those described above for past and present actions, as these activities are expected to continue into the future. Direct cumulative impacts from the Proposed Action would include the short-term incremental impact of disturbance and compaction from hoof action around horse corrals. However, the long-term incremental impact to soil resources/watersheds would be positive as the number of horses are decreased with this gather and over time with subsequent gathers. This would result in restored soil structure, increased stability, and improved biological function of soils resulting in increased water-holding capacity, reduced erosion and enhanced vegetation community support.

Cumulative Impacts of the No Action Alternative

Under the No Action Alternative, no incremental gather-associated impacts would occur to soils/watersheds, thus the declining conditions from compaction, erosion, and consequent poor vegetation support would continue to increase as horse populations increase.

3.12. Fire / Fuels

Affected Environment

Pancake and Sand Springs West HMAs, Monte Cristo WHT as well as the Jakes Wash HA are located in areas that are dominated by vegetation typical of the great basin consisting of Pinyon and Juniper Woodlands, Sagebrush ecological sites, Salt Desert Scrub and Greasewood communities (see Vegetation 3.10 for a detailed description). Maintaining a balance of grazing animals and controlling the timing and amount of forage that is consumed each year by wildlife, livestock, and wild horses is crucial to maintaining healthy upland plant communities within the HMAs. Appropriate grazing levels by large ungulates has been associated with the known effect of reducing the cover, density, and volume of fuels, particularly fine fuels, on the landscape (Schmelzer et al., 2014). In turn, this reduces the probability and severity of catastrophic wildfires. Within the shrub and grasslands of the HMAs and surrounding areas, the fuel reducing benefits are known. Recent research has identified that grazing by many global herbivore species, including but not limited to horses, aids in the reduction of fuel loading and the impact of grazing by herbivores, including livestock, have long been recognized (Rouet-Leduc, 2021; Davies et al., 2010).

Year-round heavy grazing on upland vegetation from all ungulates reduces the overall amount of fuels available for wildfires but heavy grazing does not allow upland sites to recover from past disturbances and those areas are in danger of trending downward in ecological health and increasing in annual invasive grasses. Additionally, plant communities and sagebrush ecosystems that have been impacted in the past by wildfires and historic livestock grazing are vulnerable to losing more of their native perennial grass component when grazed at higher than moderate utilization levels (less than 60%) (USFS, 2017).

Past and present fire history data within the Pancake HMA is characterized by relatively low occurrence with few large fires. This is characteristic of its rural location and sparse vegetation types. There have been 47 reported ignitions for a total of 40.6 acres over the last 20 years. The median fire size is 0.1 acres with the largest being 21 acres. Over that last 20 years there have been no fires over 300 acres. Fuels treatments are disproportionately low within the HMA's as compared to the treatments approved whereas the Ely District is intentionally avoiding areas that are over AML thereby resulting in a reduced chance of success of the vegetation treatments. This is particularly true of treatment methods to restore landscapes encroached upon by pinyon and juniper or depleted sagebrush that require seeding (i.e. chaining, mastication, mowing, etc.).

Environmental Effects

No Action Alternative

The No Action Alternative could be expected to result in a continued decrease of the overall availability of fuels, particularly fine fuels, within the HMAs and surrounding areas in the short term. However, it would result in a continued increase in the number of wild horses above AML, which would have compounding impacts upon upland vegetation composition and the potential for future fires. The continued overgrazing of the landscape could be expected to decrease the native grass component and increase the invasive non-native species across the landscape which would reduce the resistance and resiliency of the landscape to disturbance such as wildfires. The increase in invasive non-native species would promote a more frequent and intense fire cycle that would further reduce native species across the landscape.

Proposed Action

The growing scientific literature has continued to affirm that even though grazing reduces fuel loading, proper grazing management is critical for the advancement of land health characteristics (Copeland et al., 2023). Soil health, hydrologic function, and biotic integrity are all impacted differently depending on the location, timing, duration, and intensity of grazing management (Hennig et al., 2021). Properly managed grazing is critical to achieve reductions in fuel loads while curbing the expansion of invasive annual grasses, promoting native perennial species, and protecting sensitive riparian habitats. Research continues to indicate that a variable season of use contributes to site resiliency while repeated early-season, high intensity use, contributes to the degradation of rangelands and the expansion of annual grasses (Copeland et al., 2023; Davies et al., 2015; Davies et al., 2024). Moderate fall grazing of uplands has also been identified with the reduction of invasive annual grasses and the promotion of native perennial species (Copeland et al., 2023; Davies et al., 2010).

While the BLM is granted the duty of managing wild horses, the day-to-day movement of wild horses on the range is inherently unmanaged from a livestock management perspective (Davies & Boyd, 2019). With the exception of fencing, wild horses graze whatever location they want to, for whatever timing and duration they want to, and whatever intensity (amount) they want to. In more natural systems, predation may augment the location, timing, and duration. However, wild horses face very limited predation and subsequently impressive reproduction rates as a result (Garrott, 2018).

Under Alternative A the numbers of wild horses would be reduced, and maintained at AML, which would result in a short-term increase in the volume of fine fuels throughout the HMAs. This would be due to a reduction in total amount of forage consumed year-round by the wild horses on the HMAs and surrounding areas. The increase of fuels available, especially during the late summer months, could result in a theoretical increase in wildfires. Conversely, the removal of excess wild horses may reduce the long-term increase in areas dominated by annual invasive grasses (cheatgrass). Reducing the amount of future area potentially dominated by annual invasive grasses and would theoretically reduce the amount and frequency of future fires.

Alternative B
Impacts of Alternative B would be similar to those of the Proposed Action as the population would be managed within AML.

Alternative C
Impacts of Alternative C would be similar to those of the Proposed Action as the population would be managed within AML.

Alternative D
Impacts of Alternative D would be similar to those of the Proposed Action as applied to the Jakes Wash HA.

Cumulative Impacts
It would be expected that the current rates and trends in ignition of wildfires would remain as see in the past and present fire history data presented in the affected environment. The current land management actions that impact wildfires and wildfire management would be expected to continue as is. Hazardous fuels reduction and habitat improvement projects would trend in different directions based upon the alternative selected.

Cumulative Impacts of the No Action Alternative
Under the no action alternative wild horse populations would be expected to increase at the national average of 20-25%. The increased herbivory and impacts of this increasing population could be expected to reduce fine fuels in the short term. In the long term it could be anticipated that it would lead to a reduction of native understory species and an increase in non-native invasive species. The fire regime could be expected to shift to a more frequent and intense fire regime as favored by non-native invasive species such as cheatgrass. Hazardous fuels reduction and habitat improvement projects would continue to avoid areas that are over AML resulting in less active improvement of the landscape.

Cumulative Impacts of the Proposed Action
The proposed action would manage wild horse populations at AML and would promote appropriate grazing across the landscape. This would be expected to increase fine fuels in the short term but would also lead to an increase in native understory species. This would increase the landscapes resistance to disturbance and resilience to change following disturbance maintaining a healthier landscape long term.

Cumulative Impacts of Alternative B
Impacts of Alternative B would be similar to those of the Proposed Action as the population would be managed within AML.

Cumulative Impacts of Alternative C
Impacts of Alternative C would be similar to those of the Proposed Action as the population would be managed within AML.

Cumulative Impacts of Alternative D
Impacts of Alternative D would be similar to those of the Proposed Action as applied to the Jakes Wash HA.

3.13. Socioeconomics

Socioeconomics considerations include the value placed on the Pancake Complex wild horses that may contribute to the economy. At this time there are no registered guided tours or known sales of commercial pictures being sold to increase the value to the communities from the wild horses that reside within or outside the Pancake Complex. It is acknowledged that some people that drive through the general area may stop and view or photograph the horses contributing to the Complex's intrinsic value.

There can also be a negative impact on socioeconomics. These impacts may effect wildlife enthusiasts that hunt, photograph, and guide big game that have abandoned use of the area due to the poor condition from the overpopulation of wild horses. Although grazing permits have not been recently reduced as a direct result of the overpopulation of wild horses, the strain of excess horses on the land, as well as impacts from recent drought and fires, have cumulatively put a strain on many agricultural related businesses in the area.

It is not possible to quantify the revenue or losses attributable to the Pancake Complex wild horses. It is recognized that for local industries the excess wild horses cause a negative impact to resources and to many businesses that rely on healthy range conditions, and healthy wildlife in the area. It is also recognized that any revenue brought by tourism, and photography of wild horses in the Complex is unknown.

4.0 Cumulative Effects

Cumulative impacts are impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The area of cumulative impact analysis is the Pancake Complex. (Appendix I).

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 that are analyzed are maintaining rangeland health and achieving and maintaining AMLs.

Past, Present, and Reasonably Foreseeable Actions

The past, present, and reasonably foreseeable future actions applicable to the assessment area are identified as the following:

Table 7. Past, Present, and Reasonably Foreseeable Future Actions

Project -- Name or Description	Status (x)		
	Past	Present	Future
Issuance of multiple use decisions and grazing permits for ranching operations through the allotment evaluation process and the reassessment of the associated allotments.	X	X	X
Livestock grazing	X	X	X
Wild horse and burro gathers	X	X	X
Mineral exploration / Mining, geothermal exploration/abandoned mine land reclamation	X	X	X
Recreation	X	X	X
Range Improvements (including fencing, wells, and water developments)	X	X	X
Wildlife guzzler construction	X	X	X
Invasive weed inventory/treatments	X	X	X
Wild horse and burro management: issuance of multiple use decisions, AML adjustments and planning	X	X	X
Fuels reduction treatment projects (Chaining, tree shrub removal)	X	X	X

Any future proposed projects within the Pancake Complex would be analyzed in an appropriate environmental document following site specific planning. Future project planning would also include public involvement.

Past Actions

In 1971 Congress passed the Wild Free-Roaming Horses and Burros Act which placed wild and free-roaming horses and burros, that were not claimed for individual ownership, under the protection of the Secretaries of Interior and Agriculture. In 1976 the Federal Land Policy and Management Act (FLPMA) gave the Secretary the authority to use motorized equipment in the capture of wild free-roaming horses as well as continued authority to inventory the public lands. In 1978, the Public Range Improvement Act (PRIA) was passed which amended the WFRHBA to provide additional directives for BLM's management of wild free-roaming horses on public lands.

Past actions include establishment of wild horse HMAs and WHTs, establishment of AML for wild horses, wild horse gathers, vegetation treatment, mineral extraction, oil and gas exploration, livestock grazing and recreational activities throughout the area. Some of these activities have increased infestations of invasive plants, noxious weeds, and pests and their associated treatments.

Pancake HMA

The Egan (1987) MFP (Ely District) designated the Monte Cristo and Sand Springs East HMAs for the long-term management of wild horses. These HMAs were later combined into the Pancake HMA in the Ely District Record of Decision (ROD) and Approved Resource Management Plan (RMP) in August 2008 due to the interchange between the two HMAs. The HMA is nearly identical in size and shape to the original Herd Areas representing where wild horses were located in 1971. Currently, management of HMA and wild horse population is guided by the 2008 Ely District ROD and RMP. The AML range for the HMA is 240-493 wild horses. The Land Use Plan analyzed impacts of management's direction for grazing and wild horses, as updated through Bureau policies, Rangeland Program direction, and Wild Horse Program direction. Forage was allocated within the allotments for livestock use and range monitoring studies were initiated to determine if allotment objectives were being achieved, or that progress toward the allotment objectives was being made.

In 2016 Public Law 11-4-232 expanded the Duckwater Tribe boundary to encompass 31,229 additional acres within the Pancake HMA. The law transferred the land from the BLM to the tribe in 2016, Thus reducing the Pancake HMA form 855,000 acres to 824,000 acres.

Jakes Wash HA

The Egan RMP (1987 Ely District) designated the Jakes Wash Herd Area (HA) for the long-term management of wild horses. The August 2008 Ely District Record of Decision (ROD) and Approved Resource Management Plan (RMP) management action WH-5 states: "remove wild horses and drop herd management area status for those… as listed in Table 13." Jakes Wash was dropped from HMA status and returned to HA status (manage "0" wild horses) with this management action. The management action to achieve 0 wild horses within the Jakes Wash HA reflects the recent evaluation based on multi-tiered analysis from the Ely Proposed Resource Management Plan/Final Environmental Impact Statement (November 2007) table 3.8-2 and page 4.8-2, of the components and herd characteristics: forage, water, cover, space, and reproductive viability. If one or more of these components were missing, the herd management area was considered unsuitable. The Jakes Wash HA has inadequate forage, water, space, and cover.

Sand Springs West HMAs

Herd Areas were identified in 1971 as areas occupied by wild horses. The HMA was established in the late 1980s through the land use planning process as areas where wild horse management was a designated land use. Since the mid-1980s, AMLs have been established on the Battle Mountain BLM District HMAs.

The Sand Springs West AML of 49 wild horses was established through a stipulated agreement (Consent Decision) between BLM, E. Wayne Hage, Colvin and Son Cattle Co., and Russell Ranches through the Department of the Interior Office of Hearings and Appeals, Hearings Division, and later confirmed by the Tonopah Resource Management Plan (RMP) approved October 6, 1997

Monte Cristo WHT

Wild Horse Territories were identified in 1971 as lands that were territorial habitat of wild horses. The WHTs were established in the late 1980s through the land use planning process as areas where wild horse management was a designated land use. Since the mid-1980s, AMLs have been established in the Forest Service Territories.

The Monte Cristo Wild & Free Roaming Horses Management Plan established a baseline AML of 72–120 wild horses, with an average of 96 head being maintained. These numbers were based on proper use studies conducted on the natural horse concentration areas. The baseline AML was adjusted to 72–96 through the Humboldt National Forest Land & Resource Management Plan in 1986 since range conditions had not improved with the number of horses occupying the area. The population within this HMA can fluctuate depending on the seasonal movement of the wild horses.

Pancake Complex

Integrated wild horse management has occurred in the Pancake and Sand Spring HMAs, Jakes Wash HA, and Monte Cristo WHT. Six gathers have been completed in the past on part or all of the HMAs/WHT, and future gathers would be scheduled on a 4- or 5- year gather cycle. Approximately 6,749 wild horses have been removed from the HMAs/WHT in the last 25 years; populations are thriving and have not been negatively impacted.

Adjustments in livestock season of use, livestock numbers, and grazing systems were made through the allotment evaluation/multiple use decision process. In addition, temporary closures to livestock grazing due to extreme drought conditions, were implemented to improve range condition.

The Mojave-Southern and Northeastern Great Basin RAC developed standards and guidelines for rangeland health that have been the basis for assessing rangeland health in relation to management of wild horse and livestock grazing within the Ely and Battle Mountain Districts. Adjustments in numbers, season of use, grazing season, and allowable use have been based on the evaluation of progress made toward achieving the standards.

Several oil and gas exploration wells have been drilled across the CESA however none of these wells have gone into production. The Ely RMP/EIS summarized the history of oil and gas exploration on pages 3.18-7 to 3.18-9.

Historical mining activities have occurred throughout the CESA.

The Pancake HMA is within the Duckwater Shoshone Tribe Reservation. In 2016 the BLM transferred 31,123.85 acres to the BIA for the expansion of the reservation.

Present Actions

Today the Pancake Complex has an estimated population of at least 1,495 wild horses (based on the 2024 population estimate). Resource damage is occurring in portions of the Complex due to excess animals. Current BLM policy is to conduct removals targeting portions of the wild horse population based upon age, and allowing the correction of any sex ratio problems that may occur. Further, the BLM's policy is to conduct gathers in order to facilitate a four-year gather cycle and to reduce population growth rates where possible. Program goals have expanded beyond establishing a "*thriving natural ecological balance*" by setting AML for individual herds to now include achieving and maintaining healthy and stable populations and controlling population growth rates.

Though authorized by the WFRHBA, current appropriations and policy prohibit the destruction of healthy animals that are removed or deemed to be excess. Only sick, lame, or dangerous animals can be euthanized, and destruction is no longer used as a population control method. A recent amendment to the WFRHBA allows the sale of excess wild horses that are over 10 years in age or have been offered unsuccessfully for adoption three times. BLM is adding additional long-term grassland pastures in the Midwest and West to care for excess wild horses for which there is no adoption or sale demand.

The BLM is continuing to administer grazing permits and authorize grazing within the CESA. Within the proposed gather area sheep and cattle grazing occurs on a yearly basis. Wildlife use by large ungulates such as elk, deer, and antelope is also currently common in the CESA.

The focus of wild horse management has also expanded to place more emphasis on achieving rangeland health as measured against the RAC Standards. The Mojave-Southern Great Basin and Northeastern Great Basin RAC standards and guidelines for rangeland health are the current basis for assessing rangeland health in relation to management of wild horse and livestock grazing within the Ely and Battle Mountain Districts. Adjustments to numbers, season of use, grazing season, and allowable use are based on evaluating achievement of or making progress toward achieving the standards.

Gold exploration and mining is on-going in the CESA, occurring primarily in Pancake Mountain Range.

Active oil and gas leases occur throughout the CESA. Many oil and gas lease sales have taken place and currently are ongoing.

Ely Gold Royalties Inc. is the Operator of the approved Green Springs Plan of Operations which is a multi-year mineral exploration project that allows up to 75 acres of earthwork disturbance in the White Pine Range on National Forest System Lands. Exploration drilling commenced in 2015 and has continued in 2017 and 2019. The next phase of drilling is anticipated in the summer/fall of 2020.

Reasonably Foreseeable Future Actions

In the future, the BLM would manage wild horses within HMAs that have suitable habitat for an AML range that maintains adequate levels of genetic diversity, age structure, and targeted sex ratios. Current policy is to express all future wild horse AMLs as a range, to allow for regular population growth, as well as better management of populations rather than individual HMAs. The Ely BLM District completed the *Ely Proposed Resource Management Plan/Final Environmental Impact Statement* (RMP/EIS, 2007) released in November 2007 which analyzed AMLs expressed as a range and addressed wild horse management on a programmatic basis. Future wild horse management in the BLM's Ely and Battle Mountain Districts as well as the USFS's Humboldt-Toiyabe National Forest would focus on an integrated ecosystem approach with the basic unit of analysis being the watershed. In 2014 the Bristlecone Field Office completed the Newark and Huntington Watersheds Implementation and Restoration Plan. This plan identifies actions associated with habitat improvement within the complex. The BLM would continue to conduct monitoring to assess progress toward meeting rangeland health standards. Wild horses would continue to be a component of the public lands, managed within a multiple use concept.

As the BLM and USFS achieve AML on a national basis, gathers should become more predictable due to facility space. Fertility control should also become more readily available as a management tool, with treatments that last between gather cycles reducing the need to remove as many wild horses and possibly extending the time between gathers. The combination of these factors should result in an increase in stability of gather schedules and longer periods of time between gathers.

The proposed gather area contains a variety of resources and supports a variety of uses. Any alternative course of wild horse management has the opportunity to affect and be affected by other authorized activities ongoing in and adjacent to the area. Future activities which would be expected to contribute to the cumulative impacts of implementing the Proposed Action include: future wild horse gathers, continuing livestock grazing in the allotments within the area, mineral exploration, new or continuing infestations of invasive plants, noxious weeds, and pests and their associated treatments, and continued native wildlife populations and recreational activities historically associated with them. The significance of cumulative effects based on past, present, proposed, and reasonably foreseeable future actions are determined based on context and intensity.

Midway Gold Company has moved from exploration into production in the Pancake Range (Pan Project). Construction of this mining facility may occur after the proper environmental analysis is completed over the next few years.

Waterton Global Resource Management Inc. /Elko Mining Group is the Operator of the approved Centennial-Seligman Mine Plan of Operations located on National Forest System Lands in the White Pine Range. The project consists of mining and exploration activities within a project area of approximately 1,454 acres. Approximately 365 acres of the project area have previously been disturbed during past mining operations at the Mt Hamilton Mine. The plan also describes operations on approximately 33.7 acres of private lands for milling and processing of ore material. It is anticipated that additional exploration work would occur prior to mining operations.

The Ely District Office has experienced continual and increased interest in Renewable Energy project applications, particularly in the Jake's Valley area, though applications exist in many areas of the Ely District. With several large-scale transmission lines proposed to cross the district, the existing 368 Corridor, as well as a proposed expansion of the Robinson Substation in Jake's Valley, it is reasonable to expect continued submission of Renewable Energy projects in the district. Proposed solar project applications received have generally proposed fencing of the project boundaries and if approved would limit transitory access in those areas.

Impacts Conclusion

Past actions regarding the management of wild horses have resulted in the current wild horse population within the Pancake Complex. Wild horse management has contributed to the present resource condition and wild horse herd structure within the gather area.

The combination of the past, present, and reasonably foreseeable future actions, along with the Proposed Action or action alternatives, should result in more stable and healthier wild horse populations, healthier rangelands (vegetation, riparian areas and wildlife habitat), and fewer multiple-use conflicts within the HMAs and WHT.

Most past and all present and reasonably foreseeable future actions have noxious and invasive weed prevention stipulations and required weed treatment requirements associated with each project. This in combination with the active BLM Ely District Weed Management Program would minimize the spread of weeds throughout the watershed. Under Alternatives A, B and C the risk from wildfire would be reduced due to increased resilience of the landscape due to disturbance. Under the no action alternative wildfire risk would increase due to increased potential for non-native species and altered fire regimes.

5.0 Mitigation Measures and Suggested Monitoring

The BLM has already incorporated design features into the Proposed Action and alternatives, which have been developed over time. These design features are listed as SOPs (Appendix II, III, and IV) and represent the "best methods" for reducing impacts associated with gathering, handling, and transporting wild horses and collecting herd data. Hair follicle samples would be collected to establish a genetic baseline for the wild horses from the Pancake and Sand Springs West HMAs, and Monte Cristo WHT; additional samples would be collected during future gathers (in 10-15 years) to determine trend. If monitoring indicates that genetic diversity (as measured in terms of observed heterozygosity) is not being adequately maintained (BLM 2010), 5-10 young mares from HMAs in similar environments may be added every generation (every 8-10 years) to avoid inbreeding depression and to maintain acceptable genetic diversity. Samples may also be collected for genetic ancestry analysis or curly gene characteristics. Ongoing resource monitoring, including climate (weather), and forage utilization, population inventory, and distribution data would continue to be collected. However, there are no separate mitigation measures necessary, as all reasonable means of reducing adverse environmental impacts have already been incorporated into the Proposed Action and alternatives as design features.

6.0 Consultation and Coordination

Public hearings are held annually regarding the use of motorized vehicles, including helicopters and fixed-wing aircraft, in the management of wild horses and burros. During these meetings, the public is given the opportunity to present new information and to voice any concerns regarding the use of the motorized vehicles. The BLM hosted its annual public hearing on the use of motorized vehicles in the management of wild horses and burros on May 23, 2024, via Zoom. The stream was also hosted live on BLM.gov/live. Twenty-three public comments were provided via audio, with more than 60 written comments sent via email. Most were not in support of the use of helicopters and the gathering of excess wild horses. Their comments were entered into the record for this hearing. Standard Operating Procedures were reviewed in response to these concerns and no changes to the SOPs were indicated based on this review.

The use of helicopters and motorized vehicles has proven to be a safe, effective, and practical means for the gather and removal of excess wild horses and burros from the range. Since 2006, Nevada has gathered over 40,000 animals with a total mortality of approximately 1.1% (of which .5% was gather related), which is very low when handling wild animals. BLM also avoids gathering wild horses prior to or during the peak of foaling and does not conduct helicopter removals of wild horses during March 1 through June 30.

The BLM Ely and Battle Mountain Districts have coordinated with Nevada Department of Wildlife (NDOW) during their yearly coordination meeting. Additionally, as required by the GRSG Land Use Plan Amendment (2015), NDOW has reviewed the Greater sage-grouse form, RDF's and has granted seasonal waivers for wild horse gathers in the Pancake Complex. BLM would continue to coordinate with NDOW in regard to staging, trapping, and corral locations to minimize impacts to wildlife.

7.0 List of Preparers

Table 8. List of Preparers

Ely District Office		
Name	**Title**	**Responsible for the Following Section(s) of this Document**
Ben Noyes	Wild Horse Specialist	Project Lead/ Wild Horse Specialist
Nancy Herms	Wildlife Biologist	Wildlife, Migratory Birds, Special Status Species
Matt Rajala	Fire / Fuels	Fire/ Fuels
John Miller	Wilderness Planner	Wilderness/WSA
Andy Gault	Hydrologist	Soil, Water, Wetlands and Riparian/Flood Plans
Stephen Andersen	Rangeland Management Specialist	Livestock Grazing Vegetation
Robert Nash	Archaeologist	Cultural Resources
Robert Nash	Native American Coordinator	Native American Religious Concerns
Greg Gresh	Planning & Environmental Specialist	National Environmental Policy Act
Battle Mountain District Office		
Eden Long	Wild Horse Specialist	Wild Horses
Michael Strother	Wildlife Biologist	Wildlife, Migratory Birds, Special Status Species
Daltrey Balmer	Assistant Field Manger	Livestock Grazing, Special Status Species

8.0 References, Glossary and Acronyms

8.1. General References Cited

American Association of Equine Practitioners (AAEP). 2011. Bureau of Land Management (BLM) Wild Horse and Burro Program, Task Force Report, August 2011, Lexington, KY.

Baker, D.L., J.G. Power, 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.

Baker, D.L., B.E. McCann, J.G. Powers, N.L. Galloway, J.E. Bruemmer, M.A. Thompson, and T.M. Nett. 2023. Reimmunization intervals for application of GnRH immunocontraceptive vaccine (GonaCon-Equine) in free-roaming horses (*Equus ferus caballus*) using syringe darts. Theriogenology Wild (3): 100061.

Baldrighi, J.M., C.C. Lyman, K. Hornberger, S.S. Germaine, A. Kane, and G.R. Holyoak. 2017. Evaluating the efficacy and safety of silicone O-ring intrauterine devices as a horse contracetive through a captive breeding trial. Clinical Theriogenology 9:471.

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.

Beck, J.L., M.C. Milligan, K.T. Smith, P.A. Street, A.C. Pratt, C.P. Kirol, C.P. Wanner, J.D. Hennig, J.B. Dinkins, J.D. Scasta, and P.S. Coates, P.S. 2024. Free-roaming horses exceeding appropriate management levels affect multiple vital rates in greater sage-grouse. Journal of Wildlife Management 2024;e22669.

Behnke, T.L., P.A. Street, S. Davies, J.Q. Ouyang, and J.S. Sedinger. 2022. Non-native grazers affect physiological and demographic responses of greater sage-grouse. Ecology and Evolution 12(9), p.e9325

Behnke, T.L., P.A. Street, and J.S. Sedinger. 2023. Climate and non-native herbivores influence reproductive investment by Greater Sage-grouse. Ecosphere 14(5), p.e4498.

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

Bureau of Land Management. 2015. Nevada and Northeastern California Greater Sage-grouse Approved Resource Management Plan Amendment. September 2015, Maintenance Action 2022.

Bureau of Land Management. 2023. Bureau of Land Management Nevada Special Status Species list. September 2023.

Carey, K.A., A. Ortiz, K. Grams, D. Elkins, J.W. Turner, and A.T. Rutberg. 2019. Efficacy of dart-delivered PZP-22 immunocontraceptive vaccine in wild horses (Equus caballus) in baited traps in New Mexico, USA. Wildlife Research 46:713-718.

Coates, P.S., O'Neil, S.T., Muñoz, D.A., Dwight, I.A., and Tull, J.C. 2021. Sage-grouse population dynamics are adversely impacted by overabundant free-roaming horses. The Journal of Wildlife Management 85:1132-1149.

Coates-Markle, L. 2000. Summary Recommendations, BLM Wild Horse and Burro Population Viability Forum April 1999, Ft. Collins, CO. Resource Notes 35:4pp.

Cothran, E.G. 2009. Genetic analysis of the Sand Springs East NV HMA. Report from Texas A&M University Department of Veterinary Integrative Bioscience.

Cothran, E.G. 2024. Genetic analysis of the Pancake NV0415 HMA. Report from Texas A&M University Department of Veterinary Integrative Bioscience.

Cothran, E.G., A. Khanshour, S. Funk, E. Conant, R. Juras, and B.W. Davis. 2024. Genetic dynamics of Mustang and Feral Horse Populations in the Western United States. BioRxiv doi.org/10.1101/2024.01.28.577652.

Curtis, P.D., Pooler, R.L., Richmond, M.E., Miller, L.A., Mattfield, G.F., Quimby, F.W. 2002. Comparative effects of GnRH and porcine zona pellucid (PZP) immuniocontraception vaccines

for controlling reproduction in white-tailed deer (Odocoileus virginianus). Reproduction Supplement 60:131-141.
Daels, P.F, and J.P. Hughes. 1995. Fertility control using intrauterine devices: an alternative for population control in wild horses. Theriogenology 44:629-639.
EPA (United States Environmental Protection Agency). 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
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). 2020. M009 Device determination review. Product name: Y-shaped silicone IUD for feral horses. October 28 letter to BLM.
Floyd, Ted et al. 2007. Atlas of the Breeding Birds of Nevada. University of Nevada Press, Reno Nevada.
Frankham, R., J. D. Ballou, and D. A. Briscoe. 2010. Introduction to conservation genetics, second edition. Cambridge University Press, New York, New York.
Freeman, C.E., and S.K. Lyle. 2015. Chronic intermittent colic in a mare attributed to uterine marbles. Equine Veterinary Education 27:469-473.
Ganskopp, D.C. 1983. Habitat use and Spatial Interactions of Cattle, Wild Horses, Mule Deer, and California Bighorn Sheep in the Owyhee Breaks of Southeast Oregon. PhD Dissertation, Oregon State University.
Ganskopp, D.C. and M. Vavra. 1986. Habitat Use by Feral Horses in the Northern Sagebrush Steppe. Journal of Range Mangement 39(3):207-211.
Ganskopp, D.C. and M. Vavra. 1987. Slope Use by cattle, feral horses, deer, and bighorn sheep. Northwest Science, 61(2):74-80
Garrot. R. A., and I. Taylor. 1990. Dynamics of a feral horse population in Montana. Journal of Wildlife Management 54:603-612.
Garrott , R.A., and D.B. Siniff. 1992. Limitations of male-oriented contraception for controlling feral horse populations. Journal of Wildlife Management 56:456-464.
Government Accountability Office (GAO). 2008. Bureau of Land Management; Effective Long-Term Options Needed to Manage Unadoptable Wild Horses. Report to the Chairman, Committee on Natural Resources, House of Representatives, GAO-09-77.
Great Basin Bird Observatory. 2003. Nevada Bird Count. A habitat-based monitoring program for breeding birds of Nevada. Instruction package and protocol for point count surveys.
Gradil, C. 2019. The Upod IUD: a potential simple, safe solution for long-term, reversible fertility control in feral equids. Oral presentation at the Free Roaming Equids and Ecosystem Sustainability Summit, Reno, Nevada.
Gradil, C.M., C.K. Uricchio, and A. Schwarz. 2019. Self-Assembling Intrauterine Device (Upod) Modulation of the Reproductive Cycle in Mares. Journal of Equine Veterinary Science 83: 102690.
Greene, E.A., C.R. Heleski, S.L. Ralston, and C.L Stull. 2013. Academic assessment of equine welfare during the gather process of the Bureau of Land Management's wild horse and burro program. Journal of Equine Veterinary Science 5: 352-353.
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 pages. https://doi.org/10.3133/tm2A16.
Heilmann, T.J., Garrott, R.A., Caldwell, L.L., Tiller, B.L. 1998. Behavioral response of free-ranging elk treated with an immunocontraceptive vaccine. Journal of Wildlife Management 62:243-250.
Hennig, J.D., J.D. Scasta, A.C. Pratt, C.P. Wanner, and J.L. Beck. 2023. Habitat selection and space use overlap between feral horses, pronghorn, and greater sage‐grouse in cold arid steppe.

Journal of Wildlife Management 87(1), e22329.
Herbel, H. Carlton., Jerry L. Holechek., Rex D. Pieper., Range Management Principles and Practices. Fifth Edition. 2004 pg 141-142
Holyoak, G.R., C.C. Lyman, S. Wang, S.S. Germaine, C.O. Anderson, J.M. Baldrighi, N. Vemula, G.B. Rexabek, and A.J. Kane. 2021. Efficacy of a Y-design intrauterine device as a horse contraceptive. Journal of Wildlife Management 85:1169-1174.
Interior Board of Land Appeals 88-591, 88-638, 88-648, 88-679 at 127.Animal Protection Institute of America v. Nevada BLM, 109 IBLA 115, (1989). Animal Protection Institute, 118 IBLA 63, 75 (1991).
Joonè, C.J., C.M. Gradil, J.A. Picard, J.D. Taylor, D. deTonnaire, and J. Cavalieri. 2021. The contraceptive efficacy of a self-assembling intra-uterine device in domestic mares. Australian Veterinary Journal. doi: 10.1111/avj.13055
Killian, G., D. Thain, N.K. Diehl, J. Rhyan, and L. Miller. 2008. Four-year contraception rates of mares treated with single-injection porcine zona pellucida and GnRH vaccines and intrauterine devices. Wildlife Research 35:531-539.
Kirkpatrick, J.F., R. Naugle, I.K.M. Lui, J.W. Turner JR., M. Bernocco. 1995. Effects of Seven Consecutive years of PZP Contraception on Ovarian Function in Feral Mares, Biology of Reproduction Monograph Series 1: Equine Reproduction VI: 411-418.
Klabnik-Bradford, J., M.S. Ferrer, C. Blevins, and L. Beard. 2013. Marble-induced pyometra in an Appaloosa mare. Clinical Theriogenology 5: 410.
Lubow, B.C. 2016. Statistical analysis for 2016 horse surveys in BLM Nevada Elko, Ely, and Battle Mountain Districts: Triple B Complex, Pancake Complex, Seaman HA, White River HA, and Diamond Complex. Report to BLM from IIF data Solutions.
Madosky, J.M., Rubenstein, D.I., Howard, J.J., Stuska, S. 2010. The effects of immunocontraception on harem fidelity in a feral horse (Equus caballus) population. Appl. Anim. Behavior Sci. 128:50-56.
McCann, B., D. Baker, J. Powers, A. Denicola, B. Soars, and M. Thompson. 2017. Delivery of GonaCon-Equine to feral horses (Equus caballus) using prototype syringe darts. Presentation to the International Wildlife Fertility Control conference, Washington, D.C.
McInnis, M.A. 1984. Ecological Relationships among Feral Horses, Cattle, and Pronghorn in Southeastern Oregon. PhD Dissertation. Oregon State University.
McInnis, M.A. and M. Vavra. 1987 Dietary relationships among feral horses, cattle, and Prognhorn in southeastern Oregon. Journal of Range Mgt 40(1):60-66.
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.
Muñoz, D.A., P.S. Coates, and M.A. Ricca. 2020. Free-roaming horses disrupt greater sage-grouse lekking activity in the great basin. Journal of Arid Environments 184: 104304.
National Research Council of the National Academies of Sciences (NRC). 2013. Using science to improve the BLM wild horse and burro program: a way forward. National Academies Press. Washington, DC.
Neel, L.A. (Editor). 1999. Nevada Partners in Flight Bird Conservation Plan. Nevada Department of Wildlife. March 2007. www.ndow.org
Nevada Natural Heritage Program. March 2008. www.heritage.nv.gov
Nie, G.J., K.E., Johnson, T.D. Braden, and J. G.W. Wenzel. 2003. Use of an intra-uterine glass ball protocol to extend luteal function in mares. Journal of Equine Veterinary Science 23:266-273.
NOAA. www.cpc.ncep.noaa.gov
Nunez, C. M.V., Adelman, J.S., Mason, C., and Rubenstein, D.I. 2009 Immunocontraception decreases group fidelity in a feral horse population during the non-breeding season. Appl. Anim. Behavior Sci. 117:74-83.
Platts, W.S., and J.N. Rinne. 1985. Riparian and stream enhancement management and research in the Rocky Mountains. North American Journal of Fisheries Management 5:115-125.
Powell, D.M. 1999. Preliminary evaluation of porcine zona pellucid (PZP) immunocontraception for

behavioral effects in feral horses (Equus caballus). J. Appl. Anim. Welfare Sci. 2:321-335.
Prochazka, BS, PS Coates, M O'Donnell, DR Edmunds, AP Monroe, MA Ricca, GT Wann, SE Hanser, LA Wiechman, KE Doherty, MP Chenaille, and CL Aldridge. 2023. A targeted annual warning system developed for the conservation of a sagebrush indicator species. https://www.usgs.gov/publications/a-targeted-annual-warning-system-developed-conservation-a-sagebrush-indicator-species
Ransom JI, Cade BS, Hobbs NT. 2010. Influences of immunocontraception on time budgets, social behavior, and body condition in feral horses. Appl. Anim. Behavior Sci. 124:51-60.
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.
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. 2019. 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.
Science and Conservation Center (SCC). 2015. Materials Safety Data Sheet, ZonaStat-H. Billings, Montana.
Schulman, M.L., N.K. Hayes, T.A. Wilson, and J.D. Grewar. 2024. Immunocontraceptive efficacy of native porcine zona pellucida (pZP) treatment of Nevada's Virginia range free-roaming horse population . Vaccines 12:96.
Shumake, S.A., Wilhelm, E.S. 1995. Comparisons of effects of four immunocontraceptive treatments on estrous cycle and rutting behavior in captive white-tailed deer. Denver Wildlife Research Center, Colorado, USA.
Singer F.J., Aeignefuss L. 2000. Genetic Effective Population Size in the Pryor Mountain Wild Horse Herd: Implications for conserving genetics and viability goals in wild horses. U.S. Geologic Survey, Midcontinent Ecological Science Center, Ft. Collins CO. Resource Notes 29:2 pp.
Smith, M.A. 1986a. Impacts of Feral Horses Grazing on Rangelands: An Overview. Equine Veterinary Science, 6(5):236-238.
Smith, M.A. 1986b. Potential Competitive Interactions Between Feral Horses and Other Grazing Animals. Equine Veterinary Science, 6(5):238-239.
Smith, M.A and J.W. Waggoner, Jr., et al. 1982. Vegetation Utilization, Diets, and Estimated Dietary Quality of Horses and Cattle Grazing in the Red Desert of Westcentral Wyoming. BLM Contract No. AA851-CTO-31.
Society for Range Management, 1989. A glossary of Terms Used in Range Management (Third ed.). Society for Range Management, Denver, Colo.
State of Nevada Sagebrush Ecosystem Program. 2020. Sagebrush Ecosystem 2020 Adaptive Management Annual Report. March 6, 2020.
Nevada Division of State Lands. 1986. Nevada Statewide Policy Plan for Public Lands. Nevada Division of State Lands, State of Nevada, Carson City, NV.
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 Jr., J.W., I.K.M. Liu, Rutberg, A., J.W., Kirkpatrick. 1997. Immunocontraception Limits Foal Production in Free Roaming Feral Horses in Nevada, J. Wildl. Manage. 61 (3):873-880.
Turner, A, and Kirkpatrick, JF. 2002. Effects of immunocontraception on population, longevity and body condition in wild mares (Equus caballus). Reproduction (Suppl. 60): 187-195.
Turner, R.M., D.K. Vanderwall, and R. Stawecki. 2015. Complications associated with the presence of two intrauterine glass balls used for oestrus suppression in a mare. Equine Veterinary Education 27:340-343.

Vavra, M. and F. Sneva. 1978. Seasonal Diets of five ungulates grazing the cold desert biome. Proceedings of the First International Rangeland Congress. Society for Range Mgt. Denver, CO.

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

USGAO. 2008. Bureau of Land Management Effective Long-Term Options Needed to Manage Unadoptable Wild Horses. GAO-09-77

USDOI. 1994. Proposed Tonopah Resource Management Plan and Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Land Management.

USDOI. 1997. Approved Tonopah RMP and Record of Decision. U.S. Department of the Interior, Bureau of Land Management.

USDOI, BLM. 2008. National Environmental Policy Act. Handbook-1790-1.

USDOI. 2007. Ely Proposed Resource Management Plan/ Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Land Management. BLM/EL/PL-07/09+1793. DOI No. FES07-40. November 2007

USDOI. 2008. Ely District Record of Decision and Approved Resource Management Plan. U.S. Department of the Interior, Bureau of Land Management. BLM/NV/EL/PL-GI08/25+1793.

USDOI, Bureau of Land Management. 1994. Guidelines for assessing and documenting cumulative impacts. WO-IB-94-310.

Wang-Cahill, F., J. Warren, T. Hall, J. O'Hare, A. Lemay, E. Ruell, and R. Wimberly. 2022. Use of GonaCon in wildlife management. Chapter XI 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.

Vavra, M. and F. Sneva. 1978. Seasonal Diets of five ungulates grazing the cold desert biome. Proceedings of the First International Rangeland Congress. Society for Range Mgt. Denver, CO.

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

CHEATGRASS CITATIONS

Beever, E.A., R.J. Tausch, and P.F. Brussard. 2003. Characterizing grazing disturbance in semiarid ecosystems across broad scales, using diverse indices. Ecological Applications 13:119-136.

Couvreur, M., B. Christian, K. Verheyen and M. Hermy. 2004. Large herbivores as mobile links between isolated nature reserves through adhesive seed dispersal. Applied Vegetation Science 7:229-236.

Jessop, B.D. and V.J. Anderson. 2007. Cheatgrass invasion in salt desert shrublands: benefits of postfire reclamation. Rangeland Ecology & Management 60:235-243.

King, S.R.B., K.A. Schoenecker, and D.J. Manier. 2019. Potential spread of cheatgrass (*Bromus tectorum*) and other invasive species by feral horses (*Equus ferus caballus*) in western Colorado. Rangeland Ecology and Management 72:706-710.

Loydi, A. and S.M. Zalba. 2009. Feral horses dung piles as potential invasion windows for alien plant species in natural grasslands. Plant Ecology 201:471-480.

Fire/ Fuels CITATIONS

Copeland S. M. et.al 2023 Variable effects of long-term livestock grazing across the western United States Appl Veg Sci. 2023;26:e12719.

Davies K.W. Boyd C.S. 2021 Ecological Effects of free-Roaming Horses in North America Rangelands BioScience • July 2019 / Vol. 69 No. 7

Davies K.W. Boyd C.S. Ecological benefits of strategically applied livestock grazing in sagebrush communities. Ecosphere. 2024;15:e4859.

Garrott R. A. 2018 Wild horse demography: implications for sustainable management within economic

constraints Human-Wildlife Interactions, Spring 2018, Vol. 12, No. 1 (Spring 2018), pp. 46-57
Hennig J.D. 2021 Temporal Overlap Among Feral Horses, Cattle, and Native Ungulates at Water Sources The Journal of Wildlife Management 85(6):1084–1090; 2021;
Rouet-Leduc J. 2021 Effects of large herbivores on fire regimes and wildfire mitigation Journal of Applied Ecology |June 2021
Schmelzer L,* Perryman B. 2014 CASE STUDY: Reducing cheatgrass(Bromus tectorum L.) fuel loads using fall cattle grazing The Professional Animal Scientist 30 (2014):270–278

GELDING CITATIONS

Angle, M., J. W. Turner Jr., R. M. Kenney, and V. K. Ganjam. 1979. Androgens in feral stallions. Pages 31–38 in Proceedings of the Symposium on the Ecology and Behaviour of Wild and Feral Equids, University of Wyoming, Laramie.
Asa, C. S. 1999. Male reproductive success in free-ranging feral horses. Behavioural Ecology and Sociobiology 47:89–93.
Berger, J. 1986. Wild horses of the Great Basin. University of Chicago Press, Chicago.
Borsberry, S. 1980. Libidinous behaviour in a gelding. Veterinary Record 106:89–90.
Chaudhuri, M., and J. R. Ginsberg. 1990. Urinary androgen concentrations and social status in two species of free ranging zebra (Equus burchelli and E. grevyi). Reproduction 88:127–133.
Colborn, D. R., D. L. Thompson, T. L. Roth, J. S. Capehart, and K. L. White. 1991. Responses of cortisol and prolactin to sexual excitement and stress in stallions and geldings. Journal of Animal Science 69:2556–2562.
Collins, G. H., and J. W. Kasbohm. 2016. Population dynamics and fertility control of feral horses. Journal of Wildlife Management 81: 289-296.
Costantini, R. M., J. H. Park, A. K. Beery, M. J. Paul, J. J. Ko, and I. Zucker. 2007. Post-castration retention of reproductive behavior and olfactory preferences in male Siberian hamsters: Role of prior experience. Hormones and Behavior 51:149–155.
Deniston, R. H. 1979. The varying role of the male in feral horses. Pages 93–38 in Proceedings of the Symposium on the Ecology and Behaviour of Wild and Feral Equids, University of Wyoming, Laramie.
Dixson, A. F. 1993. Sexual and aggressive behaviour of adult male marmosets (Callithrix jacchus) castrated neonatally, prepubertally, or in adulthood. Physiology and Behavior 54:301–307.
Dunbar, I. F. 1975. Behaviour of castrated animals. The Veterinary Record 92–93.
Eagle, T. C., C. S. Asa, R. A. Garrott, E. D. Plotka, D. B. Siniff, and J. R. Tester. 1993. Efficacy of dominant male sterilization to reduce reproduction in feral horses. Wildlife Society Bulletin 21:116–121.
Feh, C. 1999. Alliances and reproductive success in Camargue stallions. Animal Behaviour 57:705–713.
Feist, J. D., and D. R. McCullough. 1976. Behavior patterns and communication in feral horses. Zietschrift für Tierpsychologie 41:337–371.
Garrott , R.A., and D.B. Siniff. 1992. Limitations of male-oriented contraception for controlling feral horse populations. Journal of Wildlife Management 56:456-464.
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.
Hart, B. L., and T. O. A. C. Jones. 1975. Effects of castration on sexual behavior of tropical male goats. Hormones and Behavior 6:247–258.

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

Jewell, P. A. 1997. Survival and behaviour of castrated Soay sheep (Ovis aries) in a feral island population on Hirta, St. Kilda, Scotland. Journal of Zoology 243:623–636.

Kaseda, Y., H. Ogawa, and A. M. Khalil. 1997. Causes of natal dispersal and emigration and their effects on harem formation in Misaki feral horses. Equine Veterinary Journal 29:262–266.

Khalil, A. M., and N. Murakami. 1999. Effect of natal dispersal on the reproductive strategies of the young Misaki feral stallions. Applied Animal Behaviour Science 62:281–291.

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 intra-uterine devices. Wildlife Research 35:531–539.

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

King, S.R.B., and J. Gurnell. 2006. Scent-marking behaviour by stallions: an assessment of function in a reintroduced population of Przewalski horses (Equus ferus przewalskii). Journal of Zoology 272:30–36.

Line, S. W., B. L. Hart, and L. Sanders. 1985. Effect of prepubertal versus postpubertal castration on sexual and aggressive behavior in male horses. Journal of the American Veterinary Medical Association 186:249–251.

Linklater, W. L., and E. Z. Cameron. 2000. Distinguishing cooperation from cohabitation: the feral horse case study. Animal Behaviour 59:F17–F21.

Nelson, K. J. 1980. Sterilization of dominant males will not limit feral horse populations. USDA Forest Service Research Paper RM-226.

Nock, B. 2017. Gelding is likely to cause wild horses undo suffering. Unpublished record of opinion.

Kirkpatrick, J. 2012. Sworn statement of Dr. Jay Kirkpatrick. Unpublished record of opinion.

Kitchell, K., S. Cohn, R. Falise, H. Hadley, M. Herder, K. Libby, K. Muller, T. Murphy, M. Preston, M.J. Rugwell, and S. Schlanger. 2015. Advancing science in the BLM: an implementation strategy. Department of the Interior, BLM, Washington DC.

Rutberg, A. 2011. Re: Modified decision record, WY-040-EA11-124. Unpublished record of opinion.

Pearce, O. 1980. Libidinous behaviour in a gelding. Veterinary Record 106:207–207.

Ransom, J. I., and B. S. Cade. 2009. Quantifying Equid Behavior--A Research Ethogram for Free-Roaming Feral Horses. Publications of the US Geological Survey. U.S. Geological Survey Techniques and Methods 2-A9.

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.

Rios, J. F. I., and K. Houpt. 1995. Sexual behavior in geldings. Applied Animal Behaviour Science 46:133–133.

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

Saltz, D., M. Rowen, and D. I. Rubenstein. 2000. The effect of space-use patterns of reintroduced Asiatic wild ass on effective population size. Conservation Biology 14:1852–1861.

Schumacher, J. 2006. Why do some castrated horses still act like stallions, and what can be done about it? Compendium Equine Edition Fall:142–146.

Shoemaker, R., Bailey, J., Janzen, E. and Wilson, D.G., 2004. Routine castration in 568 draught colts: incidence of evisceration and omental herniation. Equine Veterinary Journal, 36:336-340.

Sigurjónsdóttir, H., M. C. Van Dierendonck, S. Snorrason, and A. G. Thorhallsdóttir. 2003. Social relationships in a group of horses without a mature stallion. Behaviour 140:783–804.

Smith, J. A. 1974. Proceedings: Masculine behaviour in geldings. The Veterinary Record 94:160–160.

Thompson, D. L., Jr, B. W. Pickett, E. L. Squires, and T. M. Nett. 1980. Sexual behavior, seminal pH and accessory sex gland weights in geldings administered testosterone and(or) estradiol-17. Journal of Animal Science 51:1358–1366.

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.

Tyler, S. 1972. The behaviour and social organisation of the New Forest ponies. Animal Behaviour Monographs 5:85–196.

Van Dierendonck, M. C., H. De Vries, and M. B. H. Schilder. 1995. An analysis of dominance, its behavioural parameters and possible determinants in a herd of Icelandic horses in captivity. Journal of Zoology 45:362–385.

Van Dierendonck, M. C., H. Sigurjónsdóttir, B. Colenbrander, and A. G. Thorhallsdóttir. 2004. Differences in social behaviour between late pregnant, post-partum and barren mares in a herd of Icelandic horses. Applied Animal Behaviour Science 89:283–297.

Van Dierendonck, M. C., H. De Vries, M. B. H. Schilder, B. Colenbrander, A. G. Þorhallsdóttir, and H. Sigurjónsdóttir. 2009. Interventions in social behaviour in a herd of mares and geldings. Applied Animal Behaviour Science 116:67–73.

Vinke, C. M., R. van Deijk, B. B. Houx, and N. J. Schoemaker. 2008. The effects of surgical and chemical castration on intermale aggression, sexual behaviour and play behaviour in the male ferret (Mustela putorius furo). Applied Animal Behaviour Science 115:104–121.

CITATIONS ABOUT PZP, GONACON, and SEX RATIO

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.

Baker, D.L., B.E. McCann, J.G. Powers, N.L. Galloway, J.E. Bruemmer, M.A. Thompson, and T.M. Nett. 2023. Reimmunization intervals for application of GnRH immunocontraceptive vaccine (GonaCon-Equine) in free-roaming horses (*Equus ferus caballus*) using syringe darts. Theriogenology Wild (3): 100061.

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.

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). 2015. Instruction Memorandum 2015-151; 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. Efficacy of dart-delivered PZP-22 immunocontraceptive vaccine in wild horses (Equus caballus) in baited traps in New Mexico, USA. 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.

Cothran, E.G. 2009. Genetic analysis of the Sand Springs East, NV HMA. Report to BLM from Texas A&M University, Department of Veterinary Integrative Bioscience.

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

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

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.
Feh, C., and B. Munkhtuya. 2008. Male infanticide and paternity analyses in a socially natural herd of Przewalski's horses: Sexual selection? Behavioral Processes 78:335-339.
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.
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., 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. Nuñez. 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. Nuñez. 2020. Rising up to the challenge of their rivals: mare infidelity intensifies stallion response to playback of aggressive conspecific vocalizations. Applied Animal Behaviour Science :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.
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 (NRC). 2013. Using science to improve the BLM wild horse and burro program: a way forward. National Academies Press. Washington, DC.
Nettles, V. F. 1997. Potential consequences and problems with wildlife contraceptives. Reproduction, Fertility and Development 9, 137–143.
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.

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

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

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

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

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

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

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

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

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.2022. 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.

8.2 Acronyms

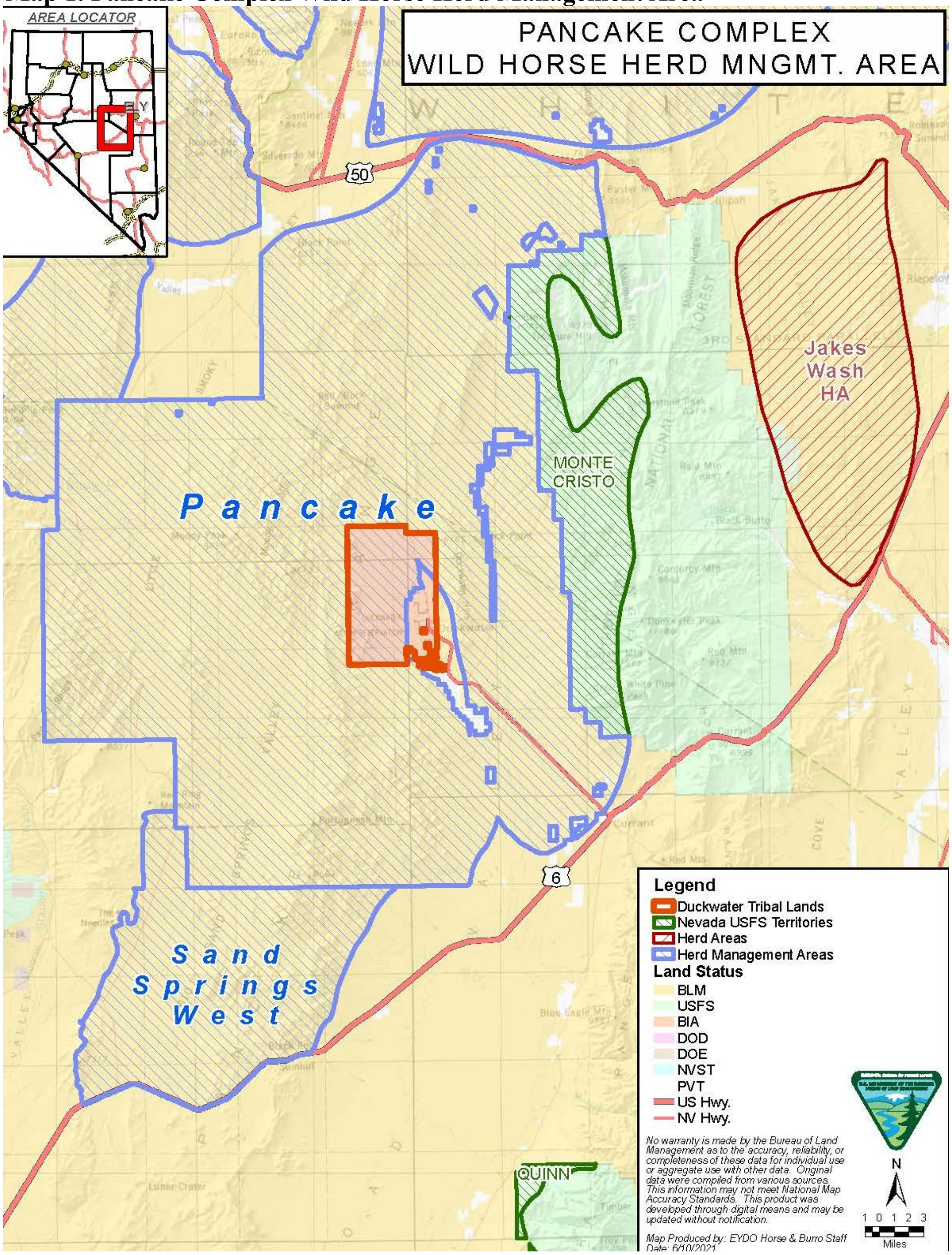
BLM-Bureau of Land Management
BIA- Bureau of Indian Affairs
CFR-Code of Federal Regulations
DR-Decision Record

EA-Environmental Assessment
EIS-Environmental Impact Statement
FLPMA-Federal Land Policy and Management Act
FONSI-Finding of No Significant Impact
HA – Herd Area
HMA – Herd Management Area
ID-Interdisciplinary
IM-Instructional Memorandum
NEPA-National Environmental Policy Act
RFS-Reasonably Foreseeable Future Action
RMP-Resource Management Plan

APPENDIX I

Maps

Map 1. Pancake Complex Wild Horse Herd Management Area



APPENDIX II

Standard Operating Procedures for Mare Fertility Control Treatments

Mare Fertility Control Treatment (SOPs)

The following management and monitoring requirements are part of the Proposed Action and Alternatives A and B.

PZP Vaccine SOPs

1. PZP vaccine would be administered by trained BLM personnel.

2. The fertility control drug is administered with two separate injections: (1) a liquid dose of PZP is administered using an 18-gauge needle primarily by hand injection; (2) the pellets are preloaded into a 14-gauge needle. These are loaded on the end of a trocar (dry syringe with a metal rod) which is loaded into the jab-stick which then pushes the pellets into the breeding mares being returned to the range. The pellets and liquid are designed to release the PZP over time similar to a time-release cold capsule.

3. Delivery of the vaccine would be as an intramuscular injection while the mares are restrained in a working chute. Half a cubic centimeter (cc) of the PZP vaccine would be emulsified with half a cc of adjuvant (a compound that stimulates antibody production) and loaded into the delivery system. The pellets would be loaded into the jab-stick for the second injection. With each injection, the liquid and pellets would be propelled into the left hindquarters of the mare, just below the imaginary line that connects the point of the hip and the point of the buttocks.

4. All treated mares would be freezemarked on the neck (or location as approved by Nevada State Department of Agriculture) and / or chipped to enable researchers to positively identify the animals during the research project as part of the data collection phase.

5. At a minimum, monitoring of reproductive rates using helicopter flyovers will be conducted in years two through four by checking for the presence or absence of foals. The flight scheduled for year four will also assist in determining the percentage of mares that have returned to fertility. In addition, field monitoring will be routinely conducted as part of other regular ground-based monitoring activities.

6. A field data sheet will be used by the field applicators to record all the pertinent data relating to identification of the mare including a photograph when possible, date of treatment, type of treatment (1- or 2-year vaccine, adjuvant used) and HMA. The original form with the data sheets will be forwarded to the Authorized Officer at the National Program Office (NPO) in Reno, Nevada. A copy of the form and data sheets and any photos taken will be maintained at the district office.

7. A tracking system will be maintained by NPO detailing the quantity of PZP issued, the quantity used, and disposition of any unused PZP, the number of treated mares by HMA, district office, and state along with the freeze-mark and / or chip applied by HMA.

8. The field office will assure that treated mares do not enter the adoption market for 3 years following treatment. In the rare instance, due to unforeseen circumstances, that treated mare(s) are removed from an HMA before 3 years have lapsed, they will be maintained in either a BLM facility or BLM-contracted Long-Term Pastures (LTPs) until expiration of the 3-year holding period. In the event it is necessary to remove treated mares, their removal and disposition will be coordinated through NPO. After

expiration of the 3-year holding period, the animal may be placed in the adoption program or sent to long-term pastures.

PZP Remote Darting SOPs

1. PZP vaccine would be administered through darting by trained BLM personnel or collaborating partners only. For any darting operation, the designated personnel must have successfully completed a nationally recognized wildlife darting course and who have documented and successful experience darting wildlife under field conditions.
2. All mares targeted for treatment will be clearly identifiable through photographs to enable darters and HMA managers to positively identify the animals during the project and at the time of removal during subsequent gathers.
3. Mares that have never been treated would receive 0.5 cc of PZP vaccine emulsified with 0.5 cc of Freund's Modified Adjuvant (FMA) and loaded into darts at the time a decision has been made to dart a specific mare. Mares identified for re-treatment receive 0.5 cc of the PZP vaccine emulsified with 0.5 cc of Freund's Incomplete Adjuvant (FIA).
4. The liquid dose of PZP vaccine is administered using 1.0 cc Pneu-Darts with 1.25" or 1.5" barbless needles fired from either Dan Inject®, Pneu-Dart® X-Caliber or Palmer® Cap-Chur rifle.
5. Only designated darters would mix the vaccine/adjuvant and prepare the emulsion. Vaccine-adjuvant emulsion would be loaded into darts at the darting site and delivered by means of an appropriate CO_2 powered or cartridge darting delivery system.
6. Delivery of the vaccine would be by intramuscular injection into the left or right hip/gluteal muscles while the mare is standing still.
7. Safety for both humans and the horse is the foremost consideration in deciding to dart a mare. Safe darting distances would depend on the skill and ability of the darter, and the particular model of dart gun being utilized. No attempt would be taken when other persons are within a 30-m radius of the target animal.
8. No attempts would be taken in high wind or when the horse is standing at an angle where the dart could miss the hip/gluteal region and hit the rib cage. The ideal is when the dart would strike the skin of the horse at a perfect 90° angle.
9. If a loaded dart is not used within two hours of the time of loading, the contents would be transferred to a new dart before attempting another horse. If the dart is not used before the end of the day, it would be stored under refrigeration and the contents transferred to another dart the next day. Refrigerated darts would not be used in the field.
10. No more than two people should be present at the time of a darting. The second person is responsible for locating fired darts. The second person should also be responsible for identifying the horse and keeping onlookers at a safe distance.
11. To the extent possible, all darting would be carried out in a discrete manner. However, if darting is to be done within view of non-participants or members of the public, an explanation of the nature of the project would be carried out either immediately before or after the darting.
12. Attempts will be made to recover all darts. To the extent possible, all darts which are discharged and drop from the horse at the darting site would be recovered before another darting occurs. In exceptional situations, the site of a lost dart may be noted and marked, and recovery efforts made at a later time. All discharged darts would be examined after recovery in order to determine if the charge fired and the plunger fully expelled the vaccine. Personnel conducting darting operations should be equipped with a two-way radio or cell phone to provide a communications link with the Project Veterinarian for advice

and/or assistance. In the event of a veterinary emergency, darting personnel would immediately contact the Project Veterinarian, providing all available information concerning the nature and location of the incident.

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

GonaCon SOPs

Orders for GonaCon–Equine are placed with the Unites States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS).

Delivering GonaCon by Hand-Injection of GonaCon

1. GonaCon-Equine vaccine is administered by hand-injection to mares that are appropriately immobilized or restrained. Important: label instructions must be followed for this product. Females identified for treatment application are hand-injected with an intramuscular injection of Gona-Equine vaccine (2 ml) in the lower gluteal musculature using a hand-held, luer-lock syringe (18-gauge, 3.8 cm needle). The syringe is made of transparent plastic with the barrel showing graduated marks indicating the volume of the vaccine in the syringe. This facilitates the visual assessment of the quantity of vaccine injected into the animal without the need to weigh the syringes. Pre-loaded syringes should be kept refrigerated overnight and then set out the morning of application at room temperature. They should not be allowed to get too warm or cold during the day.

2. 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.

3. Although infrequent, hand-injections to immobilized or restrained horses can result in partial delivery of the vaccine due to inexperienced personnel and/or unexpected movement of the horse. As a precaution, order extra doses of the vaccine. For hand-injection application, assume a 10% failure rate and increase the original quantity accordingly.

4. Examine each syringe before and after injection and visually determine approximately how much vaccine was injected. A full dose is considered 90% (1.8 ml) or greater of the original 2 ml dose. Ensure a full dose is administered.

5. It is recommended that all treated mares be photographed to facilitate identification by individual markings, RFID chip, and/or freeze-marked on the hip or neck to positively identify the animals as a GonaCon-Equine vaccinated mare during field observations or subsequent gathers.

Preparation of Darts for GonaCon 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.

Administering the GonaCon Vaccine Remotely (via Darting):

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.

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.

SOPs for Intrauterine Devices

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

Preparation: IUDs must be clean and sterile. Sterilize IUDs with a low-temperature sterilization system, such as Sterrad.

The Introducer is two PVC pipes. The exterior pipe is a 29” length of ½” diameter pipe, sanded smooth at one end, then heat-treated to smooth its curvature further (Fig. 1). The IUD will be placed into this smoothed end of the exterior pipe. The interior pipe is a 29 ½” long, ¼” riser tube (of the kind used to connect water lines to sinks), with one end slightly flared out to fit more snugly inside the exterior pipe (Fig. 1), and a plastic stopper attached to the other end (Fig. 2).

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

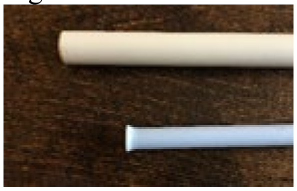
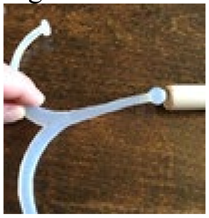


Figure 2. Interior pipe shown within exterior pipe. After the introducer is 4” beyond the os, the stopper is pushed forward (outside the mare), causing the IUD to be pushed out from the exterior pipe.

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

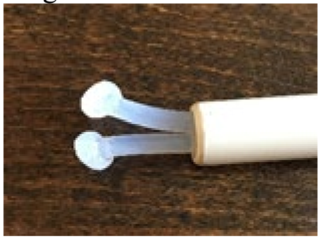
Prepare the IUD: Lubricate with sterile veterinary lube, and insert into the introducer. The central stem of the IUD goes in first (Fig. 3).

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



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

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



Restraint and Medication: The mare should be restrained in a padded squeeze chute to provide access to the rear end of the animal, but with a solid lower back door, or thick wood panel, for veterinarian safety.

Some practitioners may choose to provide sedation. If so, when the mare's head starts to droop, it may be advisable to tie the tail up to prevent risk of the animal sitting down on the veterinarian's arm (i.e., double half hitch, then tie tail to the bar above the animal).
Some practitioners may choose to provide a dose of long-acting progesterone to aid in IUD retention. Example dosage: 5mL of BioRelease LA Progesterone 300 mg/mL (BET labs, Lexington KY), *or* long-acting Altrenogest). No other intrauterine treatments of any kind should be administered at the time of IUD insertion.

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

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

Peak Foaling Season

Peak foaling season of wild horses on public lands occurs in late April and early May. The great majority of foaling happens March through June. As a precaution, unless there is an approved emergency situation, the BLM does not use helicopters to gather wild horses from March through June.

Though foals typically grow rapidly and within days are capable of maintaining speed with their mother, the BLM's Comprehensive Animal Welfare Program includes provisions to protect the welfare of foals that are part of gather operations. For example, the rate of movement and herding distance the pilot uses are based on the weakest or smallest animal in the group (i.e., foals or pregnant mares). Other provisions include re-uniting dependent foals that become separated from their mare/jenny and ensuring foals are protected from larger stallions and/or jacks while in a holding corral or during transport.
A 2016 metaanalysis of available demographic literature for wild equids indicated that foaling rates in feral horses, in the northern hemisphere, drop precipitously after June (Ransom et al., figure 6-2). The same metaanalysis shows that burros appear to have a bimodal foaling season, with foals born largely from February to September.
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.

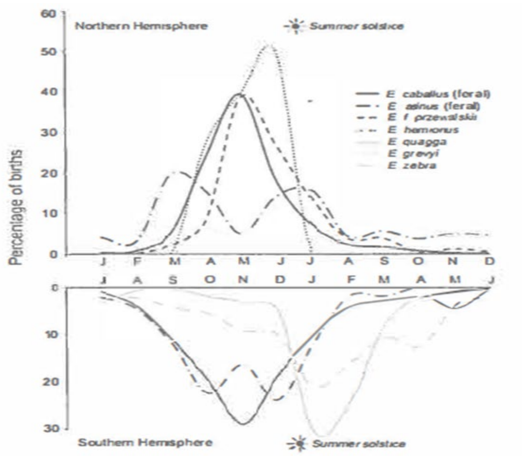


Fig 6.2 Percentage of births by month across equid species. Data are smoothed and shown as the mean across populations. Data for *E. caballus* derived from Tyler 1972, Boyd 1980, Keiper and Houpt 1984, Berger 1986, Berman 1991, Lucas *et al.* 1991, Ashley 2000, Gomes and Oom 2000, Linklater *et al.* 2004, Greyling 2005, Nuñez *et al.* 2010, Scorolli and Lopez Cazorla 2010, Lagos 2013, Ransom *et al.* 2013, and N. Spasskaya, unpublished data data for *E. asinus* derived from Moehlman 1974, McCool *et al.* 1981, Ruffner and Carothers 1982, and Santiapillai *et al.* 1999; data for *E. f. przewalskii* derived from Chen *et al.* 2008, Prague Zoo 2010 (wild and semiwild populations only), and Usukhjargal and Bandi 2013; data for *E. hemionus* derived from Wolfe 1979 and O. Ganbaatar, unpublished data; data for *E. quagga* derived from Klingel 1965, Smuts 1976*b*, and Sinclair *et al.* 2000, data for *E. grevyi* derived from Dobroruka *et al.* 1987 and Rowen 1992, data for *E. zebra* derived from Joubert 1974*b*, Penzhorn 1985, Westlin-van Aarde *et al.* 1988, and H. Hrabar, unpublished data.

APPENDIX III

Field Castration (Gelding) SOPs

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

Pre-Surgery Animal Selection, Handling, and Care

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

Gelding Procedure

1. All gelding operations will be performed under a general anesthetic administered by a qualified and experienced veterinarian. Stallions will be restrained in a portable squeeze chute to allow the veterinarian to administer the anesthesia.
2. The anesthetics used will be based on a Xylazine/ketamine combination protocol. Drug dosages and combinations of additional drugs will be at the discretion of the attending veterinarian.
3. Animals may be held in the squeeze chute until the anesthetic takes effect or may be released into the working pen to allow the anesthesia to take effect. If recumbency and adequate anesthesia is

not achieved following the initial dose of anesthetics, the animal will either be re-dosed or the surgery will not be performed on that animal at the discretion of the attending veterinarian.

4. Once recumbent, rope restraints or hobbles will be applied for the safety of the animal, the handlers and the veterinarian.
5. The specific surgical technique used will be at the discretion of the attending veterinarian.
6. Flunixin meglumine or an alternative analgesic medication will be administered prior to recovery from anesthesia at the professional discretion of the attending veterinarian.
7. Tetanus prophylaxis will be administered at the time of surgery.

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

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

Selected stallions would be shipped to the facility, gelded, and returned to the range within 30 days. Before release back to the range, they may be marked for visibility with a freeze brand or other method of marking. Gelded animals could be monitored periodically for complications for approximately 7-10 days following release. In the proposed alternatives, gelding is not part of a research study, but additional monitoring on the range could be completed either through aerial reconnaissance, if available, or field observations from major roads and trails. It is not anticipated that all the geldings would be observed but if the goal is to detect complications on the range, then this level of casual observation may help BLM determine if those are occurring. Periodic observations of the long-term outcomes of gelding could be recorded during routine resource monitoring work. Such observations could include but not be limited to band size, social interactions with other geldings and harem bands, distribution within their habitat, forage utilization, and activities around key water sources. Periodic population inventories and future gather statistics could provide additional anecdotal information about how logistically effective it is to manage a portion of the herd as non-breeding animals.

APPENDIX IV

GATHER OPERATIONS STANDARD OPERATING PROCEDURES

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 for 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.

A. Gather Methods used in the Performance of Gather Contract Operations

1. The primary concern of the contractor is the safe and humane handling of all animals gathered. All gather attempts shall incorporate the following:

   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. The Contractor may also be required to change or move trap locations as determined by the COR/PI. All traps and holding facilities not located on public land must have prior written approval of the landowner.

2. The rate of movement and distance the animals travel shall not exceed limitations set by the COR who will consider terrain, physical barriers, access limitations, weather, extreme temperature (high and low), condition of the animals, urgency of the operation (animals facing drought, starvation, fire rehabilitation, etc.) and other factors. In consultation with the contractor the distance the animals travel will account for the different factors listed above and concerns with

each HMA.

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. 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.

    b. All loading chute sides shall be a minimum of 6 feet high and shall be fully covered, plywood, metal without holes larger than 2"x4".

    c. All runways shall be a minimum of 30 feet long and a minimum of 6 feet high for horses, and 5 feet high for burros, and shall be covered with plywood, burlap, plastic snow fence or like material a minimum of 1 foot to 5 feet above ground level for burros and 1 foot to 6 feet for horses. The location of the government furnished portable fly chute to restrain, age, or provide additional care for the animals shall be placed in the runway in a manner as instructed by or in concurrence with the COR/PI.

    d. All crowding pens including the gates leading to the runways shall be covered with a material which prevents the animals from seeing out (plywood, burlap, plastic snow fence, etc.) and shall be covered a minimum of 1 foot to 5 feet above ground level for burros and 2 feet to 6 feet for horses

    e. All pens and runways used for the movement and handling of animals shall be connected with hinged self-locking or sliding gates.

4. No modification of existing fences will be made without authorization from the COR/PI. The Contractor shall be responsible for restoration of any fence modification which he has made.

5. 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.

6. Alternate pens, within the holding facility shall be furnished by the Contractor to separate mares or jennies with small foals, sick and injured animals, estrays or other animals the COR determines need to be housed in a separate pen from the other animals. Animals shall be sorted as to age, number, size, temperament, sex, and condition when in the holding facility so as to minimize, to the extent possible, injury due to fighting and trampling. Under normal conditions, the government will require that animals be restrained for the purpose of determining an animal's age, sex, or other necessary procedures. 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 gather area(s). 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 COR.

7. The Contractor shall provide animals held in the traps and/or holding facilities with a continuous supply of fresh clean water at a minimum rate of 10 gallons per animal per day. Animals held for

10 hours or more in the traps or holding facilities shall be provided good quality hay at the rate of not less than two pounds of hay per 100 pounds of estimated body weight per day. The contractor will supply certified weed free hay if required by State, County, and Federal regulation.

   a. An animal that is held at a temporary holding facility through the night is defined as a horse/burro feed day. An animal that is held for only a portion of a day and is shipped or released does not constitute a feed day.

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

9. The Contractor shall restrain sick or injured animals if treatment is necessary. The COR/PI will determine if animals must be euthanized and provide for the destruction 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 COR/PI.

10. Animals shall be transported to their final destination from temporary holding facilities as quickly as possible after gather unless prior approval is granted by the COR for unusual circumstances. Animals to be released back into the HMA following gather operations may be held up to 21 days or as directed by the COR. Animals shall not be held in traps and/or temporary holding facilities on days when there is no work being conducted except as specified by the COR. The Contractor shall schedule shipments of animals to arrive at final destination between 7:00 a.m. and 4:00 p.m. No shipments shall be scheduled to arrive at final destination on Sunday and Federal holidays, unless prior approval has been obtained by the COR. Animals shall not be allowed to remain standing on trucks while not in transport for a combined period of greater than three (3) hours in any 24 hour period. Animals that are to be released back into the gather area may need to be transported back to the original trap site. This determination will be at the discretion of the COR/PI or Field Office horse specialist.

B. Gather Methods That May Be Used in the Performance of a Gather

1. Gather attempts may be accomplished by utilizing bait (feed, water, mineral licks) to lure animals into a temporary trap. If this gather method is selected, the following applies:

   a. Finger gates shall not be constructed of materials such as "T" posts, sharpened willows, etc., that may be injurious to animals.

   b. All trigger and/or trip gate devices must be approved by the COR/PI prior to gather of animals.

   c. Traps shall be checked a minimum of once every 10 hours.

2. Gather attempts may be accomplished by utilizing a helicopter to drive animals into a temporary trap. If the contractor selects this method the following applies:

   a. A minimum of two saddle-horses shall be immediately available at the trap site to accomplish roping if necessary. Roping shall be done as determined by the COR/PI. Under no circumstances shall animals be tied down for more than one half hour.

   b. The contractor shall assure that foals shall not be left behind, and orphaned.

3. Gather attempts may be accomplished by utilizing a helicopter to drive animals to ropers. If the contractor, with the approval of the COR/PI, selects this method the following applies:

    a. Under no circumstances shall animals be tied down for more than one hour.

    b. The contractor shall assure that foals shall not be left behind, or orphaned.

    c. The rate of movement and distance the animals travel shall not exceed limitations set by the COR/PI who will consider terrain, physical barriers, weather, condition of the animals and other factors.

C. Use of Motorized Equipment

1. All motorized equipment employed in the transportation of gathered animals shall be in compliance with appropriate State and Federal laws and regulations applicable to the humane transportation of animals. The Contractor shall provide the COR/PI, if requested, 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 gathered animals are transported without undue risk or injury.

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

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

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:

    11 square feet per adult horse (1.4 linear foot in an 8 foot wide trailer);
    8 square feet per adult burro (1.0 linear foot in an 8 foot wide trailer);
    6 square feet per horse foal (.75 linear foot in an 8 foot wide trailer);

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 gathered animals. The COR/PI shall provide for any brand and/or inspection services required for the gathered 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.

D. Safety and Communications

1. The Contractor shall have the means to communicate with the COR/PI and all contractor personnel engaged in the gather of wild horses 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 is 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.

2. Should the contractor choose to utilize a helicopter the following will apply:

    a. The Contractor must operate in compliance with Federal Aviation Regulations, Part 91. Pilots provided by the Contractor shall comply with the Contractor's Federal Aviation Certificates, applicable regulations of the State in which the gather is located.

    b. Fueling operations shall not take place within 1,000 feet of animals.

E. Site Clearances

No personnel working at gather sites may excavate, remove, damage, or otherwise alter or deface or attempt to excavate, remove, damage or otherwise alter or deface any archaeological resource located on public lands or Indian lands.

Prior to setting up a trap or temporary holding facility, BLM will conduct all necessary clearances (archaeological, T&E, 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 arranged for by the COR, PI, or other BLM employees.

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

F. Animal Characteristics and Behavior

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

G. Public Participation

Opportunities for public viewing (i.e. media, interested public) of gather operations will be made available to the extent possible; however, the primary considerations will be to protect the health, safety and welfare of the animals being gathered and the personnel involved. The public must adhere to guidance from the on-site BLM representative. It is BLM policy that the public will not be allowed to come into direct contact with wild horses or burros being held in BLM facilities. Only authorized BLM personnel or contractors may enter the corrals or directly handle the animals. The general public may not enter the corrals or directly handle the animals at anytime or for any reason during BLM operations.

H. Responsibility and Lines of Communication

Contracting Officer's Representative/Project Inspector

Ben Noyes, Wild Horse and Burro Specialist, Ely District
Tyler Reese, Wild Horse and Burro Specialist, Ely District
Shawna Richardson, Wild Horse and Burro Specialist, Battle Mountain District
Ruth Thompson, NV WH&B Program Lead
Amery Sifre, Homboldt Toiyabe National Forrest

The Contracting Officer's Representatives (CORs) and the project inspectors (PIs) have the direct responsibility to ensure the Contractor's compliance with the contract stipulations. The Bristlecone Supervisory Natural Resource Specialist and the Bristlecone Field Managers will take an active role to ensure the 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, formal public contact and inquiries will be handled through the Field Manager and/or the Supervisory Natural Resource Specialist and Field Office Public Affairs. These individuals will be the primary contact and will coordinate with the COR/PI on any inquiries.

The COR will coordinate with the contractor and the BLM Corrals to ensure animals are being transported from the gather site in a safe and humane manner and are arriving in good condition.

The contract specifications 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 gather of the animals. The specifications will be vigorously enforced.

Should the Contractor show negligence and/or not perform according to contract stipulations, he will be issued written instructions, stop work orders, or defaulted.

APPENDIX V

Wild Horse Gather Observation Protocol

BLM recognizes and respects the right of interested members of the public and the press to observe wild horse gather operations. At the same time, BLM must ensure the health and safety of the public, BLM's employees and contractors, and America's wild horses. Accordingly, the BLM developed these rules to maximize the opportunity for reasonable public access to the gather while ensuring that BLM's health and safety responsibilities are fulfilled. Failure to maintain safe distances from operations at the gather and temporary holding sites could result in members of the public inadvertently getting in the path of the wild horses or gather personnel, thereby placing themselves and others at risk, or causing stress and potential injury to the wild horses. The BLM and the contractor's helicopter pilot must comply with 14 CFR Part 91 of the Federal Aviation Regulations, which determines the minimum safe altitudes and distance people must be from the aircraft. To be in compliance with these regulations, the viewing location at the gather site and holding corrals must be approximately 500 feet from the operating location of the helicopter at all times. The viewing locations may vary depending on topography, terrain and other factors.

Daily Visitor Protocol

- A Wild Horse Gather Information Phone Line would be set up prior to the gather so the public can call for daily updates on gather information and statistics. Visitors are strongly encouraged to check the phone line the evening before they plan to attend the gather to confirm the gather and their tour of it is indeed taking place the next day as scheduled (weather, mechanical issues or other things may affect this) and to confirm the meeting location.

- Visitors must direct their questions/comments to either their designated BLM representative or the BLM spokesperson on site, and not engage other BLM/contractor staff and disrupt their gather duties/responsibilities - professional and respectful behavior is expected of all. BLM may make the BLM staff available during down times for a Q&A session on public outreach and education days. However, the contractor and its staff would not be available to answer questions or interact with visitors.

- Observers must provide their own 4-wheel drive high clearance vehicle, appropriate shoes, winter clothing, food, and water. Observers are prohibited from riding in government and contractor vehicles and equipment.

- Gather operations may be suspended if bad weather conditions create unsafe flying conditions.

- BLM would establish one or more observation areas, in the immediate area of the gather and holding sites, to which individuals would be directed. These areas would be placed so as to maximize the opportunity for public observation while providing for a safe and effective wild horse gather. The utilization of such observation areas is necessary due to the use and presence of heavy equipment and aircraft in the gather operation and the critical need to allow BLM personnel and contractors to fully focus on attending to the needs of the wild horses while maintaining a safe environment for all involved. In addition, observation areas would be sited so as to protect the wild horses from being spooked, startled, or impacted in a manner that results in increased stress.

- BLM would delineate observation areas with yellow caution tape (or a similar type of tape or ribbon).
- Visitors would be assigned to a specific BLM representative on public outreach and education days and must stay with that person at all times.

- ❖ Visitors are NOT permitted to walk around the gather site or temporary holding facility unaccompanied by their BLM representative.

- ❖ Observers are prohibited from climbing/trespassing onto or in the trucks, equipment, or corrals, which is the private property of the contractor.

- ❖ When BLM is using a helicopter or other heavy equipment in close proximity to a designated observation area, members of the public may be asked to stay by their vehicle for some time before being directed to an observation area once the use of the helicopter or the heavy machinery is complete.

- ❖ When given the signal that the helicopter is close to the gather site bringing wild horses in, visitors must sit down in areas specified by BLM representatives and must not move or talk as the wild horses are guided into the corral.

- ❖ Individuals attempting to move outside a designated observation area would be requested to move back to the designated area or to leave the site. Failure to do so may result in citation or arrest. It is important to stay within the designated observation area to safely observe the wild horse gather.

- ❖ Observers would be polite, professional and respectful to BLM managers and staff and the contractor/employees. Visitors who do not cooperate and follow the rules would be escorted off the gather site by BLM law enforcement personnel and would be prohibited from participating in any subsequent observation days.

- ❖ BLM reserves the right to alter these rules based on changes in circumstances that may pose a risk to health, public safety or the safety of wild horses (such as weather, lightening, wildfire, etc.).

Public Outreach and Education Day

- ❖ The media and public are welcome to attend the gather any day and are encouraged to attend on public outreach and education days. On this day, BLM would have additional interpretive opportunities and staff available to answer questions.

- ❖ The number of public outreach and education days per week, and which days they are, would be determined prior to the gather and would be announced through a press release and on the website. Interested observers should RSVP ahead through the BLM-Ely District Office number (TBD). A meeting place would be set for each public outreach and education day and the RSVP list notified. BLM representatives would escort observers on public outreach and education days to and from the gather site and temporary holding facility.

APPENDIX VI

Pancake Complex Population Modeling

PopEquus (1.0.2) Advanced Tool - Simulation Report

16 September 2024 16:53:04

Population inputs

You used the *PopEquus* Advanced Tool to simulate a horse population that started with 1495 horses, had a population sex ratio where 0.5 of the population is female, was censused at a time that foals were present (Yes), had a mean annual population growth rate of 20 percent per year, and a capture probability during management (e.g., helicopter gather) of 0.75. You assumed that the target population size range for the population (i.e., Appropriate Management Level) was 361-638 horses, that removals aimed for a target population size of 361, and that if the population decreased to beneath 30 horses that it would be at high risk of local extirpation. In summary:

• Population size: 1495
• Female proportion of population: 0.5
• Foals included in population size? Yes
• Population growth rate (% increase per year): 20
• Capture proportion during gathers: 0.75
• Appropriate management level (minimum): 361
• Appropriate management level (maximum): 638
• Target population size: 361
• Persistence threshold (i.e., minimum number of individuals): 30

Simulation inputs

You simulated populations over a 10-year projection interval, and you performed 10 replicate projections.

• Projection interval (years): 10
• Number of simulation replicates: 10

Management alternatives

You simulated 6 management alternatives using the tool: **GonaCon, No management, PZP-22, Removals, Removals and GonaCon, Removals and PZP-22**.

The following settings were specified for management actions:

Gather options

• Short-term holding costs ($ per day): 7.61

Removal options

• Removal years: 1, 4, 7, 10
• Reactive removals: Yes
• Minimum gather interval (years) for a reactive removal: 2
• Selective removals: Yes
• Male proportion of population returned after a removal: 0.6
• Maximum number removed from the population per year: 2000
• Number of years to project holding population: 25
• Long-term holding costs ($ per day): 2.02
• Proportion of horses adopted per year: 0.69
• Net adoption cost to agency ($ per horse): 1775
• Breeding reduction (%) of removed females in captivity the first year after removal: 25

GonaCon options

• Treatment years: 1, 4, 7, 10
• Treatment ages: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20
• Treatment percentage (%) for age-eligible females: 100
• Treatment cost per shot ($): 50
• Hold to give booster treatment: Yes
• Days in holding until booster: 30

PZP-22 options

- Treatment years: 1, 4, 7, 10
- Treatment ages: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20
- Treatment percentage (%) for age-eligible females: 100
- Primer treatment cost ($): 430
- Days in holding to receive treatment: 7
- Booster treatment cost ($): 30

Results

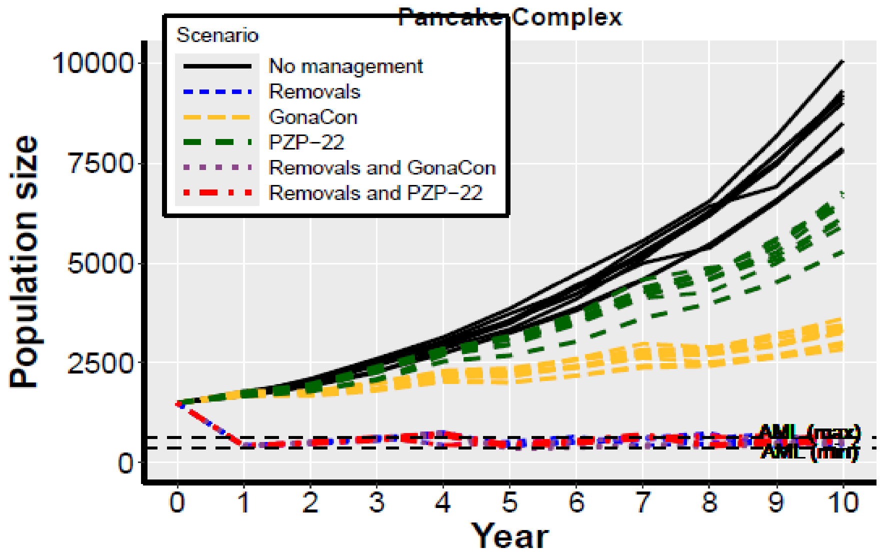
Simulation outcomes can be summarized with a table(s) describing mean values among replicates for relevant metrics. Metrics include: population size in the final year of the projection interval ('Final population size'), average population size across all years ('Mean population size'), proportion of replicates that ended within the AML (i.e., the likelihood that an alternative yielded AML in the final year; 'AML probability'), proportion of replicates that ended above the persistence threshold ('Persistence probability'), total number of horses gathered ('Number gathered'), total number of horses removed ('Number removed'), total number of horses treated ('Number treated'), cost of management in the Herd Management Area (HMA) in millions of USD ['On-range cost ($ million)'], and total cost of management, including costs incurred at the HMA and in holding facilities ['Total cost ($ million)']. Values in parentheses are 95% confidence intervals.

Alternative	Final population size	Overall mean population size	AML probability
No management	8788 (7805-9889)	4140 (3783-4480)	0.00
Removals	493 (431-643)	623 (610-637)	0.90
GonaCon	3245 (2855-3566)	2293 (2109-2419)	0.00
PZP-22	6149 (5281-6741)	3320 (2967-3489)	0.00
Removals and GonaCon	536 (463-664)	579 (552-632)	0.90
Removals and PZP-22	610 (477-717)	628 (611-662)	0.70

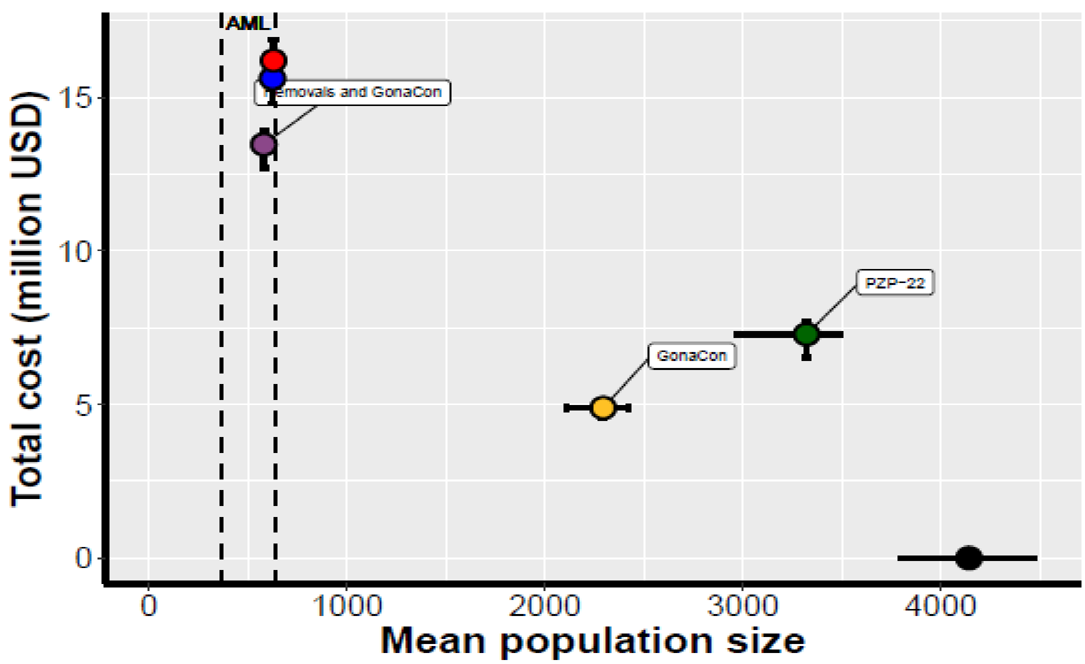
Alternative	Persistence probability	Number gathered	Number removed	Number treated
No management	1.00	0 (0-0)	0 (0-0)	0 (0-0)
Removals	1.00	2177 (2109-2233)	1805 (1706-1880)	0 (0-0)
GonaCon	1.00	6594 (6105-6967)	0 (0-0)	2988 (2837-3152)
PZP-22	1.00	9286 (8336-9834)	0 (0-0)	3998 (3665-4185)
Removals and GonaCon	1.00	2738 (2537-2837)	1472 (1412-1524)	546 (485-593)
Removals and PZP-22	1.00	3281 (2926-3555)	1791 (1734-1856)	571 (432-677)

Alternative	On-range cost ($ million)	Off-range cost ($ million)	Total cost ($ million)
No management	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.00 (0.00-0.00)
Removals	1.55 (1.50-1.58)	14.07 (13.30-14.73)	15.62 (14.80-16.31)
GonaCon	4.89 (4.54-5.16)	0.00 (0.00-0.00)	4.89 (4.54-5.16)
PZP-22	7.29 (6.54-7.69)	0.00 (0.00-0.00)	7.29 (6.54-7.69)
Removals and GonaCon	2.14 (1.96-2.21)	11.33 (10.74-11.72)	13.47 (12.70-13.93)
Removals and PZP-22	2.59 (2.29-2.81)	13.61 (13.08-14.08)	16.20 (15.58-16.89)

A graph of population size through time can be used to visualize effects of management alternatives on population size. Different colored lines indicate management alternatives simulated by the user; for each alternative, individual lines are different simulation replicates, that vary due to random chance. Dashed horizontal black lines indicate the minimum and maximum target population size range (i.e., AML).



Individuals might be interested in identifying a management alternative(s) that achieves the reduction or maintenance of a population within the target population size range (i.e., AML) while also incurring lower direct costs relative to other options. We can visualize the relationship between predicted population size and direct costs of management by graphing the overall mean population size (number of horses) on the x-axis and total cost of management (millions of USD) on the y-axis predicted by each alternative. Points are mean predictions among replicates and are colored by scenario (as in in the first graph); horizontal and vertical lines from points represent 95% confidence intervals in predicted population size and cost, respectively, for each scenario. While this graph does not account for all factors that might be important during management decisions, the graph provides a useful illustration of the trade-off between predicted population size and total direct cost of management resulting from the simulated alternatives.



Summary
The alternative that yielded the smallest average population size was:
[1] "Removals and GonaCon"
The alternative that incurred the lowest direct costs 'on range' (other than 'no management') over the next 10 years was:
[1] "Removals"
The alternative that incurred the lowest total direct costs across the sum of 'on range' and 'off range' (other
than 'no management') over the next 35 years was:
[1] "GonaCon"
Among the alternatives that achieved population size within Appropriate Management Levels, the alternative
that incurred the lowest total direct costs across the sum of 'on range' and 'off range':
[1] "Removals"
Note: results from the simulations may not be the sole basis for a management decision. The model does not explicitly account for or consider multiple uses on public lands, local land use planning considerations,
ecological costs of horses on ecosystems, or other important values. The results presented here reflect considerations related to population size, amount of management, and fiscal costs of management that were estimated, given the input parameters and alternatives specified.

APPENDIX VII

Rangeland Health Standards Summary

The Standard Determination Documents (SDD) evaluate and assess livestock grazing management practices, to determine whether those practices are conforming to the standards and guidelines for rangeland health, as required by 43 C.F.R. Subpart 4180. These SDDs provide insights into whether wild horses are contributing to non-attainment of overall standards during the livestock permit renewal process.

HMA/HA	Allotment	Use Area	Rangeland Health Standards	Completion
Pancake HMA	Duckwater	Broom Canyon	**Standard 1: Soils;** Achieving the Standard.	2007
			Standard 2: Ecosystem Components; Not achieving the Standard, but making significant progress towards. Livestock are not a contributing factor to not achieving the Standard. Failure to achieve the Standard is related to other issues or conditions such as historical livestock use, historical wild horse use, drought, lack of wildfire, fire suppression, flooding, insects, or other disturbances.	
			Standard 3: Habitat and Biota; Not achieving the Standard, but making significant progress towards. Livestock are not a contributing factor to not achieving the Standard. Failure to achieve the Standard is related to other issues or conditions, such as historical livestock use, historical wild horse use, drought, lack of wildfire, or other disturbances.	
Pancake HMA	Duckwater	Bull Creek/North Railroad Valley	**Standard 1: Upland Sites;** Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or condition. Both livestock and wild horses are contributing factors. Due to shrub dominance, lack of native vegetation cover, the risk of invasive species spread, risk of erosion and loss of soil structure, and heavy or severe utilization at times, the soil resources lack much resiliency or capability to maintain or improve in this use area.	2009
			Standard 2: Riparian and Wetland Sites; Not Applicable.	
			Standard 3: Habitat; Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Both livestock and wild horses are contributing factors. Due to shrub dominance, lack of vegetation production, lack of appropriate cover, lack of appropriate structure, and the risk of invasive species spread, the vegetative resources lack much resiliency or capability to maintain or improve in the term permit renewal area.	
			Standard 1: Upland Sites; Not Achieving the Standard, Not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Both livestock and wild horses are contributing factors. Due to shrub dominance, lack of native vegetation cover, lack of	

HMA/HA	Allotment	Use Area	Rangeland Health Standards	Completion
Pancake HMA	Duckwater	Bull Corner/Poison Patch	appropriate vegetation structure, the risk of invasive species spread, risk or erosion and loss of soil structure, and severe utilization at times, the soil resources lack much resiliency or capability to maintain or improve in this use area.	2009
			Standard 2: Riparian and Wetland Sites; This Standard was not evaluated since there are no public land riparian systems present in the Bull Corner/Poison Patch Use Area.	
			Standard 3: Habitat; Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Both livestock and wild horses are contributing factors. Due to shrub dominance, lack or vegetation production, lack of cover, lack of appropriate structure, and the risk of invasive species spread, the vegetative resources lack much resiliency or capability to maintain or improve in the term permit renewal area.	
Pancake HMA	Duckwater	Duckwater Hills	**Standard 1: Upland Sites;** Achieving the Standard.	2009
			Standard 2: Riparian and Wetland Sites; Not Applicable.	
			Standard 3: Habitat; Not Achieving the Standard, not making significant progress towards. Livestock are not a contributing factor to not achieving the Standard. Failure to achieve the Standard is related to other issues or conditions. This is attributable to drought, historic heavy livestock grazing from 1870-1994, and possibly lack of natural wildfire.	
Pancake HMA	Duckwater	Green Spring	**Standard 1: Upland Sites;** Not achieving the Standard, but making significant progress towards. Livestock are not a contributing factor to not achieving the Standard. Failure to achieve the Standard is related to other issues or conditions.	2009
			Standard 2: Riparian and Wetland Sites; This Standard was not evaluated since there are no public land riparian systems present in the Green Springs Use Area.	
			Standard 3: Habitat; Not achieving the Standard, not making significant progress towards. Livestock are not a contributing factor to not achieving the Standard. Failure to achieve the Standard is related to other issues or conditions. The BLM interdisciplinary team determined that significant progress is not being made towards achievement of Habitat Standard because movement towards achieving the Habitat Standards is not occurring at an acceptable level of rate and that wild horses populations above the AML are a contributing factor. A livestock grazing system is in place that defers cattle use until June each year in Green Springs Valley. Thus there is no livestock use during the critical growing period.	
Pancake HMA	Duckwater	Ike Springs/ Ike Bench	**Standard 1: Soils;** Achieving the Standard.	2007
			Standard 2: Ecosystem Components; Achieving the Standard regarding the upland and water quality indicators. Not achieving the Standard, and not making significant progress towards, regarding the riparian function of Indian Spring. Livestock are not a contributing factor to not achieving the Standard. Wild horses are a causal factor.	
			Standard 3: Habitat and Biota; Achieving the Standard.	

HMA/HA	Allotment	Use Area	Rangeland Health Standards	Completion
Pancake HMA	Duckwater	Little Smoky Valley	**Standard 1: Upland Sites;** Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Livestock, wild horses, drought, historic heavy grazing from 1870-1995 and possibly lack of natural wildfire are also considered factors in non-achievement of the Standard.	2009
			Standard 2: Riparian and Wetland; This Standard was not evaluated since there are no public land riparian systems present in that portion of the Little Smoky Valley Use Area grazed by cattle or sheep.	
			Standard 3: Habitat; Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Livestock, wild horses, drought, historic heavy grazing from 1870-1995 and possibly lack of natural wildfire are also considered factors in non-achievement of the Standard.	
			Standard 1: Upland Sites; Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Livestock (cattle), wild horses, drought, historic heavy grazing from 1870-1995 and possibly lack of natural wildfire are also considered factors in non-achievement of the Standard.	2013
			Standard 2: Riparian and Wetland; This Standard was not evaluated since there are no public land riparian systems present in that portion of the Little Smoky Valley Use Area grazed by cattle, sheep, or wild horses.	
			Standard 3: Habitat; Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Livestock (cattle), wild horses, drought, historic heavy grazing from 1870-1995 and possibly lack of natural wildfire are also considered factors in non-achievement of the Standard.	
Pancake HMA	Duckwater	North Sand Springs Valley	**Standard 1: Upland Sites;** Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Both livestock and wild horses are contributing factors. Due to shrub dominance, lack of an herbaceous understory, and the risk of invasive species spread at Key Area DW-61, the soil resources lack capability to maintain or improve in this use area.	2009
			Standard 2: Riparian and Wetland; This Standard was not evaluated since there are no public land riparian systems present in the North Sand Springs Use Area.	
			Standard 3: Habitat; Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Both livestock and wild horses are contributing factors. Due to shrub dominance, lack of herbaceous production, and the risk of	

HMA/HA	Allotment	Use Area	Rangeland Health Standards	Completion
			invasive species spread, the vegetative resources lack much resiliency or capability to maintain or improve in this use area. Based on professional judgment, the native plant communities here are in better shape than other use areas of the Duckwater Allotment, yet not sustainable in the long term.	
Pancake HMA	Duckwater	Pancake East Bench/Duckwater valley	**Standard 1: Upland Site;** North Pancake Area-North of McClure Spring Pipeline: Not achieving the Standard, not making significant progress towards. Livestock are not a contributing factor to not achieving the Standard. Failure to achieve the Standard is related to other issues or conditions. Wild Horses are a contributing factor. Due to shrub dominance, lack of native vegetation cover, the risk of invasive species spread, risk of erosion and loss of soil structure. And heavy or severe utilization at times, the soil resources lack much resiliency or capability to maintain or improve in this use are. Duckwater Corner Area: Achieving the Standard.	2009
			Standard 2: Riparian and Wetland; Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Both livestock and wild horses are contributing factors. Due to lack of riparian species cover, heavy or severe utilization, trampling, drought, the risk of invasive species spread, and other factors, the riparian areas lack much resiliency or capability to maintain or improve in this use area.	
			Standard3: Habitat; North Pancake Area: Not achieving the Standard, not making significant progress towards. Livestock are not a contributing factor to not achieving the Standard. Failure to achieve the Standard is related to other issues or conditions. Both livestock and wild horses are contributing factors. Due to shrub dominance (inappropriate composition), inappropriate vegetation production, inappropriate vegetation structure, and the moderate risk of invasive species spread, the vegetative resources lack much capability to maintain or improve in the use area. The native plant communities here are not sustainable. Duckwater Corner: Not Achieving the Standard, but making significant progress towards. Livestock are not a contributing factor to not achieving the Standard. Failure to achieve the Standard is related to other issues or conditions. Inappropriate plant composition and structure at four study sites. These sites have transitioned somewhat to shrub dominance, although a healthy diversity of shrubs are present for winter grazing, including four wing saltbush and spiny hopsage. Black sagebrush and rabbitbrush are dominated over much of the area.	
			Standard 1: Upland Sites; Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Both livestock and wild horses are contributing factors. Due to inappropriate plant composition, lack of vegetative cover, and	2009

HMA/HA	Allotment	Use Area	Rangeland Health Standards	Completion
Pancake HMA	Duckwater	Pogues Station	the risk of invasive species spread, the soil resources lack much resiliency or capability to maintain or improve in this use area. **Standard 2: Riparian and Wetland Sites;** This Standard was not evaluated since there are no public land riparian systems present in the pogues station use area. **Standard 3: Habitat;** Not achieving the Standard, not making significant progress towards. Livestock are a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Due to shrub dominance, lack of production, and the risk of invasive species spread, the vegetative resources lack much resiliency or capability to maintain to maintain or improve in this use area.	
Pancake HMA	Duckwater	South Sand Springs Valley*	**Standard 1: Upland Sites;** Not achieving the Standard, not making significant progress towards. Livestock are not a contributing factor to not achieving the Standard. Failure to achieve the Standard is related to other issues or conditions. Wild horses are a contributing factor. Due to inappropriate plant composition, lack of vegetative cover and production, a history of heavy and severe use, and the risk of invasive species spread, the soil resources lack much resiliency or capability to maintain or improve in this use area. **Standard 2: Riparian and Wetland;** Not achieving the Standard, not making significant progress towards. Livestock are not a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Wild horses are a contributing factor. Martiletti Spring has been monitored many times since 1991 and has always been in a very degraded state. **Standard 3: Habitat** Not achieving the Standard, not making significant progress towards. Livestock are not a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions. Wild horses are a contributing factor. Due to shrub dominance, lack of production, inappropriate plant community structure, and the risk of invasive species spread, the vegetative resources lack much resiliency or capability to maintain or improve in this use area.	2009
Pancake HMA	Monte Cristo		**Standard 1: Upland Site;** Achieving the Standard. **Standard 2: Riparian and Wetland Sites;** Not Applicable. **Standard 3: Habitat;** Not achieving the Standard, but making significant progress towards. Livestock are not a causal factor to not achieving the Standard. Failure to achieve the Standard is related to other issues or conditions. No livestock use occurred since 2002. Wild horse populations above the appropriate management level (AML) are a contributing factor to non-achievement of the Habitat Standard.	2009
Pancake HMA	Pancake Black Point			On going
Pancake HMA	Six Mile		**Standard 1: Upland Site;** Achieving the Standard. **Standard 2: Riparian and Wetland Sites;** Not applicable. **Standard 3: Habitat;** The Habitat Standard is achieved in the Fernando Seeding, but not achieved in native range. Current sheep management practices (2000-2010) at a level of 314	2010

HMA/HA	Allotment	Use Area	Rangeland Health Standards	Completion
			active AUMs average actual use in native range annually is not a contributing factor to not achieving the Standard in native range. Failure to achieve the standard is related to other issues or conditions, including wild horses, drought, historical heavy livestock grazing prior to 1990, and lack of natural wildfire.	
Pancake HMA	South Pancake		**Standard 1: Upland Site;** The Standard is being achieved. **Standard 2: Riparian and Wetland Sites;** The Standard is not applicable. **Standard 3: Habitat;** The Standard is not being achieved. Livestock are not a significant factor to not achieving the Standard; failure to meet the standard is related to other issues or conditions. In addition to livestock grazing, wild horses and wildlife use, variable precipitation, and altered natural disturbance regimes occur on the South Pancake Allotment. Non-attainment of this Standard is largely due to grasses being in poor vigor, declining, or absent. Sheep grazing is not a significant contributing factor to these conditions because of the forage preference of sheep, which primarily forage on shrubs and especially black sagebrush. Also, as a result of this forage preference, sheep grazing will not harm the grasses but will allow for grass conditions to improve while sheep grazing occurs. Furthermore, licensed sheep use has been lower than allowable levels over the past ten years and utilization has been slight to moderate which is within proper use levels across the allotment. This is a winter, sheep grazing allotment where grazing does not occur during most of the critical growing season. This further supports the conclusion that sheep grazing is not a significant contributing factor to not meeting Standard 3.	2009
Pancake HMA	Newark		**Standard 1: Upland Standards;** The Standard is being achieved. **Standard 2: Riparian and Wetland Sites;** Not achieving the Standard, and not making significant progress towards. Livestock are contributing factor to not achieving the Standard, failure to meet the standard is related to other issues or concerns. In addition to livestock grazing, wild horse and wildlife use, variable precipitation, and altered natural disturbance regimes occur on the Newark Allotment. **Standard 3: Habitat;** Not achieving the Standard but making significant progress towards. Livestock are not a contributing factor to not achieving the Standard, failure to meet the standard is related to other issues or conditions. Utilization has been within proper levels of use across the allotment and permitted use is lower than allowed over the past ten years. The causal factor for the loss of herbaceous understory and low production has not been determined.	2009
	Badger Spring		**Standard 1: Upland Standards;** Not achieving the Standard, but making significant progress towards. Livestock are not a significant contributing factor. Failure to meet the standard is related to other issues or conditions 1.e. past wild horse use, lack of precipitation, drought conditions, livestock drift from adjacent areas and changes in climate. **Standard 2: Riparian and Wetland Sites;** Not Applicable.	2009

HMA/HA	Allotment	Use Area	Rangeland Health Standards	Completion
Jakes Wash HA			**Standard 3: Habitat;** Not achieving the Standard, but making significant progress towards. Livestock are not a significant contributing factor. Failure to meet the standard is related to other issues or conditions i.e. past wild horse use, lack of precipitation, drought conditions, livestock drift from adjacent areas and changes in climate and fire suppression.	
Jakes Wash HA	Giroux Wash			On going
Jakes Wash HA	Indian Jake		**Standard 1: Upland Site;** Achieving the Standard. **Standard 2: Riparian and Wetland Sites;** Not applicable. **Standard 3: Habitat;** Not achieving the Standard, not making significant progress towards. Cattle grazing is a contributing factor to not achieving the Standard. Failure to achieve the Standard is also related to other issues or conditions including wild horses, drought, historical heavy livestock grazing, and lack of natural wildfire.	2010
Jakes Wash HA	Tom Plain		**Standard 1: Upland Site;** Achieving the Standard. **Standard 2: Riparian and Wetland Sites;** Not achieving the Standard, but making significant progress towards. Cattle grazing is a contributing factor to not achieving the Standard, but historical grazing, drought, and climate change were also attributable. **Standard 3: Habitat;** Not achieving the Standard, but making significant progress towards. The non-achievement of this Standard is primarily caused by historic overgrazing, drought, lack of natural wildfire, road construction, and other factors, but existing livestock grazing management was also a causal factor.	2007
Sand Springs West HMA	Sand Springs**		**Standard 1: Soils;** Achieving the Standard. **Standard 2: Ecosystem Components;** Achieving the Standard. **Standard 3: Habitat and Biota;** Not achieving the Standard, but making significant progress towards. Livestock are not a contributing factor to not achieving the Standard, failure to meet the standard is related to other issues or conditions.	2009

*Duckwater Allotment; South Sand Springs Valley Use Area has been closed to cattle grazing since 2000.

**This Standards Determination Document only evaluated and assessed sheep grazing management and it did not assess cattle grazing.

APPENDIX VIII

Risk Assessment For Noxious & Invasive Weeds

PANCAKE COMPLEX
WILD HORSE GATHER

Nye and White Pine Counties, Nevada

On May 11, 2020 a Noxious & Invasive Weed Risk Assessment was completed for the Pancake Complex wild horse gather. This weed risk assessment includes the Ely District portion of the Pancake, and Sand Springs West Wild Horse Herd Management Areas (HMAs), and the Jakes Wash Wild Horse Herd Area (HA). The Ely District also has a Memorandum of Understanding with the Battle Mountain District to inventory and treat weeds in a portion of the Sand Springs West HMA.

Alternatives analyzed include the following:

Proposed Action (Alternative A). Over a ten year period, gather and remove excess wild horses, selective removal of excess wild horses to low end AML, population growth control using fertility control treatments (ZonaStat-H, Porcine Zona Pellucida (PZP, PZP-22, GonaCon), sex ratio adjustments and management of a portion of the male population as geldings that brings the total population to mid-AML.

Alternative B. Alternative B is the same as Alternative A, but would not include a nonreproducing (i.e., gelding) portion of the population.

Alternative C. Under Alternative C, Gather and remove excess animals to within AML range without fertility control, sex ratio adjustments, or geldings.

Alternative D. The BLM would capture 100% of the current population of wild horses from the Jakes Wash Herd Area over a ten-year period. No animals would be released under this alternative. All of the animals gathered would be removed and transported to BLM holding facilities where they would be prepared for adoption and/or sale to qualified individuals for long term holding.

No Action Alternative
Although the No Action Alternative does not comply with the WFRHBA of 1971 and does not meet the purpose and need for the action in this EA, it is included as a basis for comparison with the Proposed Action.

Under the No Action Alternative, a gather to remove excess wild horses would not occur. There would be no active management to control the size of the wild horse population or to bring the wild horse population to AML. The current wild horse population would continue to increase at a rate of 20-25% per year. Within two years, the wild horse population could exceed 5000. Wild horses residing outside the HMAs and H.A. would remain in areas not designated for management of wild horses and population numbers would continue to increase. Increasing numbers of excess wild horses crossing highways would create a Wild Horse/Public Safety situation.

No field weed surveys were completed for this project. Instead the Ely District weed inventory data was consulted. Currently, the following weed species are found within the Pancake Complex project area or along roads and drainages leading to the project area:

Acroptilon repens	Russian knapweed
Carduus nutans	Musk thistle
Centaurea stoebe	Spotted knapweed
Centaurea squarrosa	Squarrose knapweed
Cirsium vulgare	Bull thistle
Conium maculatum	Poison hemlock
Hyoscyamus niger	Black henbane
Lepidium draba	Hoary cress
Lepidium latifolium	Tall whitetop
Onopordum acanthium	Scotch thistle
Tamarix spp.	Salt cedar
Bromus tectorum	Cheatgrass
Salsola iberica	Russian thistle

The project area was last inventoried for noxious weeds in 2017. The following noxious and invasive weeds occur in and/or around the project area:

Bromus tectorum	Cheatgrass	*Marrubium vulgare*	Horehound
Ceratocephala testiculata	Bur buttercup	*Salsola kali*	Russian thistle
Convolvulus arvensis	Field bindweed	*Sysimbrium altissimum*	Tumble mustard
Halogeton glomeratus	Halogeton	*Verbascum thapsus*	Common mullein

Factor 1 assesses the likelihood of noxious/invasive weed species spreading to the project area.

None (0)	Noxious/invasive weed species are not located within or adjacent to the project area. Project activity is not likely to result in the establishment of noxious/invasive weed species in the project area.
Low (1-3)	Noxious/invasive weed species are present in the areas adjacent to but not within the project area. Project activities can be implemented and prevent the spread of noxious/invasive weeds into the project area.
Moderate (4-7)	Noxious/invasive weed species located immediately adjacent to or within the project area. Project activities are likely to result in some areas becoming infested with noxious/invasive weed species even when preventative management actions are followed. Control measures are essential to prevent the spread of noxious/invasive weeds within the project area.
High (8-10)	Heavy infestations of noxious/invasive weeds are located within or immediately adjacent to the project area. Project activities, even with preventative management actions, are likely to result in the establishment and spread of noxious/invasive weeds on disturbed sites throughout much of the project area.

For Alternative A, B, C, and D, the factors rate as Moderate (6) at the present time. The concentrated use around capture sites could result in new infestations, specifically at the capture sites and holding pens. Also, a large infestation of tall whitetop occurs in Railroad Valley that the district is currently treating. There is a potential for the gather operation to spread this weed into the other valleys during the gather of the complex. However, by removing excess horses, native plant communities should have increased vigor and out compete weed species. Those alternatives that reach AML faster and offer solutions to slow population growth would have the most benefit to native vegetation recovery and preventing weeds from establishing and spreading. For the no action alternative, the factor rates as High (8). No gather operation would occur to spread weeds, and excess horses would remain on the range. This would have detrimental impact on native plant populations by decreased vigor due to overgrazing and weeds would be more competitive.

Factor 2 assesses the consequences of noxious/invasive weed establishment in the project area.

Low to Nonexistent (1-3)	None. No cumulative effects expected.
Moderate (4-7)	Possible adverse effects on site and possible expansion of infestation within the project area. Cumulative effects on native plant communities are likely but limited.
High (8-10)	Obvious adverse effects within the project area and probable expansion of noxious/invasive weed infestations to areas outside the project area. Adverse cumulative effects on native plant communities are probable.

For alternatives A, B C, and D, this project rates as Moderate (5) at the present time. The project area has several noxious and invasive weed infestations, especially along the main roads and in old fires. New weed infestations could spread to the area during gather operations which would have an adverse effect on the surrounding native vegetation, as well as an increase in cheatgrass populations which could alter the fire regime in the area. The potential to spread weeds would be limited primarily to identified areas making follow up monitoring and treatment, if necessary, more manageable. Following the gather operations native plant populations should have increased vigor and reproduction, slowing weed infestations from spreading outside the gather sites. For the no action alternative this project rates as High (8). By not gathering horses down to AML native plant communities could continue to be stressed due to over grazing allowing the expansion of invasive plants such as cheat grass, Russian thistle and halogeton. Overtime native plant communities would be not be able to recover and would be lost to monocultures of invasive species. Another concern is that as wild horse population increases, wild horses would need to seek alternative forage sources and consume noxious and invasive weeds found within the HMA. Russian knapweed is prevalent throughout the HMA and if consumed causes “chewing disease” in horses by damaging the area of the brain that controls fine motor movements, particularly of the mouth resulting in starvation or dehydration.

The Risk Rating is obtained by multiplying Factor 1 by Factor 2.

None (0)	Proceed as planned.
Low (1-10)	Proceed as planned. Initiate control treatment on noxious/invasive weed populations that get established in the area.
Moderate (11-49)	Develop preventative management measures for the proposed project to reduce the risk of introduction of spread of noxious/invasive weeds into the area. Preventative management measures should include modifying the project to include seeding the area to occupy disturbed sites with desirable species. Monitor the area for at least 3 consecutive years and provide for control of newly established populations of noxious/invasive weeds and follow-up treatment for previously treated infestations.
High (50-100)	Project must be modified to reduce risk level through preventative management measures, including seeding with desirable species to occupy disturbed site and controlling existing infestations of noxious/invasive weeds prior to project activity. Project must provide at least 5 consecutive years of monitoring. Projects must also provide for control of newly established populations of

	noxious/invasive weeds and follow-up treatment for previously treated infestations.

For all alternatives, this project Risk Rating is Moderate.

- Gather capture sites will be chosen in previously disturbed areas which are free from noxious weed infestations, to the greatest extent possible.
- Where appropriate, vehicles and heavy equipment used for the completion, maintenance, inspection, or monitoring of ground disturbing activities; or for authorized off-road driving will be free of soil and debris capable of transporting weed propagules. Vehicles and equipment will be cleaned with power or high-pressure equipment prior to entering or leaving the work site or **moving to another valley.** Cleaning efforts will concentrate on tracks, feet and tires, and on the undercarriage. Special emphasis will be applied to axels, frames, cross members, motor mounts, on and underneath steps, running boards, and front bumper/brush guard assemblies. Vehicle cabs will be swept out and refuse will be disposed of in waste receptacles. Cleaning sites will be recorded using global positioning systems or other mutually acceptable equipment and provided to the Ely District Office Weed Coordinator or designated contact person.
- Prior to entry of vehicles and equipment to a planned disturbance area, a weed scientist or qualified biologist will identify and flag areas of concern. The flagging will alert personnel or participants to avoid areas of concern.
- Removal and disturbance of vegetation would be kept to a minimum through site management (e.g. using previously disturbed areas and existing easements, limiting equipment/materials storage and staging area sites, etc.)
- Monitoring of the capture sites and holding pens on public lands will be conducted for at least three years and will include weed detection. Any newly established populations of noxious/invasive weeds discovered will be communicated to the Ely District Noxious and Invasive Weeds Coordinator for treatment.

The Ely District normally requires that all hay, straw, and hay/straw products used in project be free of plant species listed on the Nevada noxious weed list. However, this gather is being implemented through the National Wild Horse & Burro Gather Contract and would follow the stipulations in this national contract regarding certified weed-free forage.

If certified weed free hay is not required, the Ely District encourages the contractor to acquire locally produced hay from the valleys nearest to the project area. By using locally produced hay it would prevent the introduction of weeds from other areas.

Reviewed by: Sheryl Post May 13, 2020

Sheryl Post
Natural Resource Specialist

Date

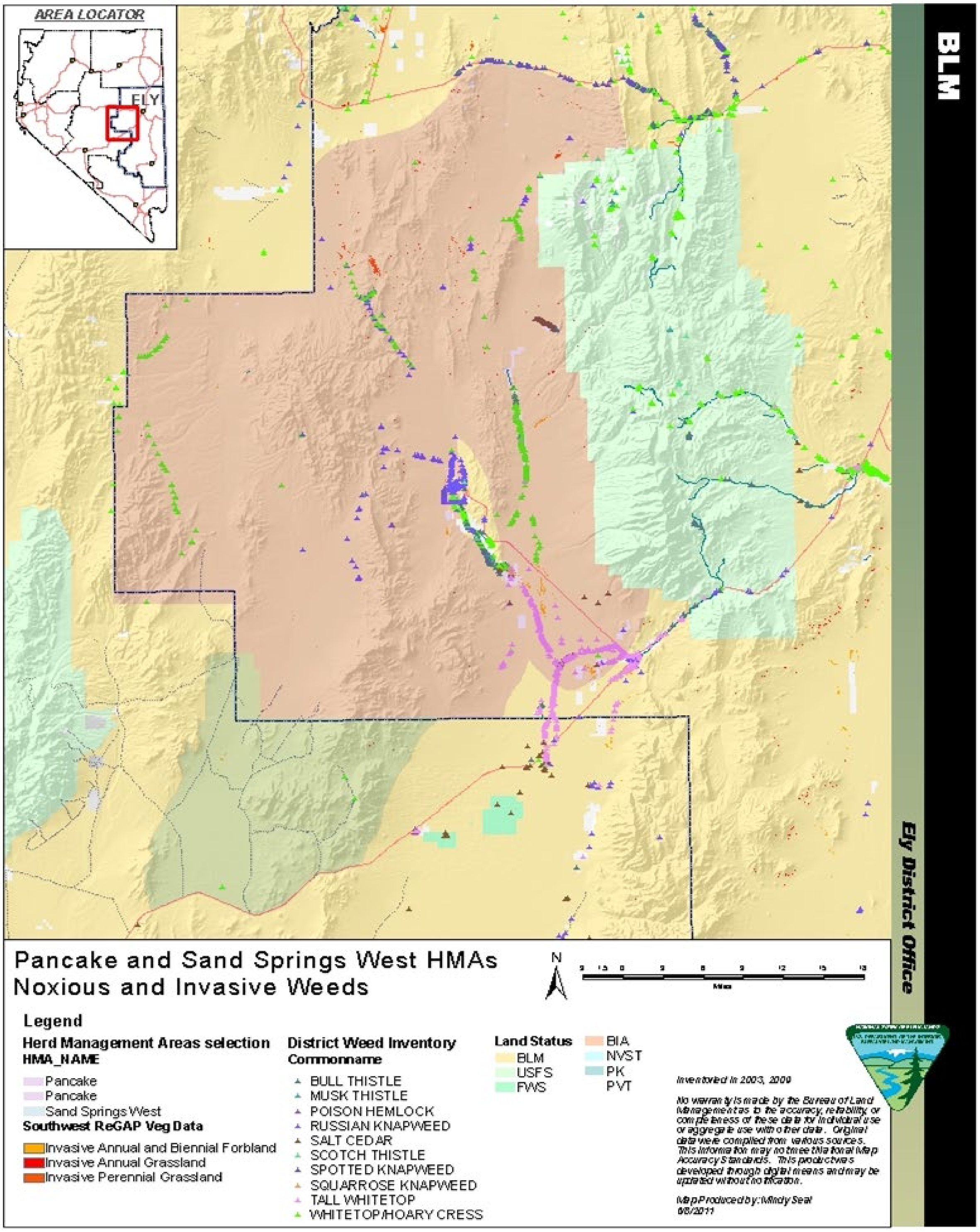
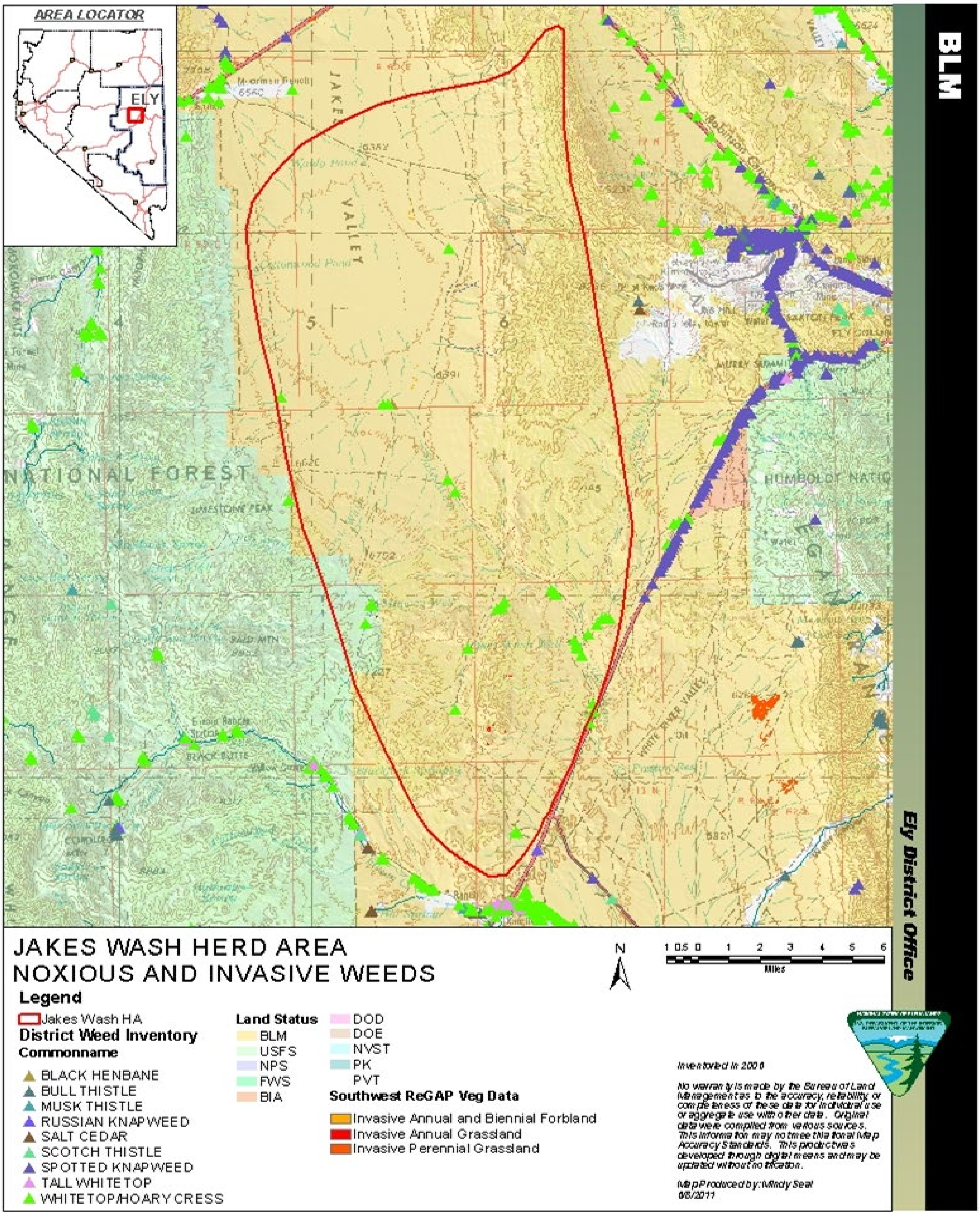


Figure 1. Map of documented noxious and invasive weeds in Pancake and Sand Springs West HMAs

Figure 2. Map of documented noxious and invasive weeds in Jakes Wash HA



APPENDIX IX

Special Status Species that may occur within or near the Complex (2023)

Common Name	Scientific Name
Birds	
Bald Eagle	*Haliaeetus leucocephalus*
Black Rosy-finch	*Leucosticte atrata*
Black-throated Gray Warbler	*Setophaga nigrescens*
Brewer's Sparrow	*Spizella breweri*
Broad-tailed Hummingbird	*Selasphorus platycercus*
Cassin's Finch	*Haemorhous cassinii*
Common Nighthawk	*Chordeiles minor*
Ferruginous Hawk	*Buteo regalis*
Flammulated Owl	*Otus flammeolus*
Golden Eagle	*Aquila chrysaetos*
Gray-crowned Rosy Finch	*Leucosticte tephrocotis*
Gray Vireo	*Vireo vicinior*
Great Basin Willow Flycatcher	*Empidonax traillii adastus*
Greater Sage-grouse	*Centrocercus urophasianus*
Juniper Titmouse	*Baeolophus griseus*
Lewis's Woodpecker	*Melanerpes lewis*
Loggerhead Shrike	*Lanius ludovicianus*
Long-billed Curlew	*Numenius americanus*
Long-eared Owl	*Asio otus*
Olive-sided Flycatcher	*Contopus cooperi*
Northern Goshawk	*Accipiter gentilis*
Peregrine Falcon	*Falco peregrinus*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Prairie Falcon	*Falco mexicanus*
Sagebrush Sparrow	*Artemisiospiza nevadensis*
Sage Thrasher	*Oreoscoptes montanus*
Short-eared Owl	*Asio flammeus*
Swainson's Hawk	*Buteo swainsoni*
Vesper Sparrow	*Pooecetes graminueus*
Virginia's Warbler	*Leiothlypis virginiae*
Western Burrowing Owl	*Athene cunicularia hypugaea*
Yellow-breasted Chat	*Icteria virens*
Mammals	
Big Brown Bat	*Eptesicus fuscus*
Bighorn Sheep	*Ovis candensis*
California Myotis	*Myotis californicus*
Dark Kangaroo Mouse	*Mycrodipodops megacephalus*
Fringed Myotis	*Myotis thysanodes*
Hoary Bat	*Lasiurus cinereus*

Little Brown Myotis	*Myotis lucifugus*
Long-eared Myotis	*Myotis evotis*
Long-legged Myotis	*Myotis volans*
Mexican Free-tailed Bat	*Tadarida brasiliensis*
Pale Kangaroo Mouse	*Mycrodipodops pallidus*
Pallid Bat	*Antrozous pallidus*
Pygmy Rabbit	*Brachylagus idahoensis*
Silver-haired Bat	*Lasionycteris noctivagans*
Spotted Bat	*Euderma maculatum*
Townsend's Big-eared Bat	*Corynorhinus townsendii*
Western Small-footed Bat	*Myotis ciliolabrum*
Yuma myotis	*Myotis yumanensis*
Reptiles	
Greater Short-horned Lizard	*Phyrnosoma hernandesi*
Sonoran Mountain Kingsnake	*Lampropeltis pyromelana*
<u>*Plants*</u>	
Blaine Pincushion	*Sclerocactus blainei*
Currant Milkvetch	*Astragalus uncialis*
Eastwood Milkweed	*Asclepias eastwoodiana*
Needle Mountains Milkvetch	*Astragalus eurylobus*
Railroad Valley Globemallow	*Sphaeralcea caespitosa var. williamsiae*
Rock Violet	*Viola lithion*
Insects	
Monarch Butterfly	*Danaus plexippus*
Railroad Valley Skipper	*Hesperia uncas fulvapalla*
Western Bumble Bee	*Bombus occidentalis*
Fish	
Railroad Valley Springfish	*Crenichthys nevadae**
Railroad Valley tui chub	*Gila bicolor ssp. 7*
Molluscs	
Big Warm Spring Pyrg	*Pyrgulopsis papillata*
Carinate Duckwater Pyrg	*Pyrgulopsis carinata*
Duckwater Pyrg	*Purgulopsis abola*
Duckwater Warm Springs Pyrg	*Purgulopsis villacompae*
Southern Duckwater Pyrg	*Purgulopsis anatina*
Grated Tryonia	*Tryonia clathrata*

*Federally Threatened Species

APPENDIX X

Greater Sage-Grouse Required Design Features

GRSG Proposed Activities Form IM 2016-038, Attachment 3: Required Design Features (RDF) identified in the Nevada and Northeastern California Greater Sage-Grouse Approved Resource Management Plan Amendment (SGPA) Appendix C

Project Name: Pancake Herd Area Horse Gather **NEPA #:**

General RDFs		Applied	If RDF not applied, select reason:
RDF Gen 1:	Locate new roads outside of GRSG habitat to the extent practical.	☐ Yes ☑ No	☑ A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. ☐ An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ ☐ A specific RDF will provide no additional protection to GRSG or its habitat. Rationale if RDF is not applied: No roads proposed.
RDF Gen 2:	Avoid constructing roads within riparian areas and ephemeral drainages. Construct lowwater crossings at right angles to ephemeral drainages and stream crossings (note that such construction may require permitting under Sections 401 and 404 of the Clean Water Act).	☐ Yes ☑ No	☑ A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. ☐ An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ ☐ A specific RDF will provide no additional protection to GRSG or its habitat. Rationale if RDF is not applied: No roads proposed.
RDF Gen 3:	Limit construction of new roads where roads are already in existence and could be used or upgraded to meet the needs of the project or operation. Design roads to an appropriate standard, no higher than necessary, to accommodate intended purpose and level of use.	☐ Yes ☑ No	☑ A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. ☐ An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ ☐ A specific RDF will provide no additional protection to GRSG or its habitat. Rationale if RDF is not applied: No roads proposed
RDF Gen 4:	Coordinate road construction and use with ROW holders to minimize disturbance to the extent possible.	☐ Yes ☑ No	☑ A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. ☐ An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ ☐ A specific RDF will provide no additional protection to GRSG or its habitat. Rationale if RDF is not applied: No new roads proposed.
RDF Gen 5:	During project construction and operation, establish and post speed limits in GRSG habitat to reduce vehicle/wildlife collisions or design roads to be driven at slower speeds.	☑ Yes ☐ No	☐ A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. ☐ An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ ☐ A specific RDF will provide no additional protection to GRSG or its habitat. Rationale if RDF is not applied: BLM and contractors will drive slower in GRSG habitat.

RDF Gen 6:	Newly constructed project roads that access valid existing rights would not be managed as public access roads. Proponents will restrict access by employing traffic control devices such as signage, gates, and fencing.	☐ Yes ☑ No	☑	A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable.
			☐	An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________
			☐	A specific RDF will provide no additional protection to GRSG or its habitat.
		Rationale if RDF is not applied: No new roads proposed.		
RDF Gen 7:	Require dust abatement practices when authorizing use on roads.	☐ Yes ☑ No	☐	A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable.
			☑	An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # Gen 5
			☐	A specific RDF will provide no additional protection to GRSG or its habitat.
		Rationale if RDF is not applied: Driving at reduced speeds in GRSG habitat.		
NO RDF 8 Identified				
RDF Gen 9:	Upon project completion, reclaim roads developed for project access on public lands unless, based on site-specific analysis, the route provides specific benefits for public access and does not contribute to resource conflicts.	☐ Yes ☑ No	☑	A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable.
			☐	An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________
			☐	A specific RDF will provide no additional protection to GRSG or its habitat.
		Rationale if RDF is not applied: No reclamation required.		
RDF Gen 10:	Design or site permanent structures that create movement (e.g., pump jack/ windmill) to minimize impacts on GRSG habitat.	☐ Yes ☑ No	☑	A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable.
			☐	An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________
			☐	A specific RDF will provide no additional protection to GRSG or its habitat.
		Rationale if RDF is not applied: No permanent structures		
RDF Gen 11:	Equip temporary and permanent aboveground facilities with structures or devices that discourage nesting and perching of raptors, corvids, and other predators.	☐ Yes ☑ No	☑	A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable.
			☐	An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________
			☐	A specific RDF will provide no additional protection to GRSG or its habitat.
		Rationale if RDF is not applied: No facilities		

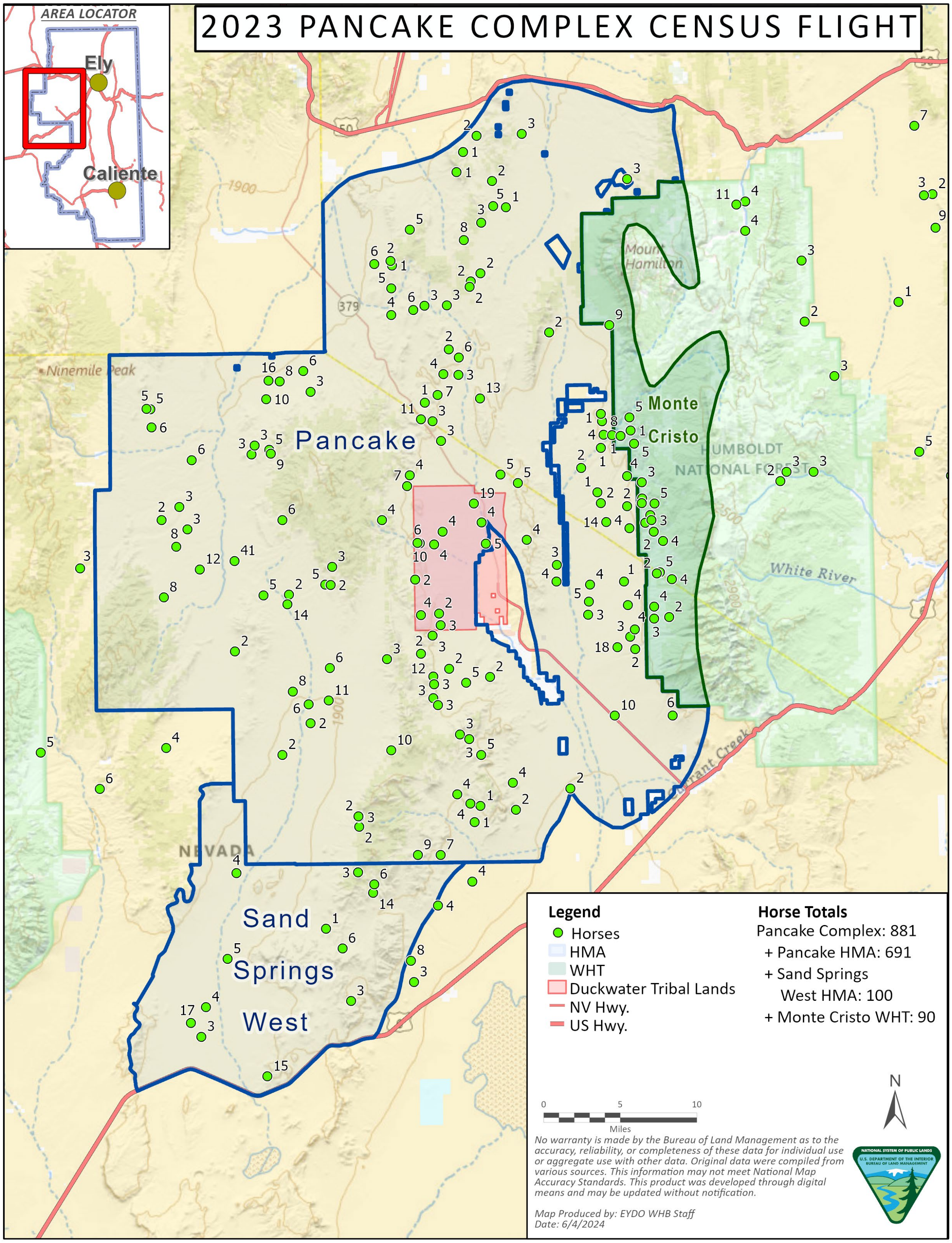
RDF Gen 12:	Control the spread and effects of nonnative, invasive plant species (e.g., by washing vehicles and equipment, minimize unnecessary surface disturbance; Evangelista et al. 2011). All projects would be required to have a noxious weed management plan in place prior to construction and operations.	☑ Yes ☐ No	☐ A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. ☐ An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ ☐ A specific RDF will provide no additional protection to GRSG or its habitat.	Rationale if RDF is not applied: Weed risk assessment prepared.
RDF Gen 13:	Implement project site-cleaning practices to preclude the accumulation of debris, solid waste, putrescible wastes, and other potential anthropogenic subsidies for predators of GRSG.	☑ Yes ☐ No	☐ A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. ☐ An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ ☐ A specific RDF will provide no additional protection to GRSG or its habitat.	Rationale if RDF is not applied:
RDF Gen 14:	Locate project related temporary housing sites outside of GRSG habitat.	☐ Yes ☑ No	☑ A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. ☐ An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ ☐ A specific RDF will provide no additional protection to GRSG or its habitat.	Rationale if RDF is not applied: No temporary housing
RDF Gen 15:	When interim reclamation is required, irrigate site to establish seedlings more quickly if the site requires it.	☐ Yes ☑ No	☑ A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. ☐ An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ ☐ A specific RDF will provide no additional protection to GRSG or its habitat.	Rationale if RDF is not applied: No reclamation
RDF Gen 16:	Utilize mulching techniques to expedite reclamation and to protect soils if the site requires it.	☐ Yes ☑ No	☑ A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. ☐ An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ ☐ A specific RDF will provide no additional protection to GRSG or its habitat.	Rationale if RDF is not applied: No reclamation

RDF	Description	Applied	Options	Rationale if RDF is not applied
RDF Gen 17:	Restore disturbed areas at final reclamation to the pre-disturbance landforms and desired plant community.	[ ] Yes [x] No	[x] A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. [ ] An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ [ ] A specific RDF will provide no additional protection to GRSG or its habitat.	No reclamation
RDF Gen 18:	When authorizing ground-disturbing activities, require the use of vegetation and soil reclamation standards suitable for the site type prior to construction.	[ ] Yes [x] No	[x] A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. [ ] An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ [ ] A specific RDF will provide no additional protection to GRSG or its habitat.	Gathers used previously disturbed areas.
RDF Gen 19:	Instruct all construction employees to avoid harassment and disturbance of wildlife, especially during the GRSG breeding (e.g., courtship and nesting) season. In addition, pets shall not be permitted on site during construction (BLM 2005b).	[x] Yes [ ] No	[ ] A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. [ ] An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ [ ] A specific RDF will provide no additional protection to GRSG or its habitat.	
RDF Gen 20:	To reduce predator perching in GRSG habitat, limit the construction of vertical facilities and fences to the minimum number and amount needed and install anti-perch devices where applicable.	[ ] Yes [x] No	[x] A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. [ ] An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ [ ] A specific RDF will provide no additional protection to GRSG or its habitat.	No facilities or fences constructed.
RDF Gen 21:	Outfit all reservoirs, pits, tanks, troughs or similar features with appropriate type and number of wildlife escape ramps (BLM 1990; Taylor and Tuttle 2007).	[x] Yes [ ] No	[ ] A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable. [ ] An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # ________ [ ] A specific RDF will provide no additional protection to GRSG or its habitat.	

RDF Gen 22:	Load and unload all equipment on existing roads to minimize disturbance to vegetation and soil.	☑ Yes ☐ No	☐	A specific RDF is documented to not be applicable to the site-specific conditions of the project/activity (e.g. due to site limitations or engineering considerations). Economic considerations, such as increased costs, do not necessarily require that an RDF be varied or rendered inapplicable.
			☐	An alternative RDF is determined to provide equal or better protection for GRSG or its habitat. Alternative RDF # __________
			☐	A specific RDF will provide no additional protection to GRSG or its habitat.
		Rationale if RDF is not applied:		

APPENDIX XI

Additional Maps



APPENDIX XII

Literature reviews on effects of gathers, ecological interactions, and population growth suppression methods

This appendix includes scientific literature reviews addressing five topics: effects of gathers, effects of wild horses and burros on rangeland ecosystems, effects of fertility control vaccines and sex ratio manipulations, effects of sterilization, and effects of intrauterine devices (IUDs).

Effects of Gathers on Wild Horses and Burros

Gathering any wild animals into pens has the potential to cause impacts to individual animals. There is also the potential for impacts to individual horses and burros during transportation, short-term holding, long-term holding that take place after a gather. However, BLM follows guidelines to minimize those impacts and ensure humane animal care and high standards of welfare. The following literature review summarizes the limited number of scientific papers and government reports that have examined the effects of gathers and holding on wild horses and burros.

Two early papers, by Hansen and Mosley (2000) and Ashley and Holcomb (2001) examined limited effects of gathers, including behavioral effects and effects on foaling rates. Hansen and Mosley (2000) observed BLM gathers in Idaho and Wyoming. They monitored wild horse behaviors before and after a gather event, and compared the behavioral and reproductive outcomes for animals that were gathered by helicopter against those outcomes for animals that were not. This comparison led to the conclusion that gather activities used at that time had no effect on observed wild horse foraging or social behaviors, in terms of time spent resting, feeding, vigilant, traveling, or engaged in agonistic encounters (Hansen and Mosley 2000). Similarly, the authors did not find any statistically significant difference in foaling rates in the year after the gather in comparisons between horses that were captured, those that were chased by a helicopter but evaded capture, or those that were not chased by a helicopter. The authors concluded that the gathers had no deleterious effects on behavior or reproduction. Ashley and Holcomb (2001) conducted observations of reproductive rates at Garfield Flat HMA in Nevada, where horses were gathered in 1993 and 1997, and compared those observations at Granite Range HMA in Nevada, where there was no gather. The authors found that the two gathers had a short-term effect on foaling rates; pregnant mares that were gathered had lower foaling rates than pregnant mares that were not gathered. The authors suggested that BLM make changes to the gather methods used at that time, to minimize the length of time that pregnant mares are held prior to their release back to the range. Since the publications by Hansen and Mosley (2000) and by Ashley and Holcomb (2001), BLM did make changes to reduce the stress that gathered animals, including pregnant females, may experience as a result of gather and removal activities; these measures have been formalized as policy in the comprehensive animal welfare program (BLM IM 2021-002). That policy also covers care of animals in corrals, where measures to ensure wild horse and burro health and welfare include oversight by attending veterinarians.

A thorough review of gather practices and their effects on wild horses and burros can be found in a 2008 report from the Government Accounting Office. The report found that the BLM had controls in place to help ensure the humane treatment of wild horses and burros (GAO 2008). The controls included SOPs for gather operations, inspections, and data collection to monitor animal welfare. These procedures led to humane treatment during gathers, and in short-term and long-term holding facilities. The report found that cumulative effects associated with the capture and removal of excess wild horses include gather-related mortality averaged only about 0.5% and approximately 0.7% of the captured animals, on average, are humanely euthanized due to pre-existing conditions (such as lameness or club feet) in accordance with BLM policy. Scasta (2020) found the same overall mortality rate (1.2%) for BLM WH&B gathers in 2010-2019, with a mortality rate of 0.25% caused directly by the gather, and a mortality rate of 0.94%

attributable to euthanasia of animals with pre-existing conditions such as blindness or club-footedness. Scasta (2020) summarized mortality rates from 70 BLM WH&B gathers across nine states, from 2010-2019. Records for 28,821 horses and 2,005 burros came from helicopter and bait/water trapping. For wild burro bait / water trapping, mortality rates were 0.05% due to acute injury caused by the gather process, and death for burros with pre-existing conditions was 0.2% (Scasta 2020). For wild horse bait / water trapping, mortality rates were 0.3% due to acute injury, and the mortality rate due to pre-existing conditions was 1.4% (Scasta 2020). For wild horses gathered with the help of helicopters, mortality rates were only slightly lower than for bait / water trapping, with 0.3% due to acute causes, and 0.8% due to pre-existing conditions (Scasta 2020). Scasta (2020) noted that for other wildlife species capture operations, mortality rates above 2% are considered unacceptable and that, by that measure, BLM WH&B "…welfare is being optimized to a level acceptable across other animal handling disciplines." In a separate analysis of 2010-2019 BLM wild horse gathers, Scasta et al. (2021) concluded that fewer than 20% of wild horse deaths at gathers were attributable to acute causes, with the great majority being euthanasia of animals with pre-existing, chronic conditions.

King et al. (2023) studied the fate of wild horse foals, as part of a broader 2016-2020 study on the effects of having some geldings in with breeding herds (King et al. 2022). In two HMAs in Utah that were intensively monitored for 4 years, about 5% of foals died in their first year of life, and about 2.5% of foals younger than 70 days old that became separated from their mothers (dams) survived and joined other social bands. BLM gather activities were not associated with any statistical increase in foal mortality, foal separation from their dams, or infanticide. King et al. (2023) concluded that, "…separation of offspring may be more common than previously considered, and that this is a natural event that does not necessarily result in mortality. … the separation of young foals from their dams was not a result of human disturbance or handling, resulting in the conclusion that foals even as young as 2 months old have a good chance of survival if separated from their dam or orphaned, as long as other social groups remain on the range that they can join."

The GAO report (2008) noted the precautions that BLM takes before gather operations, including screening potential gather sites for environmental and safety concerns, approving facility plans to ensure that there are no hazards to the animals there, and limiting the speeds that animals travel to trap sites. BLM used SOPs for short-term holding facilities (e.g., corrals) that included procedures to minimize excitement of the animals to prevent injury, separating horses by age, sex, and size, regular observation of the animals, and recording information about the animals in a BLM database. The GAO reported that BLM had regular inspections of short-term holding facilities and that animals I there, ensuring that the corral equipment is up to code and that animals are treated with appropriate veterinary care (including that hooves are trimmed adequately to prevent injury). Mortality was found to be about 5% per year associated with transportation, short term holding, and adoption or sale with limitations. The GAO noted that BLM also had controls in place to ensure humane care at long-term holding facilities (i.e., pastures). BLM staff monitor the number of animals, the pasture conditions, winter feeding, and animal health. Veterinarians from the USDA Animal and Plant Health Inspection Service inspect long-term facilities annually, including a full count of animals, with written reports. Contract veterinarians provide animal care at long-term facilities, when needed. Weekly counts provide an incentive for contractors that operate long-term holding facilities to maintain animal health (GAO 2008). Mortality at long-term holding was found to be about 8% per year, on average (GAO 2008). The mortality rates at short-term and long-term holding facilities are comparable to the natural annual mortality rate on the range of about 16% per year for foals (animals under age 1), about 5-10% per year for horses ages 1-10 years, and about 10-25% for animals aged 10-20 years (Ransom et al. 2016).

In 2010, the American Association of Equine Practitioners (AAEP 2011) was invited by the BLM to visit the BLM operations and facilities, spend time on WH&B gathers and evaluate the management of the wild equids. The AAEP Task Force evaluated horses in the BLM Wild Horse and Burro Program through several visits to wild horse gathers, and short- and long-term holding facilities. The task force was specifically asked to "review animal care and handling within the Wild Horse and Burro Program, and make whatever recommendations, if any, the Association feels may be indicated, and if possible, issue a public statement regarding the care and welfare of animals under BLM management." In their report (AAEP 2011), the task force concluded "that the care, handling and management practices utilized by the agency are appropriate for this population of horses and generally support the safety, health status and welfare of the animals." The comprehensive animal welfare program (BLM 2021) includes standards of care of animals in corrals, where measures include oversight by attending veterinarians.

In June 2010 BLM invited independent observers organized by American Horse Protection Association (AHPA) to observe BLM gathers and document their findings. AHPA engaged four independent credentialed professionals who are academia-based equine veterinarians or equine specialists. Each observer served on a team of two, and was tasked specifically to observe the care and handling of the animals for a 3-4-day period during the gather process, and submit their findings to AHPA. An Evaluation Checklist was provided to each of the observers that included four sections: Gather Activities; Horse Handling During Gather; Horse Description; and Temporary Holding Facility. The independent group visited 3 separate gather operations and found that "BLM and contractors are responsible and concerned about the welfare of the horses before, during and after the gather process" and that "gentle and knowledgeable, used acceptable methods for moving horses… demonstrated the ability to review, assess and adapt procedures to ensure the care and well-being of the animals" (Greene et al. 2011).

BLM commissioned the Natural Resources Council of the National Academies of Sciences (NRC) to conduct an independent, technical evaluation of the science, methodology, and technical decision making approaches of the BLM Wild Horse and Burro Management Program. Among the conclusions of their 2013 report, NRC (2013) concluded that wild horse populations grow at 15-20 percent a year, and that predation will not typically control population growth rates of free-ranging horses. The report (NRC 2013) also noted that, because there are human-created barriers to dispersal and movement (such as fences and highways) and not enough substantial predator pressure to actually cause herds to decrease, maintaining a herd within an AML requires removing animals in roundups, also known as gathers, and may require management actions that limit population growth rates. The report (NRC 2013) examined a number of population growth suppression techniques, including the use of sterilization, fertility control vaccines, and sex ratio manipulation.

The effects of gathers as part of feral horse management have also been documented on National Park Service Lands. Since the 1980s, managers at Theodore Roosevelt National Park have used periodic gathers, removals, and auctions to maintain the feral horse herd size at a carrying capacity level of 50 to 90 horses (Amberg et al. 2014). In practical terms, this carrying capacity is equivalent to an AML. Horse herd sizes at those levels were determined to allow for maintenance of certain sensitive forage plant species. Gathers every 3-5 years did not prevent the herd from self-sustaining. The herd continues to grow, to the point that the NPS now uses gathers and removals along with temporary fertility control methods in its feral horse management (Amberg et al. 2014).

Literature Cited; Effects of Gathers

Amberg, S., K. Kilkus, M. Komp, A. Nadeau, K. Stark, L. Danielson, S. Gardner, E. Iverson, E. Norton, and B. Drazkowski. 2014. Theodore Roosevelt: National Park: Natural resource condition assessment. Natural Resource Report NPS/THRO/NRR—2014/776. National Park Service, Fort Collins, Colorado.

American Association of Equine Practitioners (AAEP). 2011. Bureau of Land Management; BLM Task Force Report.

Ashley, M.C., and D.W. Holcomb. 2001. Effect of stress induced by gathers and removals on reproductive

success of feral horses. Wildlife Society Bulletin 29: 248-254.
Bureau of Land Management (BLM). 2021. Wild horse and burro comprehensive animal welfare program. Permanent Instruction Memorandum (IM) 2021-002. Bureau of Land Management, Washington, D.C.
Government Accountability Office (GAO). 2008. Bureau of Land Management; Effective Long-Term Options Needed to Manage Unadoptable Wild Horses. Report to the Chairman, Committee on Natural Resources, House of Representatives, GAO-09-77.
Greene, E.A., C.R. Heleski, S.L. Ralston, and C.L Stull. 2011. Academic assessment of equine welfare during the gather process of the Bureau of Land Management's wild horse and burro program. Journal of Equine Veterinary Science 31: 352-353.
King, S.R.B., K.A. Schoenecker and M.J. Cole. 2022. Effect of adult male sterilization on the behavior and social associations of a feral polygynous ungulate: the horse. Applied Animal Behaviour Science 249:105598.
King, S.R.B., M.J. Cole, C. Barton, and K.A. Schoenecker. 2023. Proximate factors affecting mortality and maternal abandonment of young free-roaming feral horse foals. Journal of Veterinary Behavior: https://doi.org/10.1016/j.jveb.2023.06.006.
Hansen, K.V., and J.C. Mosley. 2000. Effects of roundups on behavior and reproduction of feral horses. Journal of Range Management 53: 479-482.
National Research Council of the National Academies of Sciences (NRC). 2013. Using science to improve the BLM wild horse and burro program: a way forward. National Academies Press. Washington, DC.
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.
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.
Scasta, J.D., J.D. Hennig, and C.M. Calkins. 2021. Feral horse cause-specific mortality relative to mustering (gathering) and individual demographic attributes in the USA. Wildlife Research 48:673–689.

Effects of Wild Horses and Burros on Rangeland Ecosystems

The presence of wild horses and wild burros can have substantial effects on rangeland ecosystems, and on the capacity for habitat restoration efforts to achieve landscape conservation and restoration goals. While wild horses and burros may have some beneficial ecological effects, such benefits are outweighed by ecological damage they cause when herds are at levels greater than supportable by allocated, available natural resources (i.e., when herds are greater than AML).

In the biological sense, all free-roaming horses and burros in North America are feral, meaning that they are descendants of domesticated animals brought to the Americas by European colonists. Available evidence has indicated that horses went extinct in the Americas by the end of the Pleistocene, about 10,000 years ago (Webb 1984; MacFadden 2005), though DNA samples from permafrost suggest their extinction from Alaska could possibly have been as recent as about 6,000 years ago (Murchie et al. 2021). Burros evolved in Eurasia (Geigl et al. 2016). After domesticated horses were introduced to the Americas, their geographic distribution was facilitated by Native Americans and colonizing Europeans (Taylor et al. 2023a, 2023b). The published literature refers to free-roaming horses and burros as either feral or wild. In the ecological context the terms are interchangeable, but the terms 'wild horse' and 'wild burro' are associated with a specific legal status. The legal status of federally recognized wild horses and burros stems entirely from the WFRHBA of 1971, and is not dependent on whether the animals are or are not considered 'native' to the particular lands of the western USA where they are managed by the BLM and US Forest Service. Whether or not those animals were continuously present throughout the Holocene period in the 10 states where they are currently managed does not appear to influence the magnitude or direction of their ecological effects (Lundgren et al. 2024), but those effects are by no measure benign with respect to less well known plant and animal species, many of which have far more limited geographic distributions.

The following literature review on the effects of wild horses and burros on rangeland ecosystems draws on scientific studies of feral horses and burros, some of which also have wild horse or wild burro legal status. Parts of this review draw heavily on Parts 1 and 2 of the 'Science framework for conservation and restoration of the sagebrush biome' interagency report (Chambers et al. 2017, Crist et al. 2019).

Because of the known damage that overpopulated wild horse and burro herds can cause in rangeland ecosystems, the presence of wild horses and burros is considered a threat to Greater sage-grouse habitat quality, particularly in the bird species' western range (Beever and Aldridge 2011, USFWS 2013). Wild horse population sizes on federal lands have more than doubled in the five years since the USFWS report (2013) was published (BLM 2018). On lands administered by the BLM, there were over 82,000 BLM-administered wild horses and burros as of March 1, 2022, which does not include foals born in 2020. Lands with wild horses and burros are managed for multiple uses; scientific studies designed to separate out effects of wild horses and burros, which are summarized below, point to conclusions that landscapes with greater wild horse and burro abundance will tend to have lower resilience to disturbance and lower resistance to invasive plants than similar landscapes with herds at or below target AML levels.

In contrast to managed livestock grazing, neither the seasonal timing nor the intensity of wild horse and burro grazing can be managed, except through efforts to manage their numbers and distribution. Wild horses live on the range year round, they roam freely, and wild horse populations have the potential to grow 15-20% per year (Wolfe 1980; Eberhardt et al. 1982; Garrott et al 1991; Dawson 2005; Roelle et al. 2010; Scorolli et al. 2010). Although this annual growth rate may be lower in some areas where mountain lions can take foals (Turner and Morrison 2001, Turner 2015), horses tend to favor use of more open habitats (Schoenecker 2016) that are dominated by grasses and shrubs and where ambush is less likely. Wild horses may compete for forage with elk, mule deer, other wild ungulates, and managed livestock (Smith et al. 1986a, Scasta et al. 2016, Platte and Torland 2024).

As a result of the potential for wild horse populations to grow rapidly, impacts from wild horses on water, soil, vegetation, and native wildlife resources (Davies and Boyd 2019) can increase exponentially unless there is active management to limit their population sizes. For the majority of wild horse herds, there is little overall evidence that population growth is significantly affected by predation (NRC 2013), although wild horse and burro herd growth rates may be somewhat reduced by predation in some localized areas, particularly where individual cougars specialize on horse or burro predation (Turner and Morrison 2001, Roelle et al. 2010, Mesler and Jones 2021). Andreasen et al. (2021) and Iacono (2023) found that the level of specializing on young horse varies across individual mountain lions (*Puma concolor*). This specialization seems more prevalent where horses are at very high densities and native ungulates are at very low densities (Andreasen et al. 2021). Some of the greatest recorded rates of predation on horses, by mountain lions, have been in the Virginia Range, where the state of Nevada manages a herd of feral horses that is not federally protected. Where lion predation on horses was common, Andreasen et al. (2021) found that female lions preyed on horses year-round, but 13% or fewer of horses killed by lions were adults. Andreasen et al. (2021) concluded that, "at landscape scales, cougar predation is unlikely to limit the growth of feral horse populations." Mesler and Jones (2021) also documented that some mountain lions have a far higher prevalence of wild burro in their diet than others, though their sample size was relatively lower than Andreasen et al. (2021) or Iacono (2023). Similarly, Lundgren et al. (2022) documented that mountain lions kill feral burros in Death Valley National Park. Lundgren et al. (2022) advocated for not eliminating wild equids from landscapes, but that is not a consideration on HMAs, where the BLM aims to have herd sizes of wild horses and burros that are at or above the low level of AML. BLM does not have the legal authority to regulate or manage mountain lion populations, and it does not appear that enough mountain lions (if any) specialize on horse predation to the extent needed to prevent herd growth in the Pancake Complex. Andreasen et al. (2021) concluded that “At landscape scales, cougar predation is unlikely to limit the growth of feral horse populations.” In a study of Mexican wolf predation in an area of Arizona with free-roaming horses, horses were not part of the documented wolf diet (Smith et al. 2023). Given the recent history of consistent growth in the Pancake Complex wild horse herd, as documented by repeated aerial surveys, the inference that predation does not limit local wild horse herd growth rates apparently applies.

The USFWS (2008), Beever and Aldridge (2011), and Chambers et al (2017) summarize much of the literature that quantifies direct ecosystem effects of wild horse presence. Beever and Aldridge (2011) present a conceptual model that illustrates the effects of wild horses on sagebrush ecosystems. In the Great Basin, areas without wild horses had greater shrub cover, plant cover, species richness, native plant cover, and overall plant biomass, and less cover percentage of grazing-tolerant, unpalatable, and invasive plant species, including cheatgrass, compared to areas with horses (Smith 1986b; Beever et al. 2008; Davies et al. 2014; Zeigenfuss et al. 2014; Boyd et al. 2017). There were also measurable increases in soil penetration resistance and erosion, decreases in ant mound and granivorous small mammal densities, and changes in reptile communities (Beever et al. 2003; Beever and Brussard 2004; Beever and Herrick 2006; Ostermann-Kelm et al. 2009). Intensive grazing by horses and other ungulates can damage biological crusts (Belnap et al. 2001). In contrast to domestic livestock grazing, where post-fire grazing rest and deferment can foster recovery, wild horse grazing occurs year round. These effects imply that horse presence can have broad effects on ecosystem function that could influence conservation and restoration actions.

Many studies corroborate the general conclusion that wild horses can lead to biologically significant changes in rangeland ecosystems, particularly when their populations are overabundant relative to water and forage resources, and other wildlife living on the landscape (Eldridge et al. 2020). The presence of wild horses is associated with a reduced degree of Greater sage-grouse lekking behavior (Muñoz et al. 2020). Moreover, increasing densities of wild horses, measured as a percentage above AML, are associated with decreasing greater sage-grouse population sizes, measured by lek counts (Coates et al. 2021). In northwest Nevada, Behnke et al. (2023) found that Greater sage-grouse nesting rates were marginally higher in areas with wild horses, but Behnke et al. (2022) found that Greater sage-grouse in areas with feral horses had elevated corticosterone levels, especially under drought conditions. Behnke et al. (2022) also found that high corticosterone levels were associated with low Greater sage-grouse nesting success rates. In Wyoming, Hennig et al (2023) found a high degree of spatial overlap between wild horses and Greater sage-grouse in summer. Horses are primarily grazers (Hanley and Hanley 1982), but shrubs – including sagebrush – can represent a large part of a horse’s diet, at least in summer in the Great Basin (Nordquist 2011). Horses may crop grazed plants closer to the ground than bovids because horses have agile lips and top and bottom teeth (Chapter 21 in McNew et al. 2023). Free-ranging equids have a high affinity for habitats that are close to water (Esmaeili et al. 2021, Karish et al 2023), which appears to be stronger than for like-sized ruminants (Esmaeili et al. 2021). Grazing by wild horses can have severe impacts on water source quality, aquatic ecosystems and riparian communities as well (Beever and Brussard 2000; Barnett 2002; Nordquist 2011; USFWS 2008; Earnst et al. 2012; USFWS 2012, Kaweck et al. 2018), sometimes excluding native ungulates from water sources (Ostermann-Kelm et al. 2008; USFWS 2008; Perry et al. 2015; Hall et al. 2016; Gooch et al. 2017; Hall et al. 2018). Impacts to riparian vegetation per individual wild horse can exceed impacts per individual domestic cow (Kaweck et al. 2018, Burdick et al. 2021). Bird nest survival may be lower in areas with wild horses (Zalba and Cozzani 2004), and bird populations have recovered substantially after livestock and / or wild horses have been removed (Earnst et al. 2005; Earnst et al. 2012; Batchelor et al. 2015). Wild horses can spread nonnative plant species, including cheatgrass, and may limit the effectiveness of habitat restoration projects (Beever et al. 2003; Couvreur et al. 2004; Jessop and Anderson 2007; Loydi and Zalba 2009). Riparian and wildlife habitat improvement projects intended to increase the availability of grasses, forbs, riparian habitats, and water will likely attract and be subject to heavy grazing and trampling by wild horses that live in the vicinity of the project. Even after domestic livestock are removed, continued wild horse grazing can cause ongoing detrimental ecosystem effects (USFWS 2008; Davies et al. 2014) which may require several decades for recovery (e.g., Anderson and Inouye 2001).

Wild horses and burros may have ecologically beneficial effects, especially when herd sizes are low relative to available natural resources, but those ecological benefits do not typically outweigh damage caused when herd sizes are high, relative to available natural resources. Under some conditions, there may not be observable competition with other ungulate species for water (e.g., Meeker 1979), but recent studies that used remote cameras have found wild horses excluding native wildlife from water sources under conditions of relative water scarcity (Perry et al. 2015, Hall et al. 2016, Hall et al. 2018). Compared to landscapes where large herbivores such as horses and burros are completely absent, the presence of some large herbivores can cause local-scale ecological disturbances that may increase local species diversity (Trepel et al. 2024); this is consistent with the intermediate disturbance hypothesis (e.g., Wilkinson 1999), which also predicts that excessive disturbance, such as may be associated with wild horse herds far above AML, leads to reduced species diversity. Wild burros (and, less frequently, wild horses) have been observed digging 'wells;' such digging may improve habitat conditions for some vertebrate species and, in one site, may improve tree seedling survival (Lundgren et al. 2021). This behavior has been observed in intermittent stream beds where subsurface water is within 2 meters of the surface (Lundgren et al. 2021). The BLM is not aware of published studies that document wild horses or burros in the western United States causing similar or widespread habitat amelioration on drier upland habitats such as sagebrush, grasslands, or pinyon-juniper woodlands. Lundgren et al. (2021) suggested that, due to well-digging in ephemeral streambeds, wild burros (and horses) could be considered 'ecosystem engineers;' a term for species that modify resource availability for other species (Jones et al. 1994). Rubin et al. (2021) and Bleich et al. (2021) responded by pointing out that ecological benefits from wild horse and burro presence must be weighted against ecological damage they can cause, especially at high densities. Rubin et al. (2024) summarized effects of burro presence on Sonoran desert vegetation, birds, small mammals, and reptiles as a function of distance to water; some species had strongly negative associations with burro presence. Burro density appears to be negatively correlated with endangered desert tortoise presence which implies that burros should be considered along with other known environmental factors that can degrade tortoise habitat and demographic rates (Berry et al. 2020).

In HMAs where wild horse and burro biomass is very large relative to the biomass of native ungulates (Boyce and McLoughlin 2021), they should probably also be considered 'dominant species' (Power and Mills 1995) whose ecological influences result from their prevalence on the landscape. Wild horse densities could be maintained at high levels in part because artificial selection for early or extended reproduction may mean that wild horse population dynamics are not constrained in the same way as large herbivores that were never domesticated (Boyce and McLoughlin 2021). Another potentially positive ecological effect of wild horses and burros is that they, like all large herbivores, redistribute organic matter and nutrients in dung piles (i.e., King and Gurnell 2007), which could disperse and improve germination of undigested seeds. This could be beneficial if the animals spread viable native plant seeds (i.e., Downer 2022), but could have negative consequences if the animals spread viable seeds of invasive plants such as cheatgrass (i.e,, Loydi and Zalba 2009, King et al. 2019). Increased wild horse and burro density would be expected to increase the spatial extent and frequency of seed dispersal, whether the seeds distributed are desirable or undesirable. As is true of herbivory by any grazing animals, light grazing can increase rates of nutrient cycling (Manley et al. 1995) and foster compensatory growth in grazed plants which may stimulate root growth (Osterheld and McNaughton 1991, Schuman et al. 1999) and, potentially, an increase in carbon sequestration in the soil (i.e., Derner and Schuman 2007, He et al. 2011). In Spain, Segarra et al. (2023) noted that an area lightly to moderately grazed by donkeys had lower net productivity but higher plant biodiversity than ungrazed pastures where trees were encroaching. However, when grazer density is high relative to available forage resources – as can be the case when wild horse and burro densities exceed AML – then overgrazing by any species can lead to long-term reductions in plant productivity, including decreased root biomass (Herbel 1982, Williams et al. 1968) and potential reduction of stored carbon in soil horizons. Ecological processes associated with large herbivore carcass decomposition can contribute to higher insect and microbial diversity and localized nutrient flux to soils and plants, with effects that may last for several years (Newsome and Barton 2023). Degraded ecosystems may not have the capacity to use and recycle the ecological benefits of decomposing carcasses to the same level as healthy, diverse, resilient ecosystems (Newsome and Barton 2023).

Recognizing the potential beneficial effects of low-density wild horse and burro herds, but also recognizing the totality of available published studies documented ecological effects of wild horse and burro herds, especially when above AML (as noted elsewhere), it is prudent to conclude that horse and burro herd sizes above AML may cause levels of disturbance that reduce landscapes' capacity for resilience in the face of further disturbance (Rubin et al. 2024), such as is posed by extreme weather events and other consequences of climate change.

Most analyses of wild horse effects have contrasted areas with wild horses to areas without, which is a study design that should control for effects of other grazers, but historical or ongoing effects of livestock grazing may be difficult to separate from horse effects in some cases (Davies et al. 2014). Analyses have generally not included horse density as a continuous covariate; therefore, ecosystem effects have not been quantified as a linear function of increasing wild horse density. One exception is an analysis of satellite imagery confirming that varied levels of feral horse biomass were negatively correlated with average plant biomass growth (Ziegenfuss et al. 2014).

Horses require access to large amounts of water; an individual can drink an average of 7.4 gallons of water per day (Groenendyk et al. 1988). Despite a general preference for habitats near water (e.g., Crane et al. 1997), wild horses will routinely commute long distances (e.g., 10+ miles per day) between water sources and palatable vegetation (Hampson et al. 2010).

Wild burros can also substantially affect riparian habitats (e.g., Tiller 1997), native wildlife (e.g., Seegmiller and Ohmart 1981), and have grazing and trampling impacts that are similar to wild horses (Carothers et al. 1976; Hanley and Brady 1977; Douglas and Hurst 1983). Where wild burros and Greater sage-grouse co-occur, burros' year-round use of low-elevation habitats may lead to a high degree of overlap between burros and Greater sage-grouse (Beever and Aldridge 2011).

Literature Cited; Impacts to Rangeland Ecosystems

Anderson, J.E., and R.S. Inouye. 2001. Landscape-scale changes in plant species abundance and biodiversity of a sagebrush steppe over 45 years. Ecological Monographs 71:531-556.
Andreasen, A.M., K.M. Stewert, W.S. Longland, and J.P. Beckmann. 2021. Prey specialization by cougars on feral horses in a desert environment. Journal of Wildlife Management: 85:1104-1120.
Barnett, J. 2002. Monitoring feral horse and burro impacts on habitat, Sheldon National Wildlife Refuge. Unpublished report, Sheldon NWR, Lakeview, Oregon.
Batchelor, J.L., W.J. Ripple, T.M. Wilson, and L.E. Painter. 2015. Restoration of riparian areas following the removal of cattle in the northwestern Great Basin. Environmental Management 55:930-942.
Beever, E.A. and C.L. Aldridge. 2011. Influences of free-roaming equids on sagebrush ecosystems, with focus on greater sage-grouse. Studies in Avian Biology 38:273-290.
Beever, E.A. and P.F. Brussard. 2000. Examining ecological consequences of feral horse grazing using exclosures. Western North American Naturalist 63:236-254.
Beever, E.A. and J.E. Herrick. 2006. Effects of feral horses in Great Basin landscapes on soils and ants: direct and indirect mechanisms. Journal of Arid Environments 66:96-112.
Beever, E.A., R.J. Tausch, and P.F. Brussard. 2003. Characterizing grazing disturbance in semiarid

ecosystems across broad scales, using diverse indices. Ecological Applications 13:119-136.
Beever, E.A., and P.F. Brussard. 2004. Community- and landscape-level responses of reptiles and small mammals to feral-horse grazing in the Great Basin. Journal of Arid Environments, 59:271-297.
Beever, E.A., R.J. Tausch, and W.E. Thogmartin. 2008. Multi-scale responses of vegetation to removal of horse grazing from Great Basin (USA) mountain ranges. Plant Ecology 196:163-184.
Behnke, T.L., P.A. Street, S. Davies, J.Q. Ouyang, and J.S. Sedinger. 2022. Non-native grazers affect physiological and demographic responses of greater sage-grouse. Ecology and Evolution 12(9), p.e9325
Behnke, T.L., P.A. Street, and J.S. Sedinger. 2023. Climate and non-native herbivores influence reproductive investment by Greater Sage-grouse. Ecosphere 14(5), p.e4498.
Belnap, J., J.H. Kaltenecker, R. Rosentreter, J. Williams, S. Leonard, and D. Eldridge. 2001. Biological soil crusts: ecology and management. USDI-BLM Technical Reference 1730-2, 119 pp.
Berry, K.H., J.L. Yee, and L.M. Lyren. 2020. Feral burro and other influences on desert tortoise presence in the western Sonoran desert. Herpetologica 76:403-413.
Bleich, V.C., J.S. Sedinger, C.M. Aiello, C. Gallinger, D.A. Jessup, and E.M. Rominger. 2021. RE: Ecological "benefits" of feral equids command disclosure of environmental impacts. Science eLetters. 19 July 2021. https://science.sciencemag.org/content/372/6541/491/tab-e-letters accessed 9 August 2021. Response to Lundgren et al., 2021, "Equids engineer desert water availability," *in* Science 372: 491–495.
BLM. 2018. Herd Area and Herd Management Area Statistics. https://www.blm.gov/programs/wild-horse-and-burro/about-the-program/program-data.
Boyce, P.N., and P.D. McLoughlin. 2021. Ecological interactions involving feral horses and predators: review with implications for biodiversity conservation. Journal of Wildlife Management. DOI: 10.1002/jwmg.21995
Boyd, C.S., K.W. Davies, and G.H. Collins. 2017. Impacts of feral horse use on herbaceous riparian vegetation within a sagebrush steppe ecosystem. Rangeland Ecology and Management 70:411-417.
Burdick, J., S. Swason, S. Tsocanos, and S. McCue. 2021. Lentic meadows and riparian functions impaired after horse and cattle grazing. Journal of Wildlife Management: DOI: 10.1002/jwmg.22088
Carothers, S.W., M.E. Stitt, and R.R. Johnson. 1976. Feral asses on public lands: an analysis of biotic impact, legal considerations and management alternatives. North American Wildlife Conference 41:396-405.
Chambers, J.C., et al. 2017. Science Framework for Conservation and Restoration of the Sagebrush Biome: Linking the Department of the Interior Secretarial Order 3336 to Long-Term Strategic Conservation Actions. Part 1. Science Basis and Applications. RMRS-GTR-360. Fort Collins, CO: U.S Department of Agriculture, Forest Service, Rocky Mountain Research Station.
Coates, P.S., O'Neil, S.T., Muñoz, D.A., Dwight, I.A., and Tull, J.C. 2021. Sage-grouse population dynamics are adversely impacted by overabundant free-roaming horses. The Journal of Wildlife Management 85:1132-1149.
Couvreur, M., B. Christian, K. Verheyen and M. Hermy. 2004. Large herbivores as mobile links between isolated nature reserves through adhesive seed dispersal. Applied Vegetation Science 7:229-236.
Crane, K.K., M.A. Smith, and D. Reynolds. 1997. Habitat selection patterns of feral horses in south central Wyoming. Journal of Range Management 50:374-380.
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.
Davies, K.W., G. Collins, and C.S. Boyd. 2014. Effects of free-roaming horses on semi-arid rangeland ecosystems: an example from the sagebrush steppe. Ecosphere 5:1-14.
Davies, K.W. and C.S. Boyd. 2019. Ecological effects of free-roaming horses in North American

rangelands. Bioscience 69:558-565.
Dawson, M. 2005. The Population Ecology of Feral Horses in the Australian Alps, Management Summary. Unpublished report. Australian Alps Liaison Committee, Canberra.
Derner, J.D. and G.E. Schuman. 2007. Carbon sequestration and rangelands: a synthesis of land management and precipitation effects. Journal of Soil and Water Conservation 62:77-85.
Douglas, C.L. and T.L. Hurst.1993. Review and annotated bibliography of feral burro literature. CPSU/UNLV 044/02, 132 pp.
Downer, C. 2022. Heber Wild Horses of Arizona's Apache-Sitgreaves National Forests with 40 Ecological Transect Results and Herd Description. Cheiron: The International Journal of Equine and Equestrian History 2:1-119.
Earnst, S.L., J.A. Ballard, and D.S. Dobkin. 2005. Riparian songbird abundance a decade after cattle removal on Hart Mountain and Sheldon National Wildlife Refuges. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191. 550-558 pp.
Earnst, S.L., D.S. Dobkin, and J.A. Ballard. 2012. Changes in avian and plant communities of aspen woodlands over 12 years after livestock removal in the northwest Great Basin. Conservation Biology 26: 862-872.
Eberhardt, L.L., A.K. Majorowicz and J.A. Wilcox, 1982. Apparent rates of increase for two feral horse herds. The Journal of Wildlife Management, pp.367-374.
Eldridge, D.J., J. Ding, and S. K. Travers. 2020. Feral horse activity reduces environmental quality in ecosystems globally. Biological Conservation 241:108367.
Esmaeili, S., B.R. Jesmer, S.E. Albeke, E.O. Aikens, K.A. Schoenecker, S.R. King, B. Abrahms, B. Buuveibaatar, J.L. Beck, R.B. Boone, F. Cagnacci, et al. 2021. Body size and digestive system shape resource selection by ungulates: A cross-taxa test of the forage maturation hypothesis. Ecology letters 24:2178-2191.
Garrott, R.A., D.B. Siniff, and L.L. Eberhardt. 1991. Growth Rates of Feral Horse Populations. Journal of Wildlife Management 55: 641-48.
Geigl, E.M., S. Bar-David, A. Beja-Pereira, E. Cothran, E. Giulotto, H. Hrabar, T. Toyunsuren, and M. Pruvost. 2016. Genetics and Paleogenetics of Equids. Pages 87-104 in Ransom, J.I. and P. Kaczensky, eds. Wild Equids: Ecology, Management, and Conservation. Johns Hopkins University Press. Baltimore, Maryland
Gooch, A.M., S.L. Petersen, G.H. Collins, T.S. Smith, B.R. McMillan, and D.L. Eggett. 2017. The impacts of feral horses on the use of water by pronghorn in the Great Basin. Journal of Arid Environments 168:38-43.
Groenendyk, P., B. English, and I. Abetz. 1988. External balance of water and electrolytes in the horse. Equine Veterinary Journal 20:189-193.
Hall, L.K., R.T. Larsen, M.D. Westover, C.C. Day, R.N. Knight, and B.R. McMillan. 2016. Influence of exotic horses on the use of water by communities of native wildlife in a semi-arid environment. Journal of Arid Environments 127:100-105.
Hall, L.K., R.T. Larsen, R.N. Knight, and B.R. McMillan. 2018. Feral horses influence both spatial and temporal patterns of water use by native ungulates in a semi-arid environment. Ecosphere 9(1):e02096
Hampson, B.A., M.A. de Laat, P.C. Mills and C.C. Pollitt. 2010. Distances travelled by feral horses in 'outback' Australia. Equine Veterinary Journal 42(s38):582-586.
Hanley, T.A. and W.W. Brady. 1977. Feral burro impact on a Sonoran Desert range. Journal of Range Management 30:374-377.
Hanley, T. A., and K. A. Hanley. 1982. Food resource partitioning by sympatric ungulates on Great Basin rangeland. Journal of Range Management 35(2):152-158.
He, N.P., Y.H. Zhang, Q. Yu, Q.S. Chen, Q.M. Pan, G.. Zhang, and X.G. Han. 2011. Grazing intensity impacts soil carbon and nitrogen storage of continental steppe. Ecosphere 2:(1;8). DOI: 10.1890/ES10-00017.1
Hennig, J.D., J.D. Scasta, A.C. Pratt, C.P. Wanner, and J.L. Beck. 2023. Habitat selection and space use

overlap between feral horses, pronghorn, and greater sage‐grouse in cold arid steppe. Journal of Wildlife Management 87(1), e22329.
Herbel, C.H. 1982. Grazing management on rangelands. Journal of Soil and Water Conservation 37:77-79.
Iacono, P. 2023. Mountain lion (*Puma concolor*) and feral horse (*Equus ferus*) interactions: examining the influence of a non-native ungulate on predator behavior in a semi-arid environment. Utah State University Thesis. https://digitalcommons.usu.edu/etd/8898.
Jessop, B.D. and V.J. Anderson. 2007. Cheatgrass invasion in salt desert shrublands: benefits of postfire reclamation. Rangeland Ecology & Management 60:235-243.
Jones, C.G., J.H. Lawton and M. Shachak. 1994. Organisms as ecosystem engineers. Oikos 69:373-386.
Karish, T., G.W. Roemer, D.K. Delaney, C.D. Reddell, and J.W. Cain III. 2023. Habitat selection and water dependency of feral burros in the Mojave Desert, California, USA. Journal of Wildlife Management 2023:e22429.
Kaweck, M.M., J.P. Severson, and K.L. Launchbaugh. 2018. Impacts of wild horses, cattle, and wildlife on riparian areas in Idaho. Rangelands 40:45-52.
King, S.R.B., and J. Gurnell. 2006. Scent-marking behaviour by stallions: an assessment of function in a reintroduced population of Przewalski horses (*Equus ferus przewalskii*). Journal of Zoology 272:30-36.
King, S.R.B., K.A. Schoenecker, and D.J. Manier. 2019. Potential Spread of Cheatgrass (Bromus tectorum) and Other Invasive Species by Feral Horses (*Equus ferus caballus*) in Western Colorado. Rangeland Ecology and Management 72:706-710.
Loydi, A. and S.M. Zalba. 2009. Feral horses dung piles as potential invasion windows for alien plant species in natural grasslands. Plant Ecology 201:471-480.
Lundgren, E.J., D. Ramp, J.C. Stromberg, J. Wu, N.C. Nieto, M. Sluk, K.T. Moeller, and A.D. Wallach. 2021. Equids engineer desert water availability. Science 372:491-495.
Lundgren, E.J., D. Ramp, O.S. Middleton, E.I. Wooster, E. Kusch, M. Balisi, W.J. Ripple, C.D. Hasselerharm, J.N. Sanchez, M. Mills, and A.D. Wallach, A.D. 2022. A novel trophic cascade between cougars and feral donkeys shapes desert wetlands. Journal of Animal Ecology DOI: 10.1111/1365-2656.13766.
Lundgren, E.J., J. Bergman, J. Trepel, E. le Roux, S. Monsarrat, J.A. Kristensen, R.Ø. Pedersen, P. Pereyra, M. Tietje, and J-C. Svenning. 2024. Functional traits – not nativeness – shape the effects of large mammalian herbivores on plant communities. Science 383:531–537.
MacFadden, B.J. 2005. Fossil horses – evidence of evolution. Science 307:1728-1730.
Manley, J.T., G.E. Schuman, J.D. Reeder, and R.H. Hart. 1995. Rangeland soil carbon and nitrogen responses to grazing. Journal of Soil and Water Conservation 50:294-298.
McNew, L.B., D.K. Dahlgren, and J.L. Beck, eds. 2023. Rangeland Wildlife Ecology and Conservation. Springer, Cham, Switzerland. https://doi.org/10.1007/978-3-031-34037-6
Meeker, J.O. 1979. Interactions between pronghorn antelope and feral horses in northwestern Nevada. University of Nevada, Reno M.S. Thesis. Reno, Nevada.
Mesler, J.I., and A.S. Jones. 2021. Feral burros as a mountain lion prey item in west central Arizona. The Southwestern Naturalist 66:338-342.
Muñoz, D.A., P.S. Coates, and M.A. Ricca. 2020. Free-roaming horses disrupt greater sage-grouse lekking activity in the great basin. Journal of Arid Environments 184: 104304.
Murchie, T.J., A.J. Monteath, M.E. Mahony, G.S. Long, S. Cocker, T. Sadoway, E. Karpinski, G. Zazula, R.D. MacPhee, D. Froese, and H.N. Poinar. 2021. Collapse of the mammoth-steppe in central Yukon as revealed by ancient environmental DNA. Nature Communications 12:1-18. doi.org/10.1038/s41467-021-27439-6
National Research Council of the National Academies of Sciences (NRC). 2013. Using science to improve the BLM wild horse and burro program: a way forward. National Academies Press, Washington, D.C.
Newsome, T. and P. Barton. 2023. Carcass ecology in the alps. Report published by the Australian Alps

National Parks.
Nordquist, M. K. 2011. Stable isotope diet reconstruction of feral horses (*Equus caballus*) on the Sheldon National Wildlife Refuge, Nevada, USA. Thesis, Brigham Young University, Provo, Utah.
Osterheld, M. and S.J. McNaughton. 1991. Effect of stress and time for recovery on the amount of compensatory growth after grazing. Oecologica 85:305-313.
Ostermann-Kelm, S., E.R. Atwill, E.S. Rubin, M.C. Jorgensen, and W.M. Boyce. 2008. Interactions between feral horses and desert bighorn sheep at water. Journal of Mammalogy 89:459-466.
Ostermann-Kelm, S.D., E.A. Atwill, E.S. Rubin, L.E. Hendrickson, and W.M. Boyce. 2009. Impacts of feral horses on a desert environment. BMC Ecology 9:1-10.
Perry, N.D., P. Morey and G.S. Miguel. 2015. Dominance of a Natural Water Source by Feral Horses. The Southwestern Naturalist 60:390-393.
Platte, R.C., and R.E. Torland. 2024. Influence of wildfire and feral horse use on mule deer summer range occupancy. Wildlife Research 51: WR23035. doi:10.1071/WR23035
Power, M.E., and L.S. Mills. 1995. The keystone cops meet in Hilo. Trends in Ecology and Evolution 10: 182-184.
Roelle, J.E., F.J. Singer, L.C. Zeigenfuss, J.I. Ransom, L. Coates-Markle, and K.A. Schoenecker. 2010. Demography of the Pryor Mountain wild horses 1993–2007. US Geological Survey Scientific Investigations Report 2010–5125. 31p.
Rubin, E.S., D. Conrad, A.S. Jones, and J.J. Hervert 2021. Feral equids' varied effects on ecosystems. Science 373:973.
Rubin, E.S., D. Conrad, L.E. Harding, and B.M. Russo. 2024. Associations between a feral equid and the Sonoran desert ecosystem. Wildlife Monographs 2024:215;e1083.
Scasta, J.D., J.L. Beck and C.J. Angwin. 2016. Meta-analysis of diet composition and potential conflict of wild horses with livestock and wild ungulates on western rangelands of North America. Rangeland Ecology & Management.
Schoenecker, K.A., S.R.B. King, M.K. Nordquist, D. Nandintseseg, and Q. Cao. 2016. Habitat and diet of equids. In: Wild equids: ecology, management, and conservation, J. I. Ransom and P. Kaczensky, eds. Johns Hopkins University Press. Baltimore, Maryland.
Schuman, G.E., J.D. Reeder, J.T. Manley, R.H. Hart, and W.A. Manley. 1999. Impact of grazing management on the carbon and nitrogen balance of a mixed-grass rangeland. Ecological Applications 9:65-71.
Scorolli, A.L. and A.C.L. Cazorla. 2010. Demography of feral horses (*Equus caballus*): a long-term study in Tornquist Park, Argentina. Wildlife Research 37:207-214.
Seegmiller, R.F., and R.D. Ohmart. 1981. Ecological relationships of feral burros and desert bighorn sheep. Wildlife Monographs 78:3-58.
Segarra, J., J. Fernàndez-Martínez, and J.L. Araus. 2023. Managing abandoned Mediterranean mountain landscapes: The effects of donkey grazing on biomass control and floral diversity in pastures. Catena 233: 107503.
Smith, M.A. 1986a. Potential competitive interactions between feral horses and other grazing animals. Journal of Equine Veterinary Science 6: 238-239.
Smith, M.A. 1986b. Impacts of feral horse grazing on rangelands: an overview. Journal of Equine Science 6:236-238.
Smith, J.B., A.R. Greenleaf, and J.K. Oakleaf. 2023. Kill rates on native ungulates by Mexican gray wolves in Arizona and New Mexico. Journal of Wildlife Management 87:e22491.
Taylor, W.T.T., P. Librado, M.H. Tašukne Icu, et al. 2023a. Early dispersal of domestic horses into the Great Plains and northern Rockies. Science 379:1316-1323.
Taylor, W.T.T., J.B. Belardi, R. Barberena, et al. 2023b. Interdisciplinary evidence for early domestic horse exploitation in southern Patagonia. Science Advances 9:eadk5201, 1-10.
Tiller, B.L. 1997. Feral burro populations: distribution and damage assessment. Pacific Northwest National Laboratory 11879. U.S. Army, Department of Public Works, Fort Irwin, California.
Trepel, J., E. le Roux, A.J. Abraham, R. Buitenwerf, J. Kamp, J.A. Kristensen, M. Tietje, E.J. Lundgren,

and J-C. Svenning. 2024. Meta-analysis shows that wild large herbivores shape ecosystem properties and promote spatial heterogeneity. Nature Ecology and Evolution: https://doi.org/10.1038/s41559-024-02327-6
Turner, J.W. and M.L. Morrison. 2001. Influence of predation by mountain lions on numbers and survivorship of a feral horse population. The Southwestern Naturalist 46:183-190.
Turner, J.W. 2015. Environmental influences on movements and distribution of a wild horse (*Equus caballus*) population in western Nevada, USA: a 25-year study. Journal of Natural History 49 (39-40):2437-2464.
USFWS. 2008. Revised, Final Environmental Assessment for Horse and Burro Management at Sheldon National Wildlife Refuge. April 2008. U.S. Fish and Wildlife Service, Lake County, Oregon.
USFWS. 2012. Sheldon National Wildlife Refuge Comprehensive Conservation Plan. USFWS, Lakeview, Oregon.
USFWS. 2013. Greater Sage-grouse conservation objectives: final report. U.S. Fish and Wildlife Service, Denver, Colorado. February 2013.
Webb, S.D. 1989. Ten million years of mammal extinction in North America. In Martin, P.S. and Klein, R.G. eds., Quaternary extinctions: a prehistoric revolution. University of Arizona Press.
Wilkinson, D.M. 1999. The disturbing history of intermediate disturbance. Oikos 84:145-147.
Williams, R. E., Allred, B. W., Denio, R. M., & H.A. Paulsen. 1968. Conservation, development, and use of the world's rangelands. Journal of Range Management. 21:355-360.
Wolfe, M.L. 1980. Feral horse demography: a preliminary report. Journal of Range Management 33:354-360.
Zalba, S.M., and N.C. Cozzani. 2004. The impact of feral horses on grassland bird communities in Argentina. Animal Conservation, 7:35-44.
Ziegenfuss, L.C., K.A. Schoenecker, J.I. Ransom, D.A. Ignizio, and T. Mask. 2014. Influence of nonnative and native ungulate biomass and seasonal precipitation on vegetation production in a great basin ecosystem. Western North American Naturalist 74:286-298.

Effects of Fertility Control Treatments and Sex Ratio Manipulations in Wild Horse and Burro Management

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). Although sex ratio manipulation is not expected to directly reduce individual fertility, it is included in discussions of fertility control treatments here because it can be a form of population growth suppression. Fertility control measures have been shown to be a cost-effective and humane treatment to slow increases in wild horse populations or, when used in combination with gathers, to reduce horse population size (Bartholow 2004, de Seve and Boyles-Griffin 2013, Fonner and Bohara 2017). Although fertility control treatments may be associated with a number of potential physiological, behavioral, demographic, and genetic effects, those impacts are generally minor and transient, do not prevent overall maintenance of a self-sustaining population, and do not generally outweigh the potential benefits of using contraceptive treatments in situations where it is a management goal to reduce population growth rates (Garrott and Oli 2013).

The percentage of effectively contracepted mares in the herd could vary over time, depending on the number of mares that are treated in different years, the formulation of vaccine that is used and the expected duration of vaccine effectiveness. After the initial gather, the BLM could use a population modeling software such as PopEquus (Folt et al. 2023a, 2023b) to help inform expectations about how many animals in future gathers or actions should be removed, or mares treated, in order to achieve herd management goals. Herd management projections and specific decisions about the number of mares to be treated in the future would be informed by the best available information at the time, based on the results of records of past treatments and on herd monitoring results. However, logistical constraints associated with gather scheduling (for vaccine hand-injection) and animal approachability (for dart-based vaccine treatments) are such that it is unlikely that the fraction of mares that are effectively contracepted in any given year would ever exceed 75%. Because of high foal and adult survival rates (Ransom et al. 2016), the likely result is that the herd will always have a positive growth rate over time.

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, as there are possible effects to individuals and groups of wild horses and burros. 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, and does not include an analysis of oocyte growth factor vaccine formulations, which are the subject of ongoing research (Bruemmer et al. 2023). 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. Burros (donkeys) are a distinct species from horses, however they are both of the family Equidae. While there are notable differences between the species in their anatomy, diet, behaviors and metabolism (Burden and Thiemann 2015), the essential endocrine controls of the hypothalamic-pituitary-gonadal axis and the function of the zona pellucida in fertility are the same. While most studies reviewed are based on results from horses, burros are similar enough in their reproductive physiology and immunology (i.e., Turini et al. 2021) that expected effects of immunocontraception are comparable.

On the whole, the identified impacts of fertility control methods are generally transient – other than the contraceptive effects which are the purpose of treatment – 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 (NRC 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 (NRC 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. Because population growth rates depend partly on the frequency of females that give birth (i.e., the foaling rate), the use of fertility control vaccination to reduce growth rates is more effective when a herd is relatively close to AML. Population modeling (i.e. Gross 2000, deSeve and Boyles-Griffin 2013, Folt et al. 2023a, 2023b) confirms the common sense conclusion that the higher the fraction of contracepted mares, generally the lower the growth rate. Schulman et al. (2024) demonstrated that a shorter duration of effect requires larger fractions of mares need to be frequently treated to maintain a 'fertility control index' large enough to reduce herd-level growth rates. This is one reason that the BLM has historically sought to use humane, longer-lasting fertility control methods. For example, it is easier to achieve the 60-90% rate of effectively treated mares if the method used does not require treatment every year. Horses are long-lived, potentially reaching 20 years of age or more in the wild. Except in cases where extremely high fractions of mares are rendered infertile over long time periods of (i.e., 10 or more years), fertility control methods such as immunocontraceptive vaccines and sex ratio manipulation are not very effective at reducing population growth rates to the point where births equal deaths in a herd. However, even more modest fertility control activities can reduce the frequency of horse gather activities, and costs to taxpayers. Bartholow (2007) concluded that the application of 2-year or 3-year contraceptives to wild mares could reduce operational costs in a project area by 12-20%, or up to 30% in carefully planned population management programs.

Population monitoring will be useful to guide BLM in achieving and maintaining the managed population at over the duration of any action. To determine desired fertility control vaccine application rates, the BLM could use a population modeling software such as PopEquus (Folt et al. 2023a, 2023b) to help assess how many animals at that time should be removed or mares treated in order to achieve herd management goals and update its herd management projections in the future, based on the results of local, contemporaneous herd monitoring. Because applying contraception to horses often requires capturing and handling, the risks and costs associated with capture and handling of horses may be comparable to those of gathering for removal, but with expectedly lower adoption and long-term holding costs. Dart-based fertility control applications would entail no capture cost, but administration costs will vary in relation to approachability. 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 (NRC 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.

It is not realistic to rely on wild horse and burro herds to limit their own population size or growth rates in the western United States. Predators such as mountain lions tend to not fully prevent free-roaming horse population growth, even in locations where relatively high numbers of foals die per year, such as in the Virginia Range of Nevada (Schulman et al. 2024). Wild horses and burros are long-lived species with documented survival rates that can exceed 95 percent (Ransom et al. 2016) and they do not self-regulate their population (NRC 2013). The National Academies of Sciences report (NRC 2013) concluded that the primary way that equid populations self-limit is through increased competition for forage at higher densities, which results in smaller quantities of forage available per animal, poorer body condition and decreased natality and survival. It also concluded that the effect of this would be impacts to resource and herd health that are contrary to BLM management objectives and statutory and regulatory mandates. In the absence of management actions to limit the herd size, wild horse and burro populations would be expected to increase to a point where forage and/ or water resources are depleted resulting in the irreversible loss of native vegetation, a loss of wildlife habitat (including riparian habitat), and eventually the potential for periodic large-scale die-offs of the wild horses and burros themselves (NRC 2013). In a detailed demographic study of a growing population of Przewalski horses in Hungary, Kerekes et al. (2021) did observe slight reductions in foaling rates at high population sizes, but not nearly enough to prevent the population from continuing to grow at high annual rates, except during a winter die-off event when a quarter of the herd died. As such, there is a continuing need for active wild horse and burro herd management, such as through removals and fertility control.

Fertility Control Vaccines

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

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

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

BLM has guidelines for fertility control vaccine application, with respect to selection of herds (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. Treated mares should be identifiable via a visible freeze brand or individual color markings, so that their vaccination history can be known. Follow-up population surveys should be used to determine the realized annual growth rate in herds treated with fertility control vaccines.

The BLM's potential application of PZP ZonaStat-H vaccine booster doses 2 weeks or more after an initial dose, and GonaCon-Equine booster doses 30 or more days after an initial dose are consistent with use specifications on the product labels (EPA 2012, 2013). Temporarily holding animals or use of dart-based delivery to provide a booster dose does not require further study for justification. The Environmental Protection Agency regulates the use of fertility control agents such as the PZP vaccine ZonaStat-H or the GnRH vaccine GonaCon-Equine, in wild horses and burros. These vaccines are registered with the EPA, and are not experimental. The EPA-required product label associated with the registration for ZonaStat-H is cited in the EA as EPA (2012). That label states that "For maximum efficacy, ZonaStat-H is administered as an initial priming dose followed by a booster dose at least two weeks later." The EPA-required product label associated with the registration for GonaCon-Equine is cited in the EA as EPA (2013). That label states that "If longer contraceptive effect is desired, a second vaccination may be given 30 or more days after the first injection or during the following year with no known adverse health effects to the vaccinated animal."

The explicit intention of BLM's potential use of fertility control vaccines such as PZP ZonaStat-H or GonaCon-Equine, is to reduce the fertility rate of treated individual mares for one or more years and, therefore, to reduce the herd-level annual growth rates. This outcome would be consistent with the Purpose and Need identified in the EA, and consistent with authorities in the WFRHBA. The BLM acknowledges that there is a range of possible duration of contraceptive effects (noted below). It is even possible that some fertility control vaccine-treated mares may not reproduce again before they die. The 2013 EPA label for GonaCon-Equine states that, "there is a chance some vaccinated females will become permanently sterile." Precise probabilistic estimates of the return time to fertility for individual mares are not required for the BLM to ensure that these methods are humane, safe, and effective, and that herd management goals of achieving and maintaining the AML are met.

Vaccine Formulations: Porcine Zona Pellucida (PZP)
PZP vaccines have been used on dozens of horse herds by the National Park Service, US Forest Service, Bureau of Land Management, and Native American tribes and PZP vaccine use is approved for free-ranging wild and feral horse herds in the United States (EPA 2012). PZP use can reduce or eliminate the need for gathers and removals, if very high fractions of mares are treated over a very long time period (Turner et al. 1997). PZP vaccines have been used extensively in wild horses (NRC 2013), and in wild and feral burros (Turner et al. 1996, French et al. 2017, French et al. 2020, Kahler and Boyles-Griffin 2022). PZP vaccine formulations are produced as ZonaStat-H, an EPA-registered commercial product (EPA 2012, SCC 2015), as PZP-22, which is a formulation of PZP in polymer pellets that can lead to a longer immune response (Turner et al. 2002, Rutberg et al. 2017, Grams et al. 2022), and as SpayVac, where the PZP protein is enveloped in liposomes (Killian et al. 2008, Roelle et al. 2017, Bechert and Fraker 2018, Bechert et al 2022). '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 muscles near the hip. PZP-22 pellets have been successfully delivered via darting (Rutberg et al 2017, Carey et al. 2019).

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. GonaCon has been produced by USDA-APHIS (Fort Collins, Colorado) in several different formulations, the history of which is reviewed by Miller et al. (2013). GonaCon vaccines present the recipient with hundreds of copies of GnRH as peptides on the surface of a linked protein that is naturally antigenic because it comes from invertebrate hemocyanin (Miller et al 2013). Early GonaCon formulations linked many copies of GnRH to a protein from the keyhole limpet (GonaCon-KHL), but more recently produced formulations where the GnRH antigen is linked to a protein from the blue mussel (GonaCon-B) proved less expensive and more effective (Miller et al. 2008). GonaCon-Equine is in the category of GonaCon-B vaccines.

As with other contraceptives applied to wild horses, the long-term goal of GonaCon-Equine use is to reduce or eliminate the need for gathers and removals (NRC 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. 2022).

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

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

Direct Effects: PZP Vaccines

The historically accepted hypothesis explaining PZP vaccine effectiveness posits that when injected as an antigen in vaccines, PZP causes the mare's immune system to produce antibodies that are specific to zona pellucida proteins on the surface of that mare's eggs. The antibodies bind to the mare's eggs surface proteins (Liu et al. 1989), and effectively block sperm binding and fertilization (Zoo Montana, 2000). Because treated mares do not become pregnant but other ovarian functions remain generally unchanged, PZP can cause a mare to continue having regular estrus cycles throughout the breeding season. More recent observations support a complementary hypothesis, which posits that PZP vaccination causes reductions in ovary size and function (Mask et al. 2015, Joonè et al. 2017b, Joonè et al. 2017c, Nolan et al. 2018b, 2018c, French et al. 2020). PZP vaccines do not appear to interact with other organ systems, as antibodies specific to PZP protein do not crossreact with tissues outside of the reproductive system (Barber and Fayrer-Hosken 2000).

Research has demonstrated that contraceptive efficacy of an injected liquid PZP vaccine, such as ZonaStat-H, is approximately 90% or more for mares or burros treated twice in the first year (Turner and Kirkpatrick 2002, Turner et al. 2008, French et al. 2020). In the PopEquus projection model (Folt et al. 2023a, 2023b), a primer and booster dose of PZP ZonaStat-H treatment is modeled as having 95% and 19% reductions on reproduction one and two years after the first two doses, respectively. The same effect is modeled for a third dose, but a higher effectiveness of 95%, 72%, 58% and 30% fertility reductions is modeled for one, two, three, and four years, respectively, after receiving a fourth dose. 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, Grams et al. 2022). 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 used in PopEquus (Folt et al. 2023a, 2023b) modeling for PZP-22 effects is based on available studies and 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)	~33-72%	~20-40%

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 efficacies following a booster dose can be expected to be in the following ranges (based on figure 3 in Rutberg et al. 2017, and used in Folt et al. (2023a, 2023b).

Year 1	Year 2	Year 3	Year 4
0 (developing fetuses come to term)	~68-85%	~70-75%	~60-72%

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, Grams et al. 2022). 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, a small number of mares may not respond to the fertility control vaccine, but instead will continue to foal normally (i.e., BLM 2023).

Direct Effects: GnRH Vaccines
GonaCon-Equine is one of several vaccines that have been engineered to create an immune response to the gonadotropin releasing hormone peptide (GnRH). GnRH is a small peptide that plays an important role in signaling the production of other hormones involved in reproduction in both sexes. When combined with an adjuvant, a GnRH vaccine stimulates a persistent immune response resulting in prolonged antibody production against GnRH, the carrier protein, and the adjuvant (Miller et al., 2008). The most direct result of successful GnRH vaccination is that it has the effect of decreasing the level of GnRH signaling in the body, as evidenced by a drop in luteinizing hormone levels, and a cessation of ovulation.

GnRH is highly conserved across mammalian taxa, so some inferences about the mechanism and effects of GonaCon-Equine in horses can be made from studies that used different anti-GnRH vaccines, in horses and other taxa. Other commercially available anti-GnRH vaccines include: Improvac (Imboden et al. 2006, Botha et al. 2008, Janett et al. 2009, 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. 2012); and Bopriva, for use in cows (Balet et al. 2014). Of these, GonaCon-Equine, Improvac, and Equity are specifically intended for horses. Other anti-GnRH vaccine formulations have also been tested, but did not become trademarked products (e.g., Goodloe 1991, Dalin et al 2002, Stout et al. 2003, Donovan et al. 2013, Schaut et al. 2018, Yao et al. 2018). The effectiveness and side-effects of these various anti-GnRH vaccines may not be the same as would be expected from GonaCon-Equine use in horses. Results could differ as a result of differences in the preparation of the GnRH antigen, and the choice of adjuvant used to stimulate the immune response. For some formulations of anti-GnRH vaccines, a booster dose is required to elicit a contraceptive response, though GonaCon can cause short-term contraception in a fraction of treated animals from one dose (Powers et al. 2011, Gionfriddo et al. 2011a, Baker et al. 2013, Miller et al 2013).

GonaCon can provide multiple years of infertility in several wild ungulate species, including horses

(Killian et al., 2008; Gray et al., 2010). The lack of estrus cycling that results from successful GonaCon vaccination has been compared to typical winter period of anoestrus in open mares. As anti-GnRH antibodies decline over time, concentrations of available endogenous GnRH increase and treated animals usually regain fertility (Power et al., 2011). In the PopEquus projection model (Folt et al. 2023a, 2023b), a single dose of GonaCon-equine treatment is modeled as having 37% and 29% reductions on reproduction one and two years; as with the PZP ZonaStat-H vaccine, GonaCon is not expected to reduce the foaling rate for existing pregnancies. The PopEquus model (Folt et al. 2023a, 2023b) models fertility reductions of 100%, 85%, and 50% respectively for years 1, 2–4, and 5–7 years after two or more doses. Unpublished results indicate that BLM-managed wild horses that were treated with a primer dose, held for 30 days, and treated with a booster dose before being returned to the range foaled at normal rates in the first season after treatment, but then had contraceptive effectiveness of approximately 85%. Those results are based on observations in three HMAs. Mares were initially treated in September 2020 (Sulphur, and Swasey HMAs) or January 2021 (Eagle HMA), held until they received a booster dose of GonaCon-equine, then released. Some mares were radio-collared (Schoenecker et al. 2020) or radio-tail-tagged (King et al 2022) before release. After release, mares were monitored visually at least once per month to document any foaling and to confirm that radio collars were not causing any negative effects to the mares. Because of the timing of vaccination, it is not expected that there would have been any reduction in foaling in 2021, as GonaCon-equine is not expected to influence the fetus of any mares that were pregnant at the time of vaccination. For these mares, 2022 was the first year when the GonaCon-equine could have had a contraceptive effect; 8 of the 59 treated mares (~14%) were observed to have a foal. 2023 was the second year of potentially observable contraceptive effect, and approximately 30% of mares were observed to have foals.

Baker et al. (2018) showed that mares which receive only one dose of GonaCon-Equine tend to return to fertility within 3 years. Baker et al. (2018, 2023) have also shown that mares treated twice with GonaCon-Equine return to fertility over time, with an increasing number of mares returning to fertility the longer the time since the second dose. The specific method of injection and the time between the first and second dose appear to influence the effectiveness. Two hand-injected doses 4 years apart caused 100% infertility for a year, but that had dropped to 80% by year 6. Two darted injections separated by 6 months, 1 year, or 2 years appear less effective: within 3-4 years after two darted injections, only between about 55% to 75% of mares were infertile. When two hand-injections were only separated by 30 days, approximately 85% of treated mares were infertile for 1 year (BLM 2022); this is more effective than one dose, but less effective than when the doses are separated by 4 years. This 30-day timing is becoming a relatively common treatment schedule and is consistent with the EPA label for this vaccine; EPA 2013).

As is true for PZP vaccine treatments, the fraction of mares treated in a herd can have a large effect on the realized change in growth rate. Due to high wild horse survival rates, in any given year, a very high fraction of mares (i.e. ~75%) must be effectively contracepted (i.e., to the point that the fertility control vaccine prevents fertility in that year) to cause overall herd-level growth rates to be anywhere close to zero. The fraction of contracepted mares at any given time has also been called the 'fertility control index' (Grams et al. 2022, Schulman et al. 2024). As part of its adaptive management in decisions about how many mares to treat with fertility control vaccine, the BLM could use results of monitoring to make inferences about the number of mares present and the expected fraction of those that may be effectively contracepted, based on their treatment histories. Due to logistical limitations associated with difficult access in the Pancake Complex, there could almost always be a sizeable portion of the female population that is fertile in any given year.

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, NRC 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. 2012, 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 et al. 2007, Botha et al. 2008, Killian et al. 2008, Miller et al. 2008, 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 et al. (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. 2002, 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 with precision which individuals of a given age class will have long-lasting immune responses to the GonaCon vaccine. Gray (2009a) 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 quantitative relationship is between various factors and the resulting contraceptive efficacy, but average efficacy rates have been reported in studies such as Baker et al. (2023).

Several studies have monitored animal health after immunization against GnRH. GonaCon treated mares did not have any measurable difference in uterine edema (Killian et al. 2006, Killian et al. 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. 2012), 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 (NRC 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.

Return to Fertility and Effects on Ovaries: PZP Vaccines

In most cases, PZP contraception appears to be temporary and most treated mares return to fertility over time (Kirkpatrick and Turner 2002) unless they receive additional vaccine treatments. The return to fertility associated with a reduced immune response to the fertility control vaccine antigen has been called 'reversibility,' but the timing of the return to fertility is not under direct human control in the same sense that a narcotic drug can be reversed by application of naloxone, for example. 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 (see Appendix B in BLM 2021).

The purpose of applying PZP vaccine treatment is to prevent mares or jennies from conceiving foals, but BLM acknowledges that long-term infertility could be a result for some number of individual wild horses receiving PZP vaccinations. The effect of the PZP vaccine treatments is an immune response but if it happens that multiple PZP vaccine treatments cause a mare to not regain fertility before death, some would interpret that course of immunocontraceptive treatment to have caused sterility. The rate of long-term or permanent sterility following vaccinations with PZP is hard to predict for individual horses, but that outcome appears to increase in likelihood as the number of doses increases (Kirkpatrick and Turner 2002). This form of vaccine-induced long-term infertility or 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, and with Congressional guidance that condones such treatment in the management of wild horses and burros, in WFRHBA section 1333(b).

In some number of individual mares and jennies, PZP vaccination may cause direct effects on ovaries (Gray and Cameron 2010, Joonè et al. 2017b, Joonè et al. 2017c, Joonè et al. 2017d, Nolan et al. 2018b, French et al. 2020). Joonè et al. (2017a) noted that effects on ovaries in mares treated with one primer dose and booster dose were temporary. Joonè et al. (2017c) and Nolan et al. (2018b) documented decreased anti-Mullerian hormone (AMH) levels in mares treated with native or recombinant PZP vaccines; AMH levels are thought to be an indicator of ovarian function. French et al. (2020) documented fewer visible follicles and reduced uterine horn diameter in PZP treated jennies; 25% of treated burros returned to fertility during that study. Bechert et al. (2013) found that ovarian function was affected by the SpayVac PZP vaccination, but that there were no effects on other organ systems. Mask et al. (2015) demonstrated that equine antibodies that resulted from SpayVac immunization could bind to oocytes, ZP proteins, follicular tissues, and ovarian tissues. It is possible that result is specific to the immune response to SpayVac, which may have lower PZP purity than ZonaStat or PZP-22 (Hall et al. 2016). However, in studies with native ZP proteins and recombinant ZP proteins, Joonè et al. (2017a) found transient effects on ovaries after PZP vaccination in some treated mares; normal estrus cycling had resumed 10 months after the last treatment. SpayVac is a patented formulation of PZP in liposomes that led to multiple years of infertility in some breeding trials (Killian et al. 2008, Roelle et al. 2017, Bechert and Fraker 2018), but unacceptably poor efficacy in a subsequent trial (Kane 2018). Kirkpatrick et al. (1992) noted effects on horse ovaries after three years of treatment with PZP. Observations at Assateague Island National Seashore indicated that the more times a mare is consecutively treated, the longer the time lag before fertility returns, but that even mares treated 7 consecutive years did eventually return to ovulation (Kirkpatrick and Turner 2002). Other studies have reported that continued PZP vaccine applications may result in decreased estrogen levels (Kirkpatrick et al. 1992) but that decrease was not biologically significant, as ovulation remained similar between treated and untreated mares (Powell and Monfort 2001). Skinner et al. (1984) raised concerns about PZP effects on ovaries, based on their study in laboratory rabbits, as did Kaur and Prabha (2014), though neither paper was a study of PZP effects in equids. Bagavant et al. (2002) demonstrated T-cell clusters on ovaries, but no loss of ovarian function after ZP protein immunization in macaques.

Return to Fertility and Effects on Ovaries: GnRH Vaccines
As with PZP vaccines, mares that are treated with GonaCon-equine vaccine can be expected to return to fertility when the immune response to the antigen declines; in the colloquial usage of the term, this also makes GonaCon-equine a ‘reversible’ treatment, even though the return to fertility is not under direct human control in the same sense that a narcotic drug can be ‘reversed’ by application of naloxone, for example. 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; a relatively ow fraction of mares that receive only one dose of GonaCon-equine may be contracepted in the first year after treatment. However, preliminary results on the effects of boostered doses of GonaCon-Equine indicate that a booster dose in horses can increase the strength and duration of immune response – this can result in high contraceptive efficacy and longer-lasting effects (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 short-term fertility outcome (McCann et al. 2017). After treatment with GonaCon-equine vaccine, some mares may return to fertility faster than others (Thompson et al. 2022).

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, 2023) and other species (Curtis et al. 2002) 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); these results are consistent with the expectation that contraceptive effect of GonaCon in mammals results from the immune response, and that return to fertility increases as that immune response wanes.

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. In 2023, Baker et al. reported that mares treated with two doses of GonaCon-Equine returned to fertility at different rates and timing, depending on the length of time between the primer and booster dose. The longer the time between primer and booster, generally the longer-lasting was the contraceptive effect. For mares re-treated 4 years after the first dose, 29% had returned to fertility within 6 years after the second dose. For mares re-treated 2 years after the first dose, 36% had returned to fertility within 4 years of the second dose. For mares retreated 1 year, or 6 months after their first dose, 57%, and 46% of mares, respectively, had returned to fertility within 3 years. Results for the timing of return to fertility among mares treated twice with GonaCon-Equine vaccine is consistent with immune response being the cause of contraception, and that those contraceptive effects wane as the immune response declines over time (Baker et al. 2023).

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. 2002, Powers et al. 2011, Thompson et al. 2022). It is not expected that the BLM would treat prepubertal mares in the Pancake Complex. 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. 2002, 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 no published data are available.

To date, short term evaluation of anti-GnRH vaccines, show contraception appears to be temporary, and a result of an immune response that can wane over time. 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 temporary infertility lasting a short time (i.e., usually less than 2 years). Baker et al (2023) noted the possibility that some mares treated twice with GonaCon-Equine vaccine could remain contracepted for over 6 years, or even until they die; the latter outcome would presumably depend on the animal's age when treated, with older animals more likely to die before regaining fertility simply because their lifespan may not be long enough for the immune reaction to wane and cause a resumption of fertility. If long-term treatment resulted in such a long duration of immune response that a mare remains infertile until death, that type of permanent infertility would be consistent with the desired effect of using GonaCon (e.g., effective contraception), and with section 1333(b) of the WFRHBA.

Other anti-GnRH vaccines also have had temporary effects in mares. Elhay et al. (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 temporary. 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).

Long-term infertility could result from multiple doses of GonaCon-equine vaccine. As is the case for PZP vaccines (noted above), it is possible that some fraction of mares treated with multiple doses of GonaCon-equine could be prevented from having any more foals before they die – this outcome would depend on the age when the mare is treated, duration of the mare's immune response, and the mare's longevity. All available evidence supports the conclusion that the effect of GonaCon-equine vaccine treatments is to cause an immune response, and that when that immune response wanes a mare is expected to return to fertility. As noted above, Baker et al (2023) demonstrated increasing rates of return to fertility over time, after a second dose of GoanCon-Equine was administered. But if it happens that GonaCon-equine vaccine treatments cause a mare or jennie to not return to fertility before death, some would interpret that course of immunocontraceptive treatment to have caused sterility. If some fraction of mares or jennies treated with GonaCon-Equine were to become sterile, though, that result would be consistent with the contraceptive purpose that motivates BLM's potential use of the vaccine, and with Congressional guidance that condones such treatment in the management of wild horses and burros, in WFRHBA section 1333(b).

In summary, based on the above results related to fertility effects of GonaCon and other anti-GnRH vaccines, application of a single dose of GonaCon-Equine to gathered or remotely-darted wild horses could be expected to prevent pregnancy in perhaps 30%-60% of mares for one year. Some smaller number of wild mares should be expected to have persistent contraception for a second year, and less still for a third year. Applying one booster dose of GonaCon to previously-treated mares may lead to four or more years with relatively high rates (80+%) of additional infertility expected (Baker et al. 2018. 2023), with the potential for additional infertility until the immune response to the vaccine wears off. The duration of effect after a second dose would appear to depend on the length of time between first and second dose, with longer-lasting effects if that time span is 4 years than if it is 1 year or less (Baker et al 2023). Given that GonaCon-Equine 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 led 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, Powers et al. 2011, Donovan et al. 2013). In studies where the vaccine required a booster, hormonal and associated results were generally observed within several weeks after delivery of the booster dose.

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

If a mare is already pregnant, the PZP vaccine has not been shown to affect normal development of the fetus or foal, or the hormonal health of the mare with relation to pregnancy (Kirkpatrick and Turner 2003). Studies on Assateague Island (Kirkpatrick and Turner 2002) showed that once female offspring born to mares treated with PZP during pregnancy eventually breed, they produce healthy, viable foals. It is possible that there may be transitory effects on foals born to mares or jennies treated with PZP. For example, in mice, Sacco et al. (1981) found that antibodies specific to PZP can pass from mother mouse to pup via the placenta or colostrum, but that did not apparently cause any innate immune response in the offspring: the level of those antibodies were undetectable by 116 days after birth. There was no indication in that study that the fertility or ovarian function of those mouse pups was compromised, nor is BLM aware of any such results in horses or burros. Unsubstantiated, speculative connections between PZP treatment and 'foal stealing' has not been published in a peer-reviewed study and thus cannot be verified. 'Foal stealing,' where a near-term pregnant mare steals a neonate foal from a weaker mare, is unlikely to be a common behavioral result of including spayed mares in a wild horse herd. McDonnell (2012) noted that "foal stealing is rarely observed in horses, except under crowded conditions and synchronization of foaling," such as in horse feed lots. Those conditions are not likely in the wild, where pregnant mares will be widely distributed across the landscape, and where the expectation is that parturition dates would be distributed across the normal foaling season. Similarly, although Nettles (1997) noted reported stillbirths after PZP treatments in cynomolgus monkeys, those results have not been observed in equids despite extensive use in horses and burros.

On-range observations from 20 years of application to wild horses indicate that PZP application in wild mares does not generally cause mares to give birth to foals out of season or late in the year (Kirkpatrick and Turner 2003). Research by Nuñez et al. (2010) 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 et al. made observations, which calls into question whether inferences drawn from island herds can be applied to western wild horse herds. Ransom et al. (2013), though, did identify a potential shift in reproductive timing as a possible drawback to prolonged treatment with PZP, stating that treated mares foaled on average 31 days later than non-treated mares. Results from Ransom et al. (2013), however, showed that over 81% of the documented births in that study were between March 1 and June 21, i.e., within the normal, peak, spring foaling season. Ransom et al. (2013) pointedly advised that managers should consider carefully before using fertility control vaccines in small refugia or rare species. Wild horses and burros managed by BLM do not generally occur in isolated refugia, nor are they at all rare species. The US Fish and Wildlife Service denied a petition to list wild horses as endangered (USFWS 2015). Moreover, any effect of shifting birth phenology was not observed uniformly: in two of three PZP-treated wild horse populations studied by Ransom et al. (2013), foaling season of treated mares extended three weeks and 3.5 months, respectively, beyond that of untreated mares. In the other population, the treated mares foaled within the same time period as the untreated mares. Furthermore, Ransom et al. (2013) found no negative impacts on foal survival even with an extended birthing season. Nuñez (2018) suggested that if there are shifts in birth phenology it would be reasonable to assume that some negative effects on foal survival for a small number of foals might result from particularly severe weather events; such effects were not observed, though, in North Dakota (Baker et al. 2023).

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 (NRC 2013). Curtis et al. (2002) 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 did not assess other possible explanatory factors such as mare social status, age, body condition, or habitat (NRC 2013). Gray et al. (2010) found no difference in sex ratio, parturition phenology, or foal survival in foals born to free-roaming mares treated with GonaCon.

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), but it is also important to note that where such shifts have been documented, there have not been any associated effects on foal survival or long-term shifts in birth phenology for individual mares. The effects of GnRH vaccination on foaling phenology appear similar to those for PZP vaccine treated mares in which the effects of the vaccine wear off. In North Dakota, Baker et al. (2023) documented that 95% of foals born to untreated mares were born between March 1 – August 1. Baker et al. (2023) found that GonaCon-Equine treated mares had, on average, a peak foaling date (May 30) that was 34 days later than that of untreated mares (April 26), which is comparable to the 31-day later peak in PZP-treated mares that Ransom et al. (2013) documented. One might suppose that if there is a shift in foaling date for some treated mares, any associated effect on foal survival could depend on weather severity and local conditions. But importantly, even though Baker et al. (2023) observed foals born to GonaCon-Equine treated mares as late as December in North Dakota, their survival rate analysis showed that "…no difference in survival resulting from contraceptive effects was observed on timing of parturition." Also, similar to results in Ransom et al. (2013) for PZP-treated mares, observations by Baker et al. (2023) lead to the conclusion that late foaling phenology is 'self correcting' for any given mare, in that if a mare gave birth to a foal later than the typical foaling season, in the following year that mare either had no foal, or gave birth to a foal during the typical foaling season. Similarly, Curtis et al. (2002) observed 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 other 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). 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 (NRC 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.

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 and / or RFID chipping, for the purpose of identifying that mare and identifying that mare's 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 2021).

Most mares recover from the stress of capture and handling quickly once released back to the range, and none are expected to suffer serious long term effects from the fertility control injections, other than the direct consequence of becoming temporarily infertile. Injection site reactions associated with fertility control treatments are possible in treated mares and jennies (Roelle and Ransom 2009, Bechert et al. 2013, French et al. 2017, Baker et al. 2018, French et al. 2020), but swelling or local reactions at the injection site are expected to be minor in nature. Roelle and Ransom (2009) found that the most time-efficient method for applying PZP is by hand-delivered injection of 2-year pellets when horses are gathered. They observed only two instances of swelling from that technique. French et al. (2020) observed localized swelling, transient lameness in PZP vaccine-treated burros, and sterile abscesses in 87% of those treated jennies. Whether injection is by hand or via darting, GonaCon-Equine is associated with some degree of inflammation, swelling, and the potential for abscesses at the injection site (Baker et al. 2013). Swelling or local reactions at the injection site are generally expected to be minor in nature, but some may develop into draining abscesses. Use of remotely delivered vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached. The dart-delivered PZP formulation produced injection-site reactions of varying intensity, though none of the observed reactions appeared debilitating to the animals (Roelle and Ransom 2009) but that was not observed with dart-delivered GonaCon (McCann et al. 2017). Joonè et al. (2017a) found that injection site reactions had healed in most mares within 3 months after the booster dose, and that they did not affect movement or cause fever.

Long-lasting nodules observed did not appear to change any animal's range of movement or locomotor patterns and in most cases did not appear to differ in magnitude from naturally occurring injuries or scars. Mares treated with one formulation of GnRH-KHL vaccine developed pyogenic abscesses (Goodloe 1991). Miller et al. (2008) noted that the water and oil emulsion in GonaCon will often cause cysts, granulomas, or sterile abscesses at injection sites; in some cases, a sterile abscess may develop into a draining abscess. In elk treated with GonaCon, Powers et al. (2011) noted up to 35% of treated elk had an abscess form, despite the injection sites first being clipped and swabbed with alcohol. Even in studies where swelling and visible abscesses followed GonaCon immunization, the longer term nodules observed did not appear to change any animal's range of movement or locomotor patterns (Powers et al. 2013, Baker et al. 2017, 2018). The result that other formulations of anti-GnRH vaccine may be associated with less notable injection site reactions in horses may indicate that the adjuvant formulation in GonaCon leads a single dose to cause a stronger immune reaction than the adjuvants used in other anti-GnRH vaccines. Despite that, a booster dose of GonaCon-Equine appears to be more effective than a primer dose alone (Baker et al. 2017). Horses injected in the hip with Improvac showed only transient reactions that disappeared within 6 days in one study (Botha et al. 2008), but stiffness and swelling that lasted 5 days were noted in another study where horses received Improvac in the neck (Imboden et al. 2006). Equity led to transient reactions that resolved within a week in some treated animals (Elhay et al. 2007). Donovan et al. noted no reactions to the canine anti-GnRH vaccine (2013). In cows treated with Bopriva there was a mildly elevated body temperature and mild swelling at injection sites that subsided within 2 weeks (Balet et al. 2014).

Indirect Effects: PZP Vaccines

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

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

Because successful fertility control in a given herd reduces foaling rates and population growth rates, another indirect effect should be to reduce the number of wild horses that have to be removed over time to achieve and maintain the established AML. Contraception may change a herd's age structure, with a relative increase in the fraction of older animals in the herd (NPS 2008). Reducing the numbers of wild horses that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild horses, and thereby could eliminate the need to send additional excess horses from this area to off-range holding corrals or pastures for long-term holding.

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

Indirect Effects: GnRH Vaccines

As noted above to PZP vaccines, an expected long-term, indirect effect on wild horses treated with fertility control would be an improvement in their overall health. Body condition of anti-GnRH-treated females was equal to or better than that of control females in published studies. Ransom et al. (2014b) observed no difference in mean body condition between GonaCon-B treated mares and controls. Goodloe (1991) found that GnRH-KHL treated mares had higher survival rates than untreated controls. Baker et al (2023) noted higher body condition scores in GonaCon-Equine vaccine treated mares than in untreated mares. In other species, treated deer had better body condition than controls (Gionfriddo et al. 2011b), treated cats gained more weight than controls (Levy et al. 2011), as did treated young female pigs (Bohrer et al. 2014).

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

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

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

Behavioral Effects: PZP Vaccines

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

PZP vaccine-treated mares may continue estrus cycles throughout the breeding season. Ransom and Cade (2009) delineated wild horse behaviors. Ransom et al. (2010) found no differences in how PZP-treated and untreated mares allocated their time between feeding, resting, travel, maintenance, and most social behaviors in three populations of wild horses, which is consistent with Powell's (1999) findings in another population. Likewise, body condition of PZP-treated and control mares did not differ between treatment groups in Ransom et al.'s (2010) study. Nuñez et al. (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. 2002, 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). Later analysis by Nuñez et al. (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) and Nuñez (2018) concluded that PZP-treated mares changing bands more frequently than control mares could lead to band instability. Nuñez et al. (2009), though, cautioned against generalizing from that island population to other herds. Also, despite any potential changes in band infidelity due to PZP vaccination, horses continued to live in social groups with dominant stallions and one or more mares. Nuñez et al. (2014) found elevated levels of fecal cortisol, a marker of physiological stress, in mares that changed bands. The research is inconclusive as to whether all the mares' movements between bands were related to the PZP treatments themselves or the fact that the mares were not nursing a foal, and did not demonstrate any long-term negative consequence of the transiently elevated cortisol levels. In separate work in a long-term study of semi-feral Konik ponies, Jaworska et al. (2020) showed that neither infanticide nor feticide resulted for mares and their foals after a change in dominant stallion. Nuñez et al. (2014) wrote that these effects "…may be of limited concern when population reduction is an urgent priority." Nuñez (2018) and Jones et al. (2019, 2020) noted that band stallions of mares that have received PZP treatment can exhibit changes in behavior and physiology. Nuñez (2018) cautioned that PZP use may limit the ability of mares to return to fertility, but also noted that, "such aggressive treatments may be necessary when rapid reductions in animal numbers are of paramount importance…If the primary management goal is to reduce population size, it is unlikely (and perhaps less important) that managers achieve a balance between population control and the maintenance of more typical feral horse behavior and physiology."

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

The National Research Council (2013) found that harem changing was not likely to result in serious adverse effects for treated mares: "The studies on Shackleford Banks (Nuñez et al., 2009; Madosky et al., 2010) suggest that there is an interaction between pregnancy and social cohesion. The importance of harem stability to mare well-being is not clear, but considering the relatively large number of free-ranging mares that have been treated with liquid PZP in a variety of ecological settings, the likelihood of serious adverse effects seem low."

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

The NAS report (2013) provides a comprehensive review of the literature on the behavioral effects of contraception that puts research up to that date by Nuñez et al. (2009, 2010) into the broader context of all of the available scientific literature, and cautions, based on its extensive review of the literature that: ". . . in no case can the committee conclude from the published research that the behavior differences observed are due to a particular compound rather than to the fact that treated animals had no offspring during the study. That must be borne in mind particularly in interpreting long-term impacts of contraception (e.g., repeated years of reproductive "failure" due to contraception)."

Behavioral Effects: GnRH Vaccines

The result that GonaCon treated mares may have suppressed estrous cycles throughout the breeding season can lead treated mares to behave in ways that are functionally similar to pregnant mares. Where it is successful in mares, GonaCon and other anti-GnRH vaccines are expected to induce fewer estrous cycles when compared to non-pregnant control mares. This has been observed in many studies (Garza et al. 1986, Curtis et al. 2002, 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. 2002). 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 (2009a) and Baker et al. (2018) found no difference in sexual behaviors in mares treated with GonaCon and untreated mares. In a sense, the hormonal state of and the behaviors of GonaCon-Equine vaccine treated animals is generally comparable to when they are pregnant, but Baker et al. (2023) noted that GonaCon-Equine treated mares actually do still "…show periodic estrous behaviors throughout the normal breeding season suggesting that vaccination only partially suppresses the hormones responsible for stimulating reproductive behavior, although concentrations are likely insufficient to induce ovulation." Mares treated with GonaCon-Equine do not leave their bands any more often than untreated mares. In fact, Ransom et al. (2014b) actually found increased levels of band fidelity after treatment with GonaCon-Equine. Baker et al. (2018) reported that GonaCon-Equine treated mares received slightly more harem-social behaviors from stallions than untreated mares, but that most of those social behaviors were allo-grooming. 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 (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 (2009a) and Ransom et al. (2014b) monitored non-reproductive behaviors in GonaCon treated populations of free-roaming horses. Gray (2009a) found no difference between treated and untreated mares in terms of activity budget, sexual behavior, proximity of mares to stallions, or aggression. Ransom et al. (2014b) found only minimal differences between treated and untreated mare time budgets, but those differences were consistent with differences in the metabolic demands of pregnancy and lactation in untreated mares, as opposed to non-pregnant treated mares.

Genetic Effects of Fertility Control Vaccines
In HMAs where large numbers of wild horses have recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses, contraception is not expected to cause an unacceptable loss of genetic diversity or an unacceptable increase in the inbreeding coefficient. In any diploid population, the loss of genetic diversity through inbreeding or drift can be prevented by large effective breeding population sizes (Wright 1931) or by introducing new potential breeding animals (Mills and Allendorf 1996). The NAS report (2013) recommended that single HMAs should not be considered as isolated genetic populations. Rather, managed herds of wild horses should be considered as components of

interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements. Introducing 1-2 mares every generation (about every 10 years) is a standard management technique that can alleviated potential inbreeding concerns (BLM 2010).

In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM, such that most alleles that are present in any given mare are likely to already be well represented in that mare's siblings, cousins, and more distant relatives. With the exception of horses in a small number of well-known HMAs that contain a relatively high fraction of alleles associated with old Spanish horse breeds (NRC 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with 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). In a relatively small population with empirically documented individual genotypes, Zimmerman et al. (2023) used projections to determine that adequate genetic diversity should be maintained despite immunocontraception and planned periodic gathers. Based on a population model, Gross (2000) found that a strategy to preferentially treat young animals with a contraceptive led to more genetic diversity being retained than either a strategy that preferentially treats older animals, or a strategy with periodic gathers and removals.

Even if it is the case that repeated treatment with a fertility control vaccine may lead to prolonged infertility, or even sterility in some mares, most HMAs have only a low risk of loss of genetic diversity if logistically realistic rates of contraception are applied to mares. Wild horses in most herd management areas are descendants of a diverse range of ancestors coming from many breeds of domestic horses. As such, the existing genetic diversity in the majority of HMAs does not contain unique or historically unusual genetic markers. Past interchange between HMAs, either through natural dispersal or through assisted migration (i.e., human movement of horses) means that many HMAs are effectively indistinguishable and interchangeable in terms of their genetic composition (i.e., see the table of Fst vales *in* NRC 2013, and several analyses in Cothran et al. 2024). Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity, in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Their results show that the risk of the loss of genetic heterozygosity is extremely low except in case where all of the following conditions are met: starting levels of genetic diversity are low, initial population size is 100 or less, the intrinsic population growth rate is low (5% per year), and very large fractions of the female population are permanently sterilized.

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

Fertility Control Vaccines and the Evolution of Immune Response

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). Based on principles of population genetics, likely application rates in wild horse and burro metapopulations, and on currently available knowledge, it appears unlikely that BLM's application of fertility control vaccines would cause biologically significant, population-level evolutionary changes in the capacity to mount healthy immune responses, for reasons noted below.

In well-monitored wild horse herds that have been treated with PZP vaccine for many years, there have been a small number of mares that are 'non-responders' – that is, they continue to be fertile despite multiple treatments with ZonaStat-H PZP vaccine (i.e., BLM 2023). To the extent that this outcome may be partly attributable to genes, then for such 'non-responder' genes to spread widely in the population, both heritability and the selection coefficient must be high. 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. 2011). The premise of the concern (Cooper and Larson 2006, Ransom et al. 2014a) is based on an assumption that lack of immune response to any given fertility control vaccine is a highly heritable trait, that the great majority of mares in a population would be treated with immunocontraceptives, that treated 'non-responder' mares would give birth to a far greater number of foals than other treated mares, and that the result would be an increasing frequency of the poor immune response associated trait 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 eutherian 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. 2002, Herbert and Trigg 2005). However, Magiafoglou et al. (2003) clarify that if the variation in immune response is due to environmental factors (i.e., body condition, social rank) and not due to genetic factors, then there will be no expected effect of the immune phenotype on future generations. It is possible that general health, as measured by body condition, can have a causal role in determining immune response, with animals in poor condition demonstrating poor immune reactions (NRC 2013).

Correlations between physical factors and immune response would not preclude, though, that there could also be a heritable response to immunocontraception. In studies not directly related to immunocontraception, immune response has been shown to be heritable (Kean et al. 1994, Sarker et al. 1999). Predictions about the long-term, population-level evolutionary response to immunocontraceptive treatments have been largely speculative up to this point, with outcomes likely to depend on several factors, including: the strength of the genetic predisposition to not respond to the fertility control vaccine; the heritability of that gene or genes; the initial prevalence of that gene or genes; the number of mares treated with a primer dose of the vaccine (which generally has a short-acting effect); the number of mares treated with one or more booster doses of the vaccine; and the actual size of the genetically-interacting metapopulation of horses within which the vaccine treatment takes place.

One recent study attempted to quantify the heritability of a decreased response to fertility control vaccine-induced duration of infertility and the pattern of single nucleotide polymorphisms (SNPs) in the genomes of feral mares in Theodore Roosevelt National Park. SNPs can be associated with DNA variants in nearby coding regions, due to linkage. 53 mares were treated with the GonaCon-Equine immunocontraception vaccine, and 25 were not. Almost all of the GonaCon treated mares became infertile for at least one year. The researchers found a correlation between a more rapid return to fertility and several SNPs. The SNPs that were correlated with a more rapid return to fertility are not known to be located in coding regions of genes that influence immune response, but based on the location of those SNPs the researchers suggested that there may be an association with genes that may influence immune response. The researchers estimated that the heritability for genetic effects on the duration of GonaCon effectiveness in feral horse mares was $h^2 = 0.27$ (SE = 0.23). They characterized this level of heritability as 'moderate.' There are several reasons to expect that in any single managed herd of wild horses, there would be the potential for only a relatively low strength of selection promoting the genes identified in the paper. Almost all of those treated mares became infertile for some time, even though certain SNPs were correlated with a marginally faster return to fertility. The fact that immunocontraception with GonaCon still reduced fertility in treated mares is indicative of a weaker selection potential than if treated mares with those SNPs had remained entirely fertile. These reasons include the only ‘moderate’ levels of heritability identified by Thompson et al. (2022), the expectation that mares treated multiple times should experience additional duration of effect after each dose, the likelihood that an essentially random selection of mares in the herd would not be treated at all with an immunocontraceptive, the possible non-genetic causes that treated mares may return to fertility, and the large genetic effective population size of wild horse metapopulations that is characterized across multiple HMAs and complexes. The results from Thompson et al. (2022) would not be expected substantively to change expectations about the effects of potentially heritable immune responses to immuncontraceptive vaccines. Thompson et al. (2022) based their results on mares that were treated twice with GonaCon-Equine. While some treated mares may carry genes that marginally decrease vaccine effectiveness and cause them to return to fertility faster, there may also be other treated mares who do not carry those genes but experience poor vaccine due to environmental or other causes. Of course, any mares that are not treated with immunocontraceptives would be expected to contribute more foals to the herd than treated mares, and the choice of which mares happen to be treated or not be treated would be essentially random with respect to the SNPs identified. In their conclusions, Thompson et al. (2022) suggest that wild horse managers should not rely solely on immunocontraceptive methods for herd management; in the three HMAs under consideration in this EA, gathers and immunocontraception are both considered for use in the Proposed Action. Therefore, the continued presence of untreated and other reproducing mares is likely to reduce any risk of long-term evolutionary reduction in immune function in these herds.

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), the BLM is unaware of any studies that tested for changes in immune competence in those areas.

Sex Ratio Manipulation

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

Sex ratio can vary in local populations of wild horses, with many having approximately equal numbers of males and females, some having more females, and some more males. Basic principles of wildlife demography posit that for populations where there is no major influence of any sex-biased immigration or emigration, the realized sex ratio is expected to be a result of sex ratios at birth and sex-specific survival rates at different ages.

Across many herds of federally managed wild horses and feral horses, there can be substantial variation in the sex ratio at birth. Ransom et al (2016) summarized information about sex ratio at birth across all wild equid species, in a meta-analysis of demographic studies that were available up to that time. Across all wild equid species, Ransom et al. (2016) documented a sex ratio at birth that was slightly skewed toward males on average, with 1.1 male foal born for every 1 female foal. However, the 95% confidence interval for that ratio across wild equid populations was from 0.93:1 to 1.29:1. The actual value of sex ratio at birth can vary from herd to herd and over time, and appears to be influenced by environmental conditions. Ransom et al. (2016) cited studies indicating that female equids tend to give birth to female foals at higher rates when they are living in conditions with inadequate natural resources, when they are in relatively poorer body condition (Cameron et al. 1999), or when they give birth for the first time at very young ages.

When free-roaming mares were experiencing improving body condition, they tended to give birth to male foals at high rates (Cameron and Linklater 2007), consistent with predictions of the Trivers-Willard hypothesis that mares in better condition will tend to invest more effort into the sex with higher variance in reproductive success.

The following is not an exhaustive review of all available studies that document adult sex ratio in wild or free-roaming horses, but a conclusion that can be drawn from across many studies is that there is a range of observed sex ratios; there is no single typical sex ratio typical in either unmanaged or managed herds. In a comprehensive 1973-1987 study of 74 management areas that did not have any fertility control applications, Garrott (1991) documented that over half had male to female ratios that were very close to 50:50 (not statistically different from equal numbers of males and females). Among the others, many herds did have more females than males. Over 84% of those areas had male to female parity in horses under 1 year old (Garrott 1991). Survival of foals appears to be, on average, equal between male and female foals. In herds without fertility control, Garrott (1991) concluded that young adult male horses had lower survival than young female horses, but that older adult male horses had higher survival than older adult female horses.

The realized overall sex ratio in any given wild horse or burro herd will also be influenced by age-specific and sex-specific survival rates. Mare fertility control application in wild horses increases adult mare survival (Turner and Kirkpatrick 2002, Ransom et al. 2014a). This is expected cause an increase in adult females over time in a herd that has been treated with mare fertility control. During 1993-2007, wild horses in the Pryor Mountains were studied intensively; during that time adult sex ratio varied in the range from 44% to 55% male. The contemporary Pryor Mountain herd sex ratio is an example of where long use of fertility control vaccine has likely affected the sex ratio, which is ~57% female. However, this is largely driven by high mare longevity in the 20+ year-old age class (20 mares vs. only 2 studs), that is most likely caused by those mares having relatively few foals. Discounting that age class, the sex ratio at Pryor Mountains herd is ~52% female (BLM 2023). Before helicopter gathers or fertility control treatments began at Sheldon national wildlife refuge, the sex ratio of adults (3 years old or older) was 55% male (424 stallions to 353 mares; Collins and Kasbahm 2016). On an Atlantic barrier island in Georgia, Goodloe et al (2000) documented overall adult sex ratio that was 62% male. On Sable Island (Canada) where resources are limited and there is relatively high post-natal mare mortality, sex ratios have been over 60% male (Regan et al. 2020).

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

Having a larger number of males than females is expected to lead to several demographic and behavioral changes as noted in the NAS report (2013), including the following. Having more fertile males than females should not alter the fecundity of individual fertile females. Wild mares may be distributed in a larger number of smaller harems (as documented by Regan et al 2020). Singer and Schoeneker (2000) found that increases in the number of males on Pryor Mountain Wild Horse Range herd management area lowered the breeding male age but did not alter the birth rate among females. If females are distributed among a larger number of smaller harems, it is expected that genetic effective population size (Ne) should increase relative to a herd of the same number of mares, but with 50:50 sex ratio. Competition and aggression between males may cause a decline in male body condition. Female foraging may be somewhat disrupted by elevated male-male aggression. With a greater number of males available to choose from, females may have opportunities to select more genetically fit sires. There would also be an increase the genetic effective population size because more stallions would be breeding and existing females would be distributed among many more small harems. This last beneficial impact is one reason that skewing the sex ratio to favor males is listed in the BLM wild horse and burro handbook (BLM 2010) as a method to consider in herds where there may be concern about the loss of genetic diversity; having more males fosters a greater retention of genetic diversity.

Changes in which stallions mate with mares are a natural part of the wild horse behavioral repertoire. Berger (1983) reported forced copulations after band stallion changes, but these were not related to sex ratio per se, considering that the sex ratio in the populations he studied were approximately 43% male (Grange et al 2009). Kirkpatrick and Turner (1991) looked for but did not find any forced copulation or induced abortions after stallion changes in wild horse bands. Infanticide is a natural behavior that has been observed in wild equids (Feh and Munkhtuya 2008, Gray 2009), but there are no published accounts of infanticide rates increasing as a result of having a skewed sex ratio in wild horse or wild burro herds. Any comment that implies such an impact would be speculative.

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

- In the 2015 Cold Springs HMA Population Management Plan EA (DOI-BLM-V040-2015-022), the low end of AML was 75. Under the preferred alternative, 37 mares and 38 stallions would remain on the HMA. This is well below the 150 head threshold noted above.
- In the 2017 Hog Creek HMA Population Management Plan EA (DOI-BLM-ORWA-V000-2017-0026-EA), BLM clearly identified that maintaining a 50:50 sex ratio was appropriate because the herd size at the low end of AML was only 30 animals.

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

Literature Cited; Fertility Control Vaccines

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.
Baker, D.L., B.E. McCann, J.G. Powers, N.L. Galloway, J.E. Bruemmer, M.A. Thompson, and T.M. Nett. 2023. Reimmunization intervals for application of GnRH immunocontraceptive vaccine (GonaCon-Equine) in free-roaming horses (*Equus ferus caballus*) using syringe darts. Theriogenology Wild (3): 100061.
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.
Bechert, U.S., J.W. Turner Jr, D.L. Baker, D.C. Eckery, J.E. Bruemmer, C.C. Lyman, T.M. Prado, S.R. King, and M.A. Fraker. 2022. Fertility control options for management of free-roaming horse populations. Human–Wildlife Interactions 16:5.
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.
Bruemmer, J.E., D.C. Eckery, M. Eisenfelder, and C. Mundell. 2023. Non-surgical sterilization of mares allowing continued reproductive behavior: a preliminary study. Journal of Equine Veterinary Science 124:10440.
Burden, F. and A. Thiemann. 2015. Donkeys are different. Journal of Equine Veterinary Science 35:376-382.
Bureau of Land Management (BLM). 2010. BLM-4700-1 Wild Horses and Burros Management Handbook. Washington, D.C.
Bureau of Land Management (BLM). 2021a. Permanent Instruction Memorandum 2021-002; Wild horse and burro comprehensive animal welfare program. Washington, D.C.
Bureau of Land Management (BLM). 2021b. BLM Wild Horse and Burro Program 2021 Strategic Research Plan. Washington, D.C.
Bureau of Land Management (BLM). 2022. WHB program research update. Presentation to the WHB

Advisory Board, September 2022, Phoenix, Arizona. www.blm.gov/sites/default/files/docs/2022-09/BLM%20WHB%20Research%20presentation_Advis%20Bd_Oct2022_508_v3.pdf
Bureau of Land Management (BLM). 2023. Pryor Mountain Wild Horse Range (PMWHR) Joint Herd Management Area Plan (JHMAP) revision, wild horse gather plan and proposed RMP Plan amendment (MD WH-7). DOI-BLM-MT-C010-2020-004-EA.
Carey, K.A., A. Ortiz, K. Grams, D. Elkins, J.W. Turner, and A.T. Rutberg. 2019. Efficacy of dart-delivered PZP-22 immunocontraceptive vaccine in wild horses (*Equus caballus*) in baited traps in New Mexico, USA. 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.
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.
Cothran, E.G., A. Khanshour, S. Funk, E. Conant, R. Juras, and B.W. Davis. 2024. Genetic dynamics of Mustang and Feral Horse Populations in the Western United States. BioRxiv doi.org/10.1101/2024.01.28.577652.
Creel, S., B. Dantzer, W. Goymann, and D.R. Rubenstein. 2013. The ecology of stress: effects of the social environment. Functional Ecology 27:66-80.
Curtis, P.D., R.L. Pooler, M.E. Richmond, L.A. Miller, G.F. Mattfeld, and F.W Quimby. 2002. 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.
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.
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.

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.

Folt, B.P., L.S. Ekernas, D.R. Edmunds, M.T. Hannon, and K.S. Schoenecker. 2023a. PopEquus: A Predictive Modeling Tool to Support Management Decisions for Free-roaming Horse Populations, Version 1.0.1. USGS Software Release. USGS Fort Collins Science Center, Fort Collins, Colorado. DOI: 10.5066/P9NMRQDG

Folt, B., K.A. Schoenecker, L.S. Ekernas, D.R. Edmunds, and M. Hannon. 2023b. PopEquus: A predictive modeling tool to support management decisions for free-roaming horse populations. Ecosphere, 14(9), e4632.

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.

French, H., E. Peterson, M. Shulman, R. Roth, M. Crampton, A. Conan, S. March, D. Knobel, H. Bertschinger. 2020. Efficacy and safety of native and recombinant zona pellucida immunocontraceptive vaccines in donkeys. Theriogenology 153:27-33.

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.

Grams, K., A. Rutberg, and J.W. Turner. 2022. Reduction in growth rates of wild horse populations treated with the controlled-release immunocontraceptive PZP-22 in the western United States. Wildlife Research doi:10.1071/WR21101

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., 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.

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., R. Stump, D. Burger, and R. Thun. 2009. Suppression of testicular function and sexual behavior by vaccination against GnRH (Equity™) in the adult stallion. Animal Reproduction Science 115:88-102.
Jaworska, J., Z. Jaworski, S.M. McDonnell, A. Górecka-Bruzda. 2020. Harem stallion changes are not associated with diminished reproductive performance of females in semi-feral Konik polski horses (*Equus caballus*). Theriogenology 151:1-6.
Jones, M.M., and C.M.V. Nuñez. 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. Nuñez. 2020. Rising up to the challenge of their rivals: mare infidelity intensifies stallion response to playback of aggressive conspecific vocalizations. Applied Animal Behaviour Science 2020:104949.
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.
Kahler, G.V., and S.L. Boyles-Griffin. 2022. Field approaches to wild burro (*Equus asinus*) identification and remote-delivery of ZonaStat-H in an American western landscape. 9th International Conference on Wildlife Fertility Control, Colorado Springs, Colorado. https://wildlifefertilitycontrol.org/wp-content/uploads/2022/05/ICWFC-2022-Program-Book.pdf
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.
Kerekes, V., I. Sándor, D. Nagy, K. Ozogány, L. Göczi, B. Ibler, L. Széles, and Z. Barta. 2021. Trends in demography, genetics, and social structure of Przewalski's horses in the Hortobagy National Park, Hungary over the last 22 years. Global Ecology and Conservation. 25:e01407.
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.
King, S.R., and K.A. Schoenecker. 2022. Application of tail transmitters for tracking feral horses as an alternative to radio collars. Wildlife Society Bulletin 46(4):e1338
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.
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.
McCann, B., J. Powers, A. Denicola, B. Soars, M. Thompson. 2017. Delivery of GonaCon-Equine to feral horses (*Equus caballus*) using prototype syringe darts. Spoken presentation at the 8th International Conference on Wildlife Fertility Control, Washington, D.C.

McDonnell, S.M. 2012. Mare and foal behavior. American Association of Equine Practitioners Proceedings 58:407-410.
Miller, L.A., B.E. Johns, and G.J. Killian. 2000. Immunocontraception of White-Tailed Deer with GnRH Vaccine. American Journal of Reproductive Immunology 44:266-274.
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 (NRC). 2013. Using science to improve the BLM wild horse and burro program: a way forward. National Academies Press. Washington, DC.
Nettles, V. F. 1997. Potential consequences and problems with wildlife contraceptives. Reproduction, Fertility and Development 9, 137–143.
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.
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 44:174-181.
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.
Schoenecker, K.A., S.R.B. King, and G.H. Collins. 2020. Evaluation of the impacts of radio-marking devices on feral horses and burros in a captive setting. Human-Wildlife Interactions 14:73-86.
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.
Schulman, M.L., N.K. Hayes, T.A. Wilson, and J.D. Grewar. 2024. Immunocontraceptive efficacy of native porcine zona pellucida (pZP) treatment of Nevada’s Virginia range free-roaming horse population . Vaccines 12:96.
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.
Singer, F.J., and K.A. Schoenecker. 2000. Managers' summary - ecological studies of the Pryor Mountain wild horse range, 1992-1997. U.S. Geological Survey, Midcontinent Ecological Science Center, Fort Collins, Colorado. 131 pp.
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.
Thompson, M.A., B.E. McCann, R.B. Simmons, and T. Rhen. 2022. Major locus on ECA18 influences effectiveness of GonaCon vaccine in feral horses. Journal of Reproductive Immunology 155:103779.
Turini, L., F. Bonelli, I. Nocera, V. Meucci, G. Conte, and M. Sgorbini. 2021. Evaluation of different methods to estimate the transfer of immunity in donkey foals fed with colostrum of good IgG quality: a preliminary study. Animals 2021(11):507. doi.org/10.3390/ani11020507
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, and T. Hall. 2022. Use of GonaCon in wildlife management. Chapter XI 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
Zimmerman, S.J., J.A. Fike, and S. Oyler-McCance. 2023. Simulation of genetic change under four removal strategies for a wild horse population. Appendix N in BLM environmental analysis DOI-BLM-MT-C010-2020-0004-EA. https://pubs.er.usgs.gov/publication/70241960
Zoo Montana. 2000. Wildlife Fertility Control: Fact and Fancy. Zoo Montana Science and Conservation Biology Program, Billings, Montana.

Literature Cited; Sex Ratio Manipulation

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.
Berger, J. 1983. Induced abortion and social factors in wild horses. Nature 303:59-61.
Bureau of Land Management (BLM). 2010. BLM-4700-1 Wild Horses and Burros Management Handbook. Washington, D.C.
Bureau of Land Management (BLM). 2023. Pryor Mountain Wild Horse Range (PMWHR) joint herd management area plan (JHMAP) revision wild horse gather plan and proposed RMP plan amendment (MD WH-7). Preliminary environmental assessment DOI-BLM-MT-C010-2020-004-EA. Billings Field Office, Montana.
Cameron, E.Z., W.L. Linklater, K.J. Stafford, and C.J. Veltman. 1999. Birth sex ratios relate to mare condition at conception in Kaimanawa horses. Behavioral Ecology 10: 472-475.
Cameron, E.Z., and W.L. Linklater. 2007. Extreme sex ratio variation in relation to change in condition around conception. Biology letters 3: 395-397.
Collins, G.H., and J.W. Kasbahm. 2016. Population Dynamics and Fertility Control ofFeral Horses. Journal of Wildlife Management 81:289-296.
Feh, C., and B. Munkhtuya. 2008. Male infanticide and paternity analyses in a socially natural herd of Przewalski's horses: Sexual selection? Behavioral Processes 78:335-339.
Garrott, R.A. 1991. Sex ratios and differential survival of feral horses. Journal of Animal Ecology 60:929-937.
Goodloe, R.B., R.J. Warren, D.A. Osborn, and C. Hall. 2000. Population characteristics of feral horses on Cumberland Island, Georgia and their management implications. Journal of Wildlife Management 64:114-121.
Grange, S., P. Duncan, and J-M Gaillard. 2009. Poor horse traders: large mammals trade survival for reproduction during the process of feralization. Proceedings of the Royal Society B 276:1911-1919.
Gray, M.E. 2009. An infanticide attempt by a free-roaming feral stallion (*Equus caballus*). Biology Letters 5:23-25.
Kirkpatrick, J.F. and J.W. Turner. 1991. Compensatory reproduction in feral horses. Journal of Wildlife Management 55:649-652.
National Research Council of the National Academies of Sciences (NRC). 2013. Using science to improve the BLM wild horse and burro program: a way forward. National Academies Press. Washington, DC.
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., 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.
Regan, C.E., S.A. Medill, J. Poissant, and P.D. McLoughlin. 2020. Causes and consequences of an unusually male-biased adult sex ratio in an unmanaged feral horse population. Journal of Animal Ecology 89:2909-2921.
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.

Effects of Female Sterilization and Male Neutering

Various forms of fertility control can be used in wild horses and wild burros, with the goals of maintaining herds at or near AML, reducing fertility rates, and reducing the frequency of gathers and removals. The WFRHBA of 1971 specifically provides for contraception and sterilization (16 U.S.C. 1333 section 3.b.1). Fertility control measures have been shown to be a cost-effective and humane treatment to slow increases in wild horse populations or, when used in combination with gathers, to reduce horse population size (Bartholow 2004, de Seve and Boyles-Griffin 2013, Fonner and Bohara 2017). Population growth suppression becomes less expensive if fertility control is long-lasting (Hobbs et al. 2000), such as with sterilization methods. Even though physical female sterilization methods are not part of any action alternative for the Pancake Complex, those effects are included in this review for comparative purposes. Sterilizing a female horse (mare) or burro (jenny) can be accomplished by several methods, some of which are minimally invasive, and others of which are surgical. In this review, 'spaying' is defined to be surgical sterilization, usually accomplished by removal of the ovaries, but other surgical methods such as tubal ligation that lead to sterility may also be considered by some to be a form of spaying. Minimally invasive, physical forms of sterilization, such as trans-cervical methods that occlude the oviduct, are not labeled as spaying in this review, but may have similar physiological outcomes as surgical methods that leave the ovaries intact. In this review, 'neutering' is defined to be the sterilization of a male horse (stallion) or burro (jack), either by removal of the testicles (castration, also known as gelding) or by vasectomy, where the testicles are retained but no sperm leave the body by severing or blocking the vas deferens or epididymis.

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

Peer-reviewed scientific literature details the expected impacts of sterilization methods on wild horses and burros. No finding of excess animals is required for BLM to pursue sterilization in wild horses or wild burros, but NEPA analysis has been required. This review focuses on peer-reviewed scientific literature. The summary that follows first examines effects of female sterilization, then neuter use in males. This review does not examine effects of fertility control vaccines. Cited studies are generally limited to those involving horses and burros, except where including studies on other species helps in making inferences about physiological or behavioral questions not exhaustively addressed in horses or burros specifically. While there are notable differences between the species in their anatomy, diet, behaviors and metabolism (Burden and Thiemann 2015), the essential endocrine controls of the hypothalamic-pituitary-gonadal axis and the function of the zona pellucida in fertility are the same. While most studies reviewed are based on results from horses, burros are similar enough in their reproductive physiology and immunology (i.e., Turini et al. 2021) that expected effects of immunocontraception are comparable.

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

Discussions about herds that include some ‘non-reproducing’ individuals, or even those that are entirely non-reproducing, should be considered in the context of this ‘metapopulation’ structure, where the ‘self-sustaining’ nature of herds is not necessarily to be measured at the scale of single HMAs. So long as the definition of what constitutes a self-sustaining herd includes the larger set of HMAs that have past or ongoing demographic and genetic connections – as is recommended by the NRC 2013 report – it is clear that particular HMAs can be managed as non-reproducing in whole or in part while still allowing for a self-sustaining population of wild horses or burros at the broader spatial scale. Wild horses are not an endangered species (USFWS 2015), nor are they rare. Over 64,000 adult wild horses and over 17,000 adult wild burros roamed BLM lands as of March 1, 2022, and those numbers do not include at least 9,000 WHB on US Forest Service lands, nor at least 100,000 feral horses on tribal lands in the Western United States (Schoenecker et al. 2021).

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

Effects of handling and marking
Sterilization techniques, while not reversible, may control horse reproduction without the kind of additional handling or darting that can be needed to administer contraceptive vaccines. In this sense, sterilization can be used to achieve herd management objectives with a relative minimum level of animal handling and management over the long term. The WFRHBA (as amended) indicates that management should be at the minimum level necessary to achieve management objectives (CFR 4710.4), and if sterilizing mares or neutering some stallions can lead to a reduced number of handling occasions and removals of excess horses from the range, then that is consistent with legal guidelines. Other fertility control options that may be temporarily effective on male horses, such as the injection of GonaCon-Equine immunocontraceptive vaccine, apparently require multiple handling occasions to achieve longer-term male infertility. Similarly, some formulations of PZP immunocontraception that is currently available for use in female wild horses and burros require handling or darting every year (though longer-term effects may result after 4 or more treatments; Nuñez et al. 2017). By some measures, any management activities that require multiple capture operations to treat a given individual could be seen as more intrusive for wild horses and potentially less sustainable than an activity that requires only one handling occasion.

It is prudent for sterilized animals to be readily identifiable, either via freeze brand marks or unique coloration, and uniquely numbered RFID chips inserted in the nuchal ligament, so that their treatment history is easily recognized (e.g., BLM 2010). Markings may also be useful into the future to determine the approximate fraction of geldings in a herd, and could provide additional insights about gather efficiency. BLM has instituted capture and animal welfare program guidelines to reduce the sources of handling stress in captured animals (BLM 2021). Handling may include freeze-marking, for the purpose of identifying an individual. Some level of transient stress is likely to result in newly captured horses that are not previously marked. Under past management practices, captured horses experienced increased, transient stress levels from handling (Ashley and Holcombe 2001). It is difficult to compare that level of temporary stress with long-term stress that can result from food and water limitation on the range (e.g., Creel et al. 2013), which could occur in the absence of herd management.

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

Observations of the long term outcomes of sterilization may be recorded during routine resource monitoring work. Such observations could include but not be limited to band size, social interactions with other geldings and harem bands, distribution within their habitat, forage utilization and activities around key water sources. Periodic population inventories and future gather statistics could provide additional anecdotal information.

Neutering Males

Whether or not stallion sterilization methods are considered in any of the action alternatives in this EA, they are included here for comparison and for the sake of completeness in the review. Castration (the surgical removal of the testicles, also called gelding or neutering) is a surgical procedure for the horse sterilization that has been used for millennia. Vasectomy involves severing or blocking the vas deferens or epididymis, to prevent sperm from being ejaculated. The procedures are fairly straight forward, and has a relatively low complication rate. As noted in the review of scientific literature that follows, the expected effects of gelding and vasectomy are well understood overall, even though there is some degree of uncertainty about the exact quantitative outcomes for any given individual (as is true for any natural system).

Including a portion of neutered males in a herd can lead to a reduced population-level per-capita growth rate if they cause a marginal decrease in female fertility or if the neutered males take some of the places that would otherwise be occupied by fertile females. By having a skewed sex ratio with fewer females than males (fertile stallions plus neutered males), the result will be that there will be a lower number of breeding females in the population. Including neutered males in herd management is not new for BLM and federal land management. Geldings have been released on BLM lands as a part of herd management in the Barren Valley complex in Oregon (BLM 2011), the Challis HMA in Idaho (BLM 2012), and the Conger HMA in Utah (BLM 2016). Vasectomized males and geldings were also included in US Fish and Wildlife Service management plans for the Sheldon National Wildlife Refuge that relied on sterilization and removals (Collins and Kasbohm 2016). Taking into consideration the literature available at the time, the National Academies of Sciences concluded in their 2013 report that a form of vasectomy was one of the three most promising methods for WH&B fertility control (NRC 2013). However, BLM is not pursuing the chemical vasectomy method. The NAS panel noted that, even though chemical vasectomy had been used in dogs and cats up to that time, "There are no published reports on chemical vasectomy in horses..." and that, "Only surgical vasectomy has been studied in horses, so side effects of the chemical agent are unknown." The only known use of chemical vasectomy in horses was published by Scully et al. (2015); this was part of a study cited in the EA (Collins and Kasbohm 2016). They injected chlorhexidine into the stallions' epididymis. That is the same chemical agent as had been used to chemically vasectomize dogs. Scully et al. (2015) found that the chemical vasectomy method failed to prevent fertile sperm from being located in the vas deferens seminal fluid. Stallions treated with the chemical vasectomy method still had viable sperm and were still potentially as fertile as untreated 'control' stallions in that study. Thus, the method did was not effective.

Nelson (1980) and Garrott and Siniff (1992) modeled potential efficacy of male-oriented contraception as a population management tool, and both studies agreed that while slowing growth, sterilizing only dominant males (i.e., harem-holding stallions) would result in only marginal reduction in female fertility rates. Eagle et al. (1993) and Asa (1999) tested this hypothesis on HMAs where dominant males were vasectomized. Their findings agreed with modeling results from previous studies, and they also concluded that sterilizing only dominant males would not provide the desired reduction in female fertility and overall population growth rate, assuming that the numbers of fertile females is not changed. While bands with vasectomized harem stallions tended to have fewer foals, breeding by bachelors and subordinate stallions meant that population growth still occurred – female fertility was not dramatically reduced. Collins and Kasbohm (2016) demonstrated that there was a reduced fertility rate in a feral horse herd with both spayed and vasectomized horses – some geldings were also present in that herd. Statistically significant reductions in mare fertility rates were only observed in the first year after geldings were introduced to a herd in Utah (King et al. 2022). Garrott and Siniff (1992) concluded from their modeling that male sterilization would effectively cause there to be zero population growth (the point where births roughly equal deaths) only if a large proportion of males (i.e., >85%) could be sterilized. In cases where the goal of harem stallion sterilization is to reduce population growth rates, success appears to be dependent on a stable group structure, as strong bonds between a stallion and mares reduce the probability of a mare mating an extra-group stallion (Nelson 1980, Garrott and Siniff 1992, Eagle et al. 1993, Asa 1999). At Conger HMA a fraction of geldings that were returned to the range with their social band did continue to live with females, apparently excluding fertile stallions, for at least 2 years (King et al. 2022).

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

Direct Effects of Neutering

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

Though neutering males is a common surgical procedure, especially gelding, some level of minor complications after surgery may be expected (Getman 2009), and it is not always possible to predict when postoperative complications would occur. Fortunately, the most common complications are almost always self-limiting, resolving with time and exercise. Individual impacts to the stallions during and following the gelding process should be minimal and would mostly involve localized swelling and bleeding. Complications may include, but are not limited to: minor bleeding, swelling, inflammation, edema, infection, peritonitis, hydrocele, penile damage, excessive hemorrhage, and eventration (Schumacher 1996, Searle et al. 1999, Getman 2009). A small amount of bleeding is normal and generally subsides quickly, within 2-4 hours following the procedure. Some degree of swelling is normal, including swelling of the prepuce and scrotum, usually peaking between 3-6 days after surgery (Searle et al. 1999). Swelling should be minimized through the daily movements (exercise) of the horse during travel to and from foraging and watering areas. Most cases of minor swelling should be back to normal within 5-7 days, more serious cases of moderate to severe swelling are also self-limiting and are expected to resolve with exercise after one to 2 weeks. Older horses are reported to be at greater risk of post-operative edema, but daily exercise can prevent premature closure of the incision, and prevent fluid buildup (Getman 2009). In some cases, a hydrocele (accumulation of sterile fluid) may develop over months or years (Searle et al. 1999). Serious complications (eventration, anesthetic reaction, injuries during handling, etc.) that result in euthanasia or mortality during and following surgery are rare (e.g., eventration rate of 0.2% to 2.6% noted in Getman 2009, but eventration rate of 4.8% noted in Shoemaker et al. 2004) and vary according to the population of horses being treated (Getman 2009). Normally one would expect serious complications in less than 5% of horses operated under general anesthesia, but in some populations these rates have been as high as 12% (Shoemaker 2004). Serious complications are generally noted within 3 or 4 hours of surgery but may occur any time within the first week following surgery (Searle et al. 1999). If they occur, they would be treated with surgical intervention when possible, or with euthanasia when there is a poor prognosis for recovery. There was no observed mortality in geldings at the Conger HMA study, and geldings retained good body condition (King et al. 2022). Vasectomized stallions may remain fertile for up to 6 weeks after surgery, so it is optimal if that treatment occurs well in advance of the season of mare fertility starting in the spring (NRC 2013). The NAS report (2013) suggested that chemical vasectomy, which has been developed for dogs and cats, may be appropriate for wild horses and burros.

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

Indirect Effects of Neutering

Other than the short-term outcomes of surgery, neutering is not expected to reduce males' survival rates. Castration is actually thought to increase survival as males are released from the cost of reproduction (Jewell 1997). In Soay sheep castrates survived longer than rams in the same cohort (Jewell 1997), and Misaki horse geldings lived longer than intact males (Kaseda et al. 1997, Khalil and Murakami 1999). Moreover, it is unlikely that a reduced testosterone level will compromise gelding survival in the wild, considering that wild mares survive with low levels of testosterone. Consistent with geldings not expending as much energy toward in attempts to obtain or defend a harem, it is expected that wild geldings may have a better body condition that wild, fertile stallions. King et al. (2022) noted that geldings maintained good body condition in the wild. In contrast, vasectomized males may continue to defend or compete for harems in the way that fertile males do, so they are not expected to experience an increase in health or body condition due to surgery.

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

Behavioral Effects of Neutering

Feral horses typically form bands composed of an adult male with 1 to 3 adult females and their immature offspring (Feist and McCullough 1976, Berger 1986, Roelle et al. 2010). In many populations subordinate 'satellite' stallions have been observed associating with the band, although the function of these males continues to be debated (see Feh 1999, and Linklater and Cameron 2000). Juvenile offspring of both sexes leave the band at sexual maturity (normally around two or three years of age (Berger 1986), but adult females may remain with the same band over a span of years. Group stability and cohesion is maintained through positive social interactions and agonistic behaviors among all members, and herding and reproductive behaviors from the stallion (Ransom and Cade 2009). Group movements and consortship of a stallion with mares is advertised to other males through the group stallion marking dung piles as they are encountered, and over-marking mare eliminations as they occur (King and Gurnell 2006). Burro jacks tend to not have as stable of relations with jennies and foals, as compared to what is most often seen in horses; wild burro social structure is more typically of a fission-fusion type nature (King et al. 2016).

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

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

Neutering males by gelding adult male horses is expected to result in reduced testosterone production, which is expected to directly influence reproductive behaviors (NRC 2013). However, testosterone levels alone are not a predictor of masculine behavior (Line et al. 1985, Schumacher 2006). In domestic geldings, 20-30% continued to show stallion-like behavior, whether castrated pre- or post-puberty (Line et al. 1985). Gelding of domestic horses most commonly takes place before or shortly after sexual maturity, and age-at-gelding can affect the degree to which stallion-like behavior is expressed later in life. In intact stallions, testosterone levels peak increase up to an age of ~4-6 years, and can be higher in harem stallions than bachelors (Khalil et al 1998). It is assumed that free roaming wild horse geldings would generally exhibit reduced aggression toward other horses, and reduced reproductive behaviors (NRC 2013). In a herd that included some geldings and some fertile stallions, there were few behavioral differences between those groups, other than that geldings engaged in more affiliative and less marking and reproductive behaviors (King et al. 2022). The behavior of wild horse geldings in the presence of intact stallions has not otherwise been well documented, but the literature review below can be used to make reasonable inferences about their likely behaviors.

Despite livestock being managed by neutering males for millennia, there was relatively little published research on castrates' behaviors (Hart and Jones 1975) until recently. Stallion behaviors in wild or pasture settings are better documented than gelding behaviors, but it inferences about how the behaviors of geldings will change, how quickly any change will occur after surgery, or what effect gelding an adult stallion and releasing him back in to a wild horse population will have on his behavior and that of the wider population may be surmised from the existing literature. There was a BLM-supported study in Utah focused on the individual and population-level effects of including some geldings in a free-roaming horse population (BLM 2016, King et al. 2022). Additional inferences about likely behavioral outcomes of gelding can be made based on available literature.

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

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

The likely effects of castration on geldings' social interactions and group membership can be inferred from available literature. In a pasture study of domestic horses, Van Dierendonk et al. (1995) found that social rank among geldings was directly correlated to the age at which the horse was castrated, suggesting that social experiences prior to sterilization may influence behavior afterward. Of the two geldings present in a study of semi-feral horses in England, one was dominant over the mares whereas a younger gelding was subordinate to older mares; stallions were only present in this population during a short breeding season (Tyler 1972). A study of domestic geldings in Iceland held in a large pasture with mares and sub-adults of both sexes, but no mature stallions, found that geldings and sub-adults formed associations amongst each other that included interactions such as allo-grooming and play, and were defined by close proximity (Sigurjónsdóttir et al. 2003). These geldings and sub-adults tended to remain in a separate group from mares with foals, similar to castrated Soay sheep rams (Ovis aries) behaving like bachelors and grouping together, or remaining in their mother's group (Jewell 1997). In Japan, Kaseda et al. (1997) reported that young males dispersing from their natal harem and geldings moved to a different area than stallions and mares during the non-breeding season. Although the situation in Japan may be the equivalent of a bachelor group in natural populations, in Iceland this division between mares and the rest of the horses in the herd contradicts the dynamics typically observed in a population containing mature stallions. Sigurjónsdóttir et al. (2003) also noted that in the absence of a stallion, allo-grooming between adult females increased drastically. Other findings included increased social interaction among yearlings, display of stallion-like behaviors such as mounting by the adult females, and decreased association between females and their yearling offspring (Sigurjónsdóttir et al. 2003). In the same population in Iceland the presence of geldings did not appear to affect the social behavior of mares (Van Dierendonck et al. 2009) or negatively influence parturition, mare-foal bonding, or subsequent maternal activities (Van Dierendonck et al. 2004). Additionally, the welfare of broodmares and their foals was not affected by the presence of geldings in the herd (Van Dierendonck et al. 2004). These findings are important because treated geldings will be returned to the range in the presence of pregnant mares and mares with foals of the year.

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

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

Mare Sterilization

Sterilizing mares has already been shown to be an effective part of feral horse management that reduced herd growth rates on federal lands (Collins and Kasbohm 2016). Herd-level birth rate is expected to decline in direct proportion to the fraction of spayed mares in a herd because spayed mares cannot become pregnant. A number of methods are available, with potentially differing effects.

Current Methods of Sterilization
This literature review of mare sterilization impacts focuses on 4 methods: pharmacological or immunocontraceptive methods, minimally invasive physical sterilization, ovariectomy via colpotomy, and ovariectomy via flank laparoscopy. The range of anticipated effects may be both physical and behavioral. Whether or not surgical mare sterilization methods are considered in any of the action alternatives in this EA, they are included here for comparison and for the sake of completeness in the review.

Pharmacological or immunocontraceptive sterilization methods would use a drug or vaccine to cause sterilization. BLM has not yet identified a pharmacological or immunocontraceptive method to sterilize mares that has been proven to reliably and humanely sterilize wild horse mares. However, there is the possibility that current or future development and testing of new methods could make an injectable sterilant available for wild horse mares. An oocyte growth factor OGF vaccine is currently under testing, for its ability to cause long-term infertility or, potentially, sterility (BLM 2020, Bruemmer et al. 2023). Mares that received 5 or more doses of ZonaStat-H vaccine have been shown to have reduced ovarian function, and to be effectively infertile for life (Nuñez et al. 2017), and it is conceivable that the contraceptive effects of repeated treatment with GonaCon-Equine may last longer than a mare's lifespan, depending on the mare's age at treatment and the number of doses received (Baker et al. 2018, 2023). While the physiological effects of various potential methods may differ, the herd-level effects of having sterile mares as a part of a wild horse herd would be expected to be similar for minimally invasive and surgical methods. Salient differences in individual breeding behavior that result from either retaining functioning ovaries, or having no or reduce ovarian function, are discussed below.

Minimally Invasive Mare Sterilization Procedures
Population growth suppression becomes less expensive if fertility control is long-lasting (Hobbs et al. 2000), such as with spaying and neutering. For the purposes of this EA, 'minimally invasive sterilization' is defined to be the minimally invasive sterilization of a female horse (mare) by physical means. The physical means considered here include forms of oviduct blockage; for the purposes of this analysis, these are considered minimally invasive insofar as no incisions are required. Unlike in dog and cat spaying, these minimally invasive forms of mare sterilization do not entail removal of the ovaries or uterus. Only healthy mares in BCS score of 3 or greater would be considered.

The specific minimally invasive sterilization procedures could include any form of procedure that leads a mare to be unable to become pregnant, or to maintain a pregnancy, but that does not entail incision by scalpel. The two transcervical procedures analyzed below are physical, minimally invasive sterilization methods that cause long-term blockage of the oviduct, so that fertile eggs cannot go from the ovaries to the uterus. A detailed analysis of those methods and their expected effects is included in Appendix D.

As is the case for IUDs, candidate mares for minimally-invasive sterilization procedure treatment would need to be screened by a veterinarian to ensure they are not pregnant, because any transcervical procedures can cause a pregnancy to terminate. If palpation or ultrasound indicate that the mare is pregnant, then that mare would not be considered for the minimally invasive sterilization procedure.

One form of minimally invasive oviduct blockage procedure, "endoscopic oviduct ablation," infuses medical-grade N-butyl cyanoacrylate glue into the oviduct (Bigolin et al. 2009). In the procedure, the veterinarian passes an endoscope through the cervix, to visualize the interior of the uterus. Treated mares would stand in a padded, hydraulic chute. Banamine may be administered intravenously prior to the procedure to minimize transient colic (abdominal cramping) following the procedure. Ketamine may be added on an as needed basis for additional standing chemical restraint. Fecal material is removed from the rectum, the tail is wrapped and suspended, the perineal and vaginal areas are cleansed. A sterilized, flexible endoscope would be placed into the vaginal vault and advanced through the cervix in an atraumatic manner. A veterinary team is required to manipulate and operate the endoscope monitor, insert and hold the endoscope, manipulate and position the fine-tipped catheter into the oviduct, and infuse the fluid into the oviduct. The uterus would be partially inflated with filtered room air to visualize the oviduct papilla located at the proximal end of the uterine horn. A sterile catheter is guided to each uterotubal junction (which is the entrance to the oviduct), and medical-grade glue (N-butyl cyanoacrylate) is introduced to the oviduct, where it causes blockage. After the procedure, the uterus could be infused with an antibiotic and saline to minimize the potential for infection secondary to any unintended bacterial contamination. The mares are monitored initially for 10 minutes, and observed by a veterinarian twice per day for 10-14 days, but no further pain management is expected to be needed. Any mare showing signs of postoperative complications would receive treatment as indicated by a veterinarian. The total duration of the procedure per mare is expected to be less than 30 minutes. After receiving support from the California legislature (California Legislature 2019), researchers at the UC Davis School of Veterinary Medicine used a similar method in burros, but with electrocauterization of the utero-tubular junction. A five-person team completed the procedure in 20-30 minutes total time which included a short wait for onset of light anesthesia and 5-6 minutes use of the endoscope to guide an elecotrocautery device to the uterotubal junction and apply enough heat to cause scarring.

Another form of minimally invasive oviduct blockage procedure, "endoscopic laser ablation of the oviduct papilla," is similar to the procedure described above, except that the oviducts are blocked via heating from a laser to ablate the oviduct papilla. The diode laser is expected to immediately "seal" the oviduct opening and the resulting inflammatory reaction is expected to result in additional scar tissue formation, forming a barrier to the passage of eggs from the ovary to the uterus. Local anesthesia could be dripped directly onto each oviduct papilla to minimize any discomfort. This method has been used successfully in Georgia (Edwards et al. 2021).

Neither of these minimally invasive procedures damages the ovaries. The mare would be sterile, although the mare would continue to have estrus cycles. Because of the retention of estrus cycles, it is expected that behavioral outcomes of either method would be similar to those observed for PZP vaccine treated mares. Namely, mares would continue with hormonal cycles and associated breeding behaviors during the typical breeding season.

If the minimally invasive sterilization techniques are either of the two noted above, then mares chosen for the minimally invasive sterilization procedure could include adult females and immature females estimated to be older than 8 months. Immature females could be included because there are no concerns regarding space for instruments, as an endoscope and associated instruments used along with the endoscope are the only tools used, and only open (non-pregnant) females would receive the procedure.

Minimally invasive, physical sterilization procedure could include any physical form of sterilization that does not involve removal of the ovaries, and entail only minimal or no incisions. Such procedures could include any form of physical procedure that leads a mare to be unable to become pregnant, or to maintain a pregnancy. For example, in endoscopic oviduct ablation, minimally invasive sterilization causes a long-term blockage of the oviduct by infusion of a surgical-grade glue into the oviducts, so that fertile eggs cannot go from the ovaries to the uterus (i.e., Bigolin et al. 2009). Or, in endoscopic laser ablation of the oviduct papilla, scarring caused by heat applied at the uterotubal junction prevents eggs from reaching the uterus (Edwards et al. 2021). These two procedures use trans-cervical endoscopy, so any treated mares would first need to have been screened by a veterinarian (e.g., using trans-rectal ultrasonography) to ensure they are not pregnant. Endoscopic approaches also require temporary insufflation of the uterus, to allow the veterinarian to fully visualize the internal structures. The result of such minimally invasive procedures that prevent pregnancy but do not harm the ovaries is that the mare would be sterile, although the mare would continue to have estrus cycles.

Ovariectomy via colpotomy is a surgical technique in which there is no external incision, reducing susceptibility to infection. Ovariectomy via colpotomy, has been an established veterinary technique since 1903 (Loesch and Rodgerson 2003, NRC 2013). Spaying via colpotomy has the advantage of not leaving any external wound that could become infected. For this reason, it has been identified as a good choice for sterilization of feral or wild mares (Rowland et al. 2018). The procedure has a relatively low complication rate, although post-surgical mortality and morbidity are possible, as with any surgery. For this reason, ovariectomy via colpotomy has been identified as a good choice for feral or wild horses (Rowland et al. 2018). Ovariectomy via colpotomy is a relatively short surgery, with a relatively quick expected recovery time. In 1903, Williams first described a vaginal approach, or colpotomy, using an ecraseur to ovariectomize mares (Loesch and Rodgerson 2003). The ovariectomy via colpotomy procedure has been conducted for over 100 years, normally on open (non-pregnant), domestic mares. It is expected that the surgeon should be able to access ovaries with ease in mares that are in the early- or mid-stage of pregnancy. The anticipated risks associated with the pregnancy are described below. When wild horses are gathered or trapped for fertility control treatment there would likely be mares in various stages of gestation. Removal of the ovaries is permanent and 100 percent effective, however the procedure is not without risk.

Ovariectomy via flank laparoscopy (Lee and Hendrickson 2008, Devick et al. 2018, Easley et al. 2018) is commonly used in domestic horses for application in mares due to its minimal invasiveness and full observation of the operative field. Ovariectomy via flank laparoscopy was seen as the lowest risk method considered by a panel of expert reviewers convened by USGS (Bowen 2015). In a review of unilateral and bilateral laparoscopic ovariectomy on 157 mares, Röcken et al. (2011) found that 10.8% of mares had minor post-surgical complications, and recorded no mortality. Mortality due to this type of surgery, or post-surgical complications, is not expected, but is a possibility. In two studies, ovariectomy by laparoscopy or endoscope-assisted colpotomy did not cause mares to lose weight, and there was no need for rescue analgesia following surgery (Pader et al. 2011, Bertin et al. 2013). This surgical approach entails three small incisions on the animal's flank, through which three cannulae (tubes) allow entry of narrow devices to enter the body cavity: these are the insufflator, endoscope, and surgical instrument. The surgical procedure involves the use of narrow instruments introduced into the abdomen via cannulas for the purpose of transecting or sealing (Easley 2018) the ovarian pedicle, but the insufflation should allow the veterinarian to navigate inside the abdomen without damaging other internal organs. The insufflator blows air into the cavity to increase the operating space between organs, and the endoscope provides a video feed to visualize the operation of the surgical instrument. This procedure can require a relatively long duration of surgery, but tends to lead to the lowest post-operative rates of complications. Flank laparoscopy may leave three small (<5 cm) visible scars on one side of the horse's flank, but even in performance horses these scars are considered minimal. It is expected that the tissues and musculature under the skin at the site of the incisions in the flank will heal quickly, leaving no long-lasting effects on horse health. Monitoring for up to two weeks at the facility where surgeries take place will allow for veterinary inspection of wound healing. The ovaries may be dropped into the abdomen, but this is not expected to cause any health problem; it is usually done in ovariectomies in cattle (e.g., the Willis Dropped Ovary Technique) and Shoemaker et al. (2014) found no problems with revascularization or necrosis in a study of young horses using this method.

Effects of Sterilization on Pregnancy and Foal

The physical, behavioral, and herd-level effects of immunocontraceptives have been addressed elsewhere in this review. In the case of repeated PZP vaccine or GonaCon applications that cause infertility through the duration of a given mare's life, that effects of that form of treatment have been discussed previously; neither vaccine appears to disrupt pregnancy or foal development. OGF vaccine effects on fetal development, if any, have not been described, as no studies on the effects of vaccinating pregnant mares have yet been published; use on pregnant mares may be limited until further information is available.

Trans-cervical, minimally-invasive sterilization methods are not suitable for pregnant mares, because disruption of the cervix may lead to termination of the pregnancy. Therefore, any mares under consideration for such methods must first be screened for pregnancy, such as via transrectal ultrasound.

The average mare gestation period ranges from 335 to 340 days (Evans et al. 1977, p. 373). There are few peer reviewed studies documenting the effects of surgical ovariectomy on the success of pregnancy in a mare. A National Research Council of the National Academies of Sciences committee that reviewed research proposals in 2015 explained, “The mare’s ovaries and their production of progesterone are required during the first 70 days of pregnancy to maintain the pregnancy” (NRC 2015). In female mammals, less progesterone is produced when ovaries are removed, but production does not cease (Webley and Johnson 1982). In 1977, Evans et al. stated that by 200 days, the secretion of progesterone by the corpora lutea is insignificant because removal of the ovaries does not result in abortion (p. 376). “If this procedure were performed in the first 120 days of pregnancy, the fetus would be resorbed or aborted by the mother. If performed after 120 days, the pregnancy should be maintained. The effect of ovary removal on a pregnancy at 90–120 days of gestation is unpredictable because it is during this stage of gestation that the transition from corpus luteum to placental support typically occurs” (NRC 2015). In 1979, Holtan et al. evaluated the effects of bilateral ovariectomy at selected times between 25 and 210 days of gestation on 50 mature pony mares. Their results show that abortion (resorption) of the conceptus (fetus) occurred in all 14 mares ovariectomized before day 50 of gestation, that pregnancy was maintained in 11 of 20 mares after ovariectomy between days 50 and 70, and that pregnancy was not interrupted in any of 12 mares ovariectomized on days 140 to 210. Those results are similar to the suggestions of the NAS committee (2015). For those pregnancies that are maintained following an ovariectomy procedure, likely those past approximately 120 days, the development of the foal is not expected to be affected. However, because this procedure is not commonly conducted on pregnant mares the rate of complications to the fetus has not yet been quantified. There is the possibility that entry to the abdominal cavity could cause premature births related to inflammation. However, after five months the placenta should hormonally support the pregnancy regardless of the presence or absence of ovaries. Gestation length was similar between ovariectomized and control mares (Holtan et al. 1979).

Direct Effects of Sterilization

The direct effects of immunocontraceptive PZP vaccines and GonaCon-Equine have been discussed previously. In cases where PZP vaccines have been administered enough times to cause effective sterility, the mechanism of action may be related to long-term reduction in ovarian activity (i.e., Nolan et al 2018c). The direct effects of OGF vaccine treatment were discussed by BLM (2020) and may include an injection site reaction that is comparable to that of GonaCon-Equine; a brief period of heightened inflammation and mild fever that is characteristic of a successful immune response; development of an immune response against GDF9 and BMP15, with related reductions in the concentration of those proteins; and a reduction in estrus activity.

The direct effects of successful minimally invasive mare sterilization procedures are sterility, for example through occlusion of the oviduct with surgical glue and associated tissue damage, or creation of scar tissue in part of the oviduct. Hysteroscopy is a common procedure in humans (i.e., WebMD 2014). Because such minimally invasive procedures do not involve major incisions or removal of ovaries, there is no risk of hemorrhage, failure of sutures, or prolonged discomfort. There is the potential for mild, transient colic (abnormal cramping) after the procedure due to temporary inflation and expansion of the uterus. Use of analgesics prior to any procedure should minimize this incidence. Side effects of minimally invasive sterilization procedures may include mild discomfort in the short term, for example at the location where the oviduct is blocked. For example, if surgical grade glue is placed in the oviduct or if a laser is used to ablate the oviduct papilla, that may cause transient irritation. For this reason, systemic and / or topical analgesics are generally provided before or during the procedure. An NAS review of the endoscopic laser ablation of the oviduct papilla technique concluded that the method is relatively non-invasive, with a relatively low risk of complications (NRC 2015); the expected severe complication rate for the laser ablation procedure may be lower than 1 percent. Ablation of the oviduct via cyanoacrylate glue has been performed successfully in mares at UC Davis, and laser ablation of the oviduct papilla has been performed successfully in burros and horses, in California and Georgia. In addition, other transcervical endoscopic procedures (including the use of a laser diode) are not uncommon in mares (Blikslager et al. 1993, Griffin and Bennet 2002, Ley et al. 2002, Brinsko 2014).

Between 2009 and 2011, the Sheldon NWR in Nevada conducted ovariectomy via colpotomy surgeries (August through October) on 114 feral mares and released them back to the range with a mixture of sterilized stallions and untreated mares and stallions (Collins and Kasbohm 2016). Gestational stage was not recorded, but a majority of the mares were pregnant (Gail Collins, US Fish and Wildlife Service (USFWS), pers. comm.). Only a small number of mares were very close to full term. Those mares with late term pregnancies did not receive surgery as the veterinarian could not get good access to the ovaries due to the position of the foal (Gail Collins, USFWS, pers. comm.). After holding the mares for an average of 8 days after surgery for observation, they were returned to the range with other treated and untreated mares and stallions (Collins and Kasbohm 2016). During holding the only complications were observed within 2 days of surgery. The observed mortality rate for ovariectomized mares following the procedure was less than 2 percent (Collins and Kasbohm 2016, Pielstick pers. comm.). During the Sheldon NWR ovariectomy study, mares generally walked out of the chute and started to eat; some would raise their tail and act as if they were defecating; however, in most mares one could not notice signs of discomfort (Bowen 2015). In their discussion of ovariectomy via colpotomy, McKinnon and Vasey (2007) considered the procedure safe and efficacious in many instances, able to be performed expediently by personnel experienced with examination of the female reproductive tract, and associated with a complication rate that is similar to or less than male castration. Nevertheless, all surgery is associated with some risk. Loesch et al. (2003) lists that following potential risks with colpotomy: pain and discomfort; injuries to the cervix, bladder, or a segment of bowel; delayed vaginal healing; eventration of the bowel; incisional site hematoma; intraabdominal adhesions to the vagina; and chronic lumbar or bilateral hind limb pain. Most horses, however, tolerate ovariectomy via colpotomy with very few complications, including feral horses (Collins and Kasbohm 2016). Evisceration is also a possibility, but these complications are considered rare (Prado and Schumacher, 2017). Mortality due to surgery or post-surgical complications is not anticipated, but it is a possibility and therefore every effort would be made to mitigate risks.

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

Most ovariectomy surgeries on mares have low morbidity[4] and with the help of medications, pain and discomfort can be mitigated. Pain management is an important aspect of any ovariectomy (Rowland et al. 2018); according to surgical protocols that would be used, a long-lasting direct anesthetic would be applied to the ovarian pedicle, and systemic analgesics in the form of butorphanol and flunixin meglumine would be administered, as is compatible with accepted animal husbandry practices. In a study

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

of the effects of bilateral ovariectomy via colpotomy on 23 mares, Hooper and others (1993) reported that postoperative problems were minimal (1 in 23, or 4%). Hooper et al. (1993) noted that four other mares were reported by owners as having some problems after surgery, but that evidence as to the role the surgery played in those subsequent problems was inconclusive. In contrast Röcken et al. (2011) noted a morbidity of 10.8% for mares that were ovariectomized via a flank laparoscopy. “Although 5 mares in our study had problems (repeated colic in 2 mares, signs of lumbar pain in 1 mare, signs of bilateral hind limb pain in 1 mare, and clinical signs of peritonitis in 1 mare) after surgery, evidence is inconclusive in each as to the role played by surgery” (Hooper et al. 1993). A recent study showed a 2.5% complication rate where one mare of 39 showed signs of moderate colic after laparoscopic ovariectomy (Devick et al. 2018).

Behavioral Effects of Mare Sterilization

All fertility control methods affect physiology or behavior of a mare (NRC 2013). Any action taken to alter the reproductive capacity of an individual has the potential to affect hormone production and therefore behavioral interactions and ultimately population dynamics in unforeseen ways (Ransom et al. 2014). The health and behavioral effects of sterilizing wild horse mares that live with other fertile and infertile wild horses has not been well documented, but the literature review below can be used to make reasonable inferences about their likely behaviors.

The behavioral effects of PZP vaccines and GonaCon-Equine have been discussed previously. For the OGF vaccine, a paired immune reaction to two proteins (GDF9 and BMP15) can prevent the completion of oocyte development, with the result being that successfully treated mares do not exhibit estrus cycles (Bruemmer et al. 2023). As a result, the behavioral and herd-level effects of OGF vaccine treatment are expected to be similar to those documented for GonaCon-Equine; namely, a reduced incidence of breeding behaviors, but a continuation of affiliative behaviors within the social band (see previous discussion of effects of GonaCon-Equine).

Horses are anovulatory (do not ovulate/express estrous behavior) during the short days of late fall and early winter, beginning to ovulate as days lengthen and then cycling roughly every 21 days during the warmer months, with about 5 days of estrus (Asa et al. 1979, Crowell-Davis 2007). Estrus in mares is shown by increased frequency of proceptive behaviors: approaching and following the stallion, urinating, presenting the rear end, clitoral winking, and raising the tail towards the stallion (Asa et al. 1979, Crowell-Davis 2007). In most mammal species other than primates estrus behavior is not shown during the anovulatory period, and reproductive behavior is considered extinguished following spaying (Hart and Eckstein 1997). However mares may continue to demonstrate estrus behavior during the anovulatory period (Asa et al. 1980).

The behavioral effects of minimally invasive mare sterilization methods that cause no change in ovarian functionality would be expected to be similar to those observed in mares treated with a small number of doses of PZP vaccine (i.e., those in which ovarian functionality is not impaired). Those behavioral outcomes are discussed previously, but include a continuation of estrus cycling, and associated proceptive and breeding behaviors, including copulation. As a result of the expectation that the minimally invasive procedures would have similar behavioral effects as treatment with PZP, BLM does not anticipate any need to study the behavioral effects of minimally invasive mare sterilization, in which functional ovaries are retained. Sterile mares with functional ovaries would be expected to continue to engage in breeding activities, although they would not become pregnant. There is the possibility that such mares may change social bands at a greater rate than fertile mares (e.g., Nuñez et al. 2017).

Ovariectomized mares may continue to exhibit estrous behavior (Scott and Kunze 1977, Kamm and Hendrickson 2007, Crabtree 2016), with one study finding that 30% of mares showed estrus signs at least once after surgery (Roessner et al 2015) and only 60 percent of ovariectomized mares cease estrous behavior following surgery (Loesch and Rodgerson 2003). Mares continue to show reproductive behavior following ovariectomy due to non-endocrine support of estrus behavior, specifically steroids from the adrenal cortex. Continuation of this behavior during the non-breeding season has the function of maintaining social cohesion within a horse group (Asa et al. 1980, Asa et al. 1984, NRC 2013). This may be a unique response of the horse (Bertin et al. 2013), as spaying usually greatly reduces female sexual behavior in companion animals (Hart and Eckstein 1997). In six ponies, mean monthly plasma luteinizing hormone[5] levels in ovariectomized mares were similar to intact mares during the anestrous season, and during the breeding season were similar to levels in intact mares at mid-estrus (Garcia and Ginther 1976).

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

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

'Foal stealing,' where a near-term pregnant mare steals a neonate foal from a weaker mare, is unlikely to be a common behavioral result of including sterilized mares in a wild horse herd, no matter the method of sterilization. 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

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

likely in the wild, where pregnant mares will be widely distributed across the landscape, and where the expectation is that parturition dates would be distributed across the normal foaling season.

Indirect Effects of Mare Sterilization

The free-roaming behavior of wild horses is not anticipated to be affected by mare sterilization, as the definition of free-roaming is the ability to move without restriction by fences or other barriers within a HMA (BLM H-4700-1, 2010) and there are no permanent physical barriers being proposed.

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

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

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

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

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

In this sense, a sterilized wild mare would be just as much ‘wild’ as defined by the WFRHBA as any fertile wild mare, even if that mare’s patterns of movement did differ slightly. Congress specified that sterilization is an acceptable management action (16 USC §1333.b.1). Sterilization is not one of the clearly defined events that cause an animal to lose its status as a wild free-roaming horse (16 USC §1333.2.C.d). As noted in the discussion of neutering, any opinions based on a semantic and subjective definition of what constitutes a ‘wild’ horse are not legally binding for BLM, which must adhere to the legal definition of what constitutes a wild free-roaming horse[6], based on the WFRHBA (as amended). BLM is not obliged to base management decisions on personal opinions, which do not meet the BLM’s principle and practice to “Use the best available scientific knowledge relevant to the problem or decision being addressed, relying on peer reviewed literature when it exists” (Kitchell et al. 2015).

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

Effects on Bone Histology
There is no known mechanism by which bone development would change in mares treated with pharmacological or immunological sterilization methods, or with minimally invasive sterilization methods. The BLM knows of no scientific, peer-reviewed literature that documents bone density loss in mares following ovariectomy. A concern has been raised in an opinion article (Nock 2013) that ovary removal in mares could lead to bone density loss. That opinion article was not peer reviewed nor was it based on research in wild or domestic horses, so it does not meet the BLM’s standard for “best available science” on which to base decisions (Kitchell et al. 2015). Hypotheses that are forwarded in Nock (2013) appear to be based on analogies from modern humans leading sedentary lives. Post-menopausal women appear to have a greater chance of developing osteoporosis (Scholz-Ahrens et al. 1996), but BLM is not aware of any research examining bone loss in horses following ovariectomy. Bone loss in humans has been linked to reduced circulating estrogen. There have been conflicting results when researchers have attempted to test for an effect of reduced estrogen on animal bone loss rates in animal models; all experiments have been on laboratory animals, rather than free-ranging wild animals. While some studies found changes in bone cell activity after ovariectomy leading to decreased bone strength (Jerome et al. 1997, Baldock et al. 1998, Huang et al. 2002, Sigrist et al. 2007), others found that changes were moderate and transient or minimal (Scholz-Ahrens et al. 1996, Lundon et al. 1994, Zhang et al. 2007), and even returned to normal after 4 months (Sigrist et al. 2007).

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

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

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

Genetic Effects of Mare Sterilization and Neutering

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

In reproducing herds where large numbers of wild horses have recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses, spaying and neutering is not expected to cause an unacceptable loss of genetic diversity or an unacceptable increase in the inbreeding coefficient. In any diploid population, the loss of genetic diversity through inbreeding or drift can be prevented by large effective breeding population sizes (Wright 1931) or by introducing new potential breeding animals (Mills and Allendorf 1996). The NAS report (2013) recommended that single HMAs should not be considered as isolated genetic populations. Rather, managed herds of wild horses should be considered as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements. It is worth noting that, although maintenance of genetic diversity at the scale of the overall population of wild horses is an intuitive management goal, there are no existing laws or policies that require BLM to maintain genetic diversity at the scale of the individual herd management area or complex. Also, there is no Bureau-wide policy that requires BLM to allow each female in a herd to reproduce before treatment with contraceptives. Introducing 1-2 mares every generation (about every 10 years) is a standard management technique that can alleviated potential inbreeding concerns (BLM 2010). The NAS report (2013) recommended that managed herds of wild horses would be better viewed as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements.

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

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

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

Literature Cited; Sterilization

Angle, M., J. W. Turner Jr., R. M. Kenney, and V. K. Ganjam. 1979. Androgens in feral stallions. Pages 31–38 in Proceedings of the Symposium on the Ecology and Behaviour of Wild and Feral Equids, University of Wyoming, Laramie.

Asa, C. S., D. A. Goldfoot, and O. J. Ginther. 1979. Sociosexual behavior and the ovulatory cycle of ponies (*Equus caballus*) observed in harem groups. Hormones and Behavior 13:49–65.
Asa, C. S., D. A. Goldfoot, M. C. Garcia, and O. J. Ginther. 1980a. Dexamethasone suppression of sexual behavior in the ovariectomized mare. Hormones and Behavior.
Asa, C., D. A. Goldfoot, M. C. Garcia, and O. J. Ginther. 1980b. Sexual behavior in ovariectomized and seasonally anovulatory pony mares (*Equus caballus*). Hormones and Behavior 14:46–54.
Asa, C., D. Goldfoot, M. Garcia, and O. Ginther. 1984. The effect of estradiol and progesterone on the sexual behavior of ovariectomized mares. Physiology and Behavior 33:681–686.
Asa, C. S. 1999. Male reproductive success in free-ranging feral horses. Behavioural Ecology and Sociobiology 47:89–93.
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.
Baldock, P. A. J., H. A. Morris, A. G. Need, R. J. Moore, and T. C. Durbridge. 1998. Variation in the short-term changes in bone cell activity in three regions of the distal femur immediately following ovariectomy. Journal of Bone and Mineral Research 13:1451–1457.
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.
Beckett, T., A. E. Tchernof, and M. J. Toth. 2002. Effect of ovariectomy and estradiol replacement on skeletal muscle enzyme activity in female rats. Metabolism 51:1397–1401.
Belsito, K. R., B. M. Vester, T. Keel, T. K. Graves, and K. S. Swanson. 2008. Impact of ovariohysterectomy and food intake on body composition, physical activity, and adipose gene expression in cats. Journal of Animal Science 87:594–602.
Berger, J. 1986. Wild horses of the Great Basin. University of Chicago Press, Chicago.
Bertin, F. R., K. S. Pader, T. B. Lescun, and J. E. Sojka-Kritchevsky. 2013. Short-term effect of ovariectomy on measures of insulin sensitivity and response to dexamethasone administration in horses. American Journal of Veterinary Research 74:1506–1513.
Bigolin, S., D.J. Fagundes, H.C. Rivoire, A.T. Negrini Fagundes, A.L. Negrini Fagundes. 2009. Transcervical hysteroscopic sterilization using cyanoacrylate: a long-term experimental study on sheep. The Journal of Obstectrics and Gynaecology Research 35:1012-1018.
Blikslager, A.T., L.P. Tate, Jr., and D. Weinstock. 1993. Effects of Neodymium: Yttrium Aluminum Garnet [YAG] Laser Irradiation on Endometrium and on Endometrial Cysts in Six Mares. Veterinary Surgery 22:351–356.
Bowen, Z. 2015. Assessment of spay techniques for mare in field conditions. Letter from US Geological Survey Fort Collins Science Center to D. Bolstad, BLM. November 24, 2015. Appendix D in Bureau of Land Management, 2016, Mare Sterilization Research Environmental Assessment, DOI-BLM-O-B000-2015-055-EA, Hines, Oregon.
Bruemmer, J.E., D.C. Eckery, M. Eisenfelder, and C. Mundell. 2023. 138 Immunization against oocyte growth factors in feral mares. Journal of Equine Veterinary Science 124: 104440.
Burden, F. and A. Thiemann. 2015. Donkeys are different. Journal of Equine Veterinary Science 35:376-382.
Bureau of Land Management (BLM). 2010. BLM-4700-1 Wild Horses and Burros Management Handbook. Washington, D.C.
Bureau of Land Management (BLM). 2011. Barren Valley Complex Wild Horse gather Plan. Final Environmental Assessment. DOI-BLM-OR-V040-2011-011-EA. BLM Oregon, Vale District / Jordan Field Office.
Bureau of Land Management (BLM). 2012. Final Environmental Assessment Challis Wild Horse Gather Plan. DOI-BLM-ID-1030-2012-0006-EA. BLM Idaho, Challis Field Office.
Bureau of Land Management (BLM). 2015. Instruction Memorandum 2015-151; Comprehensive animal welfare program for wild horse and burro gathers. Washington, D.C.
Bureau of Land Management (BLM). 2016. Population Control Research Wild Horse Gather for the Conger and Frisco Herd Management Areas. Final Environmental Assessment. DOI-BLM-UT-

W020-2015-0017-EA. BLM Utah, West Desert District.
Bureau of Land Management (BLM). 2020. Oocyte growth factor vaccine study. DOI-BLM-NV-0000-2020-0001-EA. BLM Nevada, Reno, Nevada.
Bureau of Land Management (BLM). 2021. Instructional Memorandum 2021-002. Wild Horse and Burro Comprehensive Animal Welfare Program. Washington, D.C.
Borsberry, S. 1980. Libidinous behaviour in a gelding. Veterinary Record 106:89–90.
Brinsko, S.P. 2014. How to perform hysteroscopy in the mare. American Association of Equine Practitioners (AAEP) Proceedings 60:289–293.
California Legislature. 2019. Senate Bill 109, Committee on Budget and Fiscal Review, Budget Act of 2019.
Camara, C., L.-Y. Zhou, Y. Ma, L. Zhu, D. Yu, Y.-W. Zhao, and N.-H. Yang. 2014. Effect of ovariectomy on serum adiponectin levels and visceral fat in rats. Journal of Huazhong University of Science and Technology [Medical Sciences] 34:825–829.
Chaudhuri, M., and J. R. Ginsberg. 1990. Urinary androgen concentrations and social status in two species of free ranging zebra (*Equus burchelli* and *E. grevyi*). Reproduction 88:127–133.
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.
Colborn, D. R., D. L. Thompson, T. L. Roth, J. S. Capehart, and K. L. White. 1991. Responses of cortisol and prolactin to sexual excitement and stress in stallions and geldings. Journal of Animal Science 69:2556–2562.
Collins, G. H., and J. W. Kasbohm. 2016. Population dynamics and fertility control of feral horses. Journal of Wildlife Management 81: 289-296.
Costantini, R. M., J. H. Park, A. K. Beery, M. J. Paul, J. J. Ko, and I. Zucker. 2007. Post-castration retention of reproductive behavior and olfactory preferences in male Siberian hamsters: Role of prior experience. Hormones and Behavior 51:149–155.
Crabtree, J. R. 2016. Can ovariectomy be justified on grounds of behaviour? Equine Veterinary Education 28: 58–59.
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.
Crowell-Davis, S. L. 2007. Sexual behavior of mares.
Deniston, R. H. 1979. The varying role of the male in feral horses. Pages 93–38 in Proceedings of the Symposium on the Ecology and Behaviour of Wild and Feral Equids, University of Wyoming, Laramie.
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).
Devick, I.F., B.S. Leise, S.Rao, and D.A. Hendrickson. 2018. Evaluation of post-operative pain after active desufflation at completion of laparoscopy in mares undergoing ovariectomy. Canadian Veterinary Journal 59:261-266.
Dixson, A. F. 1993. Sexual and aggressive behaviour of adult male marmosets (Callithrix jacchus) castrated neonatally, prepubertally, or in adulthood. Physiology and Behavior 54:301–307.
Dunbar, I. F. 1975. Behaviour of castrated animals. The Veterinary Record 92–93.
Eagle, T. C., C. S. Asa, R. A. Garrott, E. D. Plotka, D. B. Siniff, and J. R. Tester. 1993. Efficacy of dominant male sterilization to reduce reproduction in feral horses. Wildlife Society Bulletin 21:116–121.
Easley, J.T., K.C. McGilvray, D.A. Hendrickson, J. Bruemmer, and E.S. Hackett. 2018. Vessel sealer and divider instrument temperature during laparoscopic ovariectomy in horses. Veterinary Surgery 47: O26-O31.
Edwards. G., R. Ellerbrock, R. Eggleston, and M. Ferrer. Laser ablation of the equine oviductal papilla as a novel contraceptive technique. Clinical Theriogenology. 2021 13:306.
Evans, J. W., A. Borton, H. F. Hintz, and L. D. Van Vleck. 1977. The Horse. San Francisco, California:

W.H. Freeman and Company. Pages 373–377.
Feh, C. 1999. Alliances and reproductive success in Camargue stallions. Animal Behaviour 57:705–713.
Feist, J. D., and D. R. McCullough. 1976. Behavior patterns and communication in feral horses. Zietschrift für Tierpsychologie 41:337–371.
Fettman, M. J., C. A. Stanton, L. L. Banks, D. W. Hamar, D. E. Johnson, R. L. Hegstad, and S. Johnston. 1997. Effects of neutering on bodyweight, metabolic rate and glucose tolerance of domestic cats. Research in Veterinary Science 62:131–136.
Fonner, R. and A.K. Bohara. 2017. Optimal control of wild horse populations with nonlethal methods. Land Economics 93:390-412.
Garcia, M. C., and O. J. Ginther. 1976. Effects of Ovariectomy and Season on Plasma Luteinizing Hormone in Mares. Endocrinology 98:958–962.
Garrott , R.A., and D.B. Siniff. 1992. Limitations of male-oriented contraception for controlling feral horse populations. Journal of Wildlife Management 56:456-464.
Garrott, R.A., and M.K. Oli. 2013. A Critical Crossroad for BLM's Wild Horse Program. Science 341:847-848.
Getman, L.M. 2009. Review of castration complications: strategies for treatment in the field. AAEP Proceedings 55:374-378.
Green, N.F. and H.D. Green. 1977. The wild horse population of Stone Cabin Valley Nevada: a preliminary report. In Proceedings, National Wild Horse Forum. University of Nevada Reno Cooperative Extension Service.
Griffin, R.L. and S.D. Bennett. 2002. Nd:YAG Laser Photoablation of Endometrial Cysts: A Review of 55 Cases (2000–2001). AAEP Proceedings 48:58–60.
Gross, J.E. 2000. A dynamic simulation model for evaluating effects of removal and contraception on genetic variation and demography of Pryor Mountain wild horses. Biological Conservation 96:319-330.
Guttilla, D. A., and P. Stapp. 2010. Effects of sterilization on movements of feral cats at a wildland–urban interface. Journal of Mammalogy 91:482–489.
Hailer, F., B. Helander, A.O. Folkestad, S.A. Ganusevich, S. Garstad, P. Hauff, C. Koren, T. Nygård, V. Volke, C. Vilà, and H. Ellegren. 2006. Bottlenecked but long-lived: high genetic diversity retained in white-tailed eagles upon recovery from population decline. Biology Letters 2:316-319.
Hampson, B. A., M. A. De Laat, P. C. Mills, and C. C. Pollitt. 2010a. Distances travelled by feral horses in ‘outback’ Australia. Equine Veterinary Journal, Suppl. 38:582–586.
Hampson, B. A., J. M. Morton, P. C. Mills, M. G. Trotter, D. W. Lamb, and C. C. Pollitt. 2010b. Monitoring distances travelled by horses using GPS tracking collars. Australian Veterinary Journal 88:176–181.
Hampton, J.O., T.H. Hyndman, A. Barnes, and T. Collins. 2015. Is wildlife fertility control always humane? Animals 5:1047-1071.
Hart, B. L. 1968. Role of prior experience in the effects of castration on sexual behavior of male dogs. Journal of Comparative and Physiological Psychology 66:719–725.
Hart, B. L., and T. O. A. C. Jones. 1975. Effects of castration on sexual behavior of tropical male goats. Hormones and Behavior 6:247–258.
Hart, B. L., and R. A. Eckstein. 1997. The role of gonadal hormones in the occurrence of objectionable behaviours in dogs and cats. Applied Animal Behaviour Science 52:331–344.
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.
Holtan, D. W., E. L. Squires, D. R. Lapin, and O. J. Ginther. 1979. Effect of ovariectomy on pregnancy in mares. Journal of Reproduction and Fertility, Supplement 27:457–463.
Hooper, R. N., T. S. Taylor, D. D. Varner, and B. T. L. 1993. Effects of bilateral ovariectomy via coloptomy in mares: 23 cases (1984-1990). Journal of the American Veterinary Medical Association 203:1043–1046.
Huang, R. Y., L. M. Miller, C. S. Carlson, and M. R. Chance. 2002. Characterization of bone mineral

composition in the proximal tibia of Cynomolgus monkeys: effect of ovariectomy and nandrolone decanoate treatment. Bone 30:492–497.
Jacob, J., J. Matulessy, and Sudarmaji. 2004. Effects of imposed sterility on movement patterns of female ricefield rats. Journal of Wildlife Management 68:1138-1144.
Jacob, J., G. R. Singleton, and L. A. Hinds. 2008. Fertility control of rodent pests. Wildlife Research 35:487.
Jerome, C. P., C. H. Turner, and C. J. Lees. 1997. Decreased bone mass and strength in ovariectomized cynomolgus monkeys (Macaca fascicularis). Calcified Tissue International 60:265–270.
Jeusette, I., J. Detilleux, C. Cuvelier, L. Istasse, and M. Diez. 2004. Ad libitum feeding following ovariectomy in female Beagle dogs: effect on maintenance energy requirement and on blood metabolites. Journal of Animal Physiology and Animal Nutrition 88:117–121.
Jeusette, I., S. Daminet, P. Nguyen, H. Shibata, M. Saito, T. Honjoh, L. Istasse, and M. Diez. 2006. Effect of ovariectomy and ad libitum feeding on body composition, thyroid status, ghrelin and leptin plasma concentrations in female dogs. Journal of Animal Physiology and Animal Nutrition 90:12–18.
Jewell, P. A. 1997. Survival and behaviour of castrated Soay sheep (Ovis aries) in a feral island population on Hirta, St. Kilda, Scotland. Journal of Zoology 243:623–636.
Kamm, J. L., and D. A. Hendrickson. 2007. Clients' perspectives on the effects of laparoscopic ovariectomy on equine behavior and medical problems. Journal of Equine Veterinary Science 27:435–438.
Kaseda, Y., H. Ogawa, and A. M. Khalil. 1997. Causes of natal dispersal and emigration and their effects on harem formation in Misaki feral horses. Equine Veterinary Journal 29:262–266.
Khalil, A.M., N. Murakami, and Y. Kaseda. 1998. Relationship between plasma testosterone concentrations and age, breeding season, and harem size in Misaki feral horses. Journal of Veterinary Medical Science 60:643-645.
Khalil, A. M., and N. Murakami. 1999. Effect of natal dispersal on the reproductive strategies of the young Misaki feral stallions. Applied Animal Behaviour Science 62:281–291.
King, S.R.B., and J. Gurnell. 2005. Habitat use and spatial dynamics of takhi introduced to Hustai National Park, Mongolia. Biological Conservation 124:277-290.
King, S.R.B., and J. Gurnell. 2006. Scent-marking behaviour by stallions: an assessment of function in a reintroduced population of Przewalski horses (*Equus ferus przewalskii*). Journal of Zoology 272:30–36.
King, S.R.B, 2016. Behavior of horses, zebras, and asses. Pages 23-40 in J. I. Ransom and P Kaczensky, eds., Wild equids; ecology, management and conservation. Johns Hopkins University Press, Baltimore, Maryland.
King, S.R.B., K.A. Schoenecker, and M.J. Cole. 2022. Effect of adult male sterilization on the behavior and social associations of a feral polygynous ungulate: the horse. Applied Animal Behaviour Science 249: 105598.
Kirkpatrick, J. 2012. Sworn statement of Dr. Jay Kirkpatrick. Unpublished record of opinion.
Kirkpatrick, J. F., and A. Turner. 2008. Achieving population goals in a long-lived wildlife species (*Equus caballus*) with contraception. Wildlife Research 35:513.
Kitchell, K., S. Cohn, R. Falise, H. Hadley, M. Herder, K. Libby, K. Muller, T. Murphy, M. Preston, M.J. Rugwell, and S. Schlanger. 2015. Advancing science in the BLM: an implementation strategy. Department of the Interior, BLM, Washington DC.
Lee, M., and D. A. Hendrickson. 2008. A review of equine standing laparoscopic ovariectomy. Journal of Equine Veterinary Science 28:105–111.
Ley, William B., Russell G. Higbee, and G. Reed Holyoak. 2002. Laser Ablation of Endometrial and Lymphatic Cysts. Clinical Techniques in Equine Practice volume 1. Pages 28–31.
Line, S. W., B. L. Hart, and L. Sanders. 1985. Effect of prepubertal versus postpubertal castration on sexual and aggressive behavior in male horses. Journal of the American Veterinary Medical Association 186:249–251.

Linklater, W. L., and E. Z. Cameron. 2000. Distinguishing cooperation from cohabitation: the feral horse case study. Animal Behaviour 59:F17–F21.
Loesch, D. A., and D. H. Rodgerson. 2003. Surgical approaches to ovariectomy in mares. Continuing Education for Veterinarians 25:862–871.
Lundon, K., M. Dumitriu, and M. Grynpas. 1994. The long-term effect of ovariectomy on the quality and quantity of cancellous bone in young macaques. Bone and Mineral 24:135–149.
Mavropoulos, A., S. Kiliaridis, R. Rizzoli, and P. Ammann. 2014. Normal masticatory function partially protects the rat mandibular bone from estrogen-deficiency induced osteoporosis. Journal of Biomechanics 47:2666–2671.
McDonnell, S.M. 2012. Mare and foal behavior. American Association of Equine Practitioners Proceedings 58:407-410.
McKinnon, A.O., and J.R. Vasey. 2007. Selected reproductive surgery of the broodmare. Pages 146-160 in Current therapy in equine reproduction, J.C. Samper, J.F. Pycock, and A.O. McKinnon, eds. Saunders Elsevier, St. Louis, Missouri.
Miller, R. 1983. Seasonal Movements and Home Ranges of Feral Horse Bands in Wyoming's Red Desert. Journal of Range Management 36:199–201.
Mills, L.S. and F.W. Allendorf. 1996. The one-migrant-per-generation rule in conservation and management. Conservation Biology 10:1509-1518.
National Research Council of the National Academies of Sciences (NRC). 2013. Using science to improve the BLM wild horse and burro program: a way forward. National Academies Press. Washington, DC.
National Research Council of the National Academies of Sciences (NRC). 2015. Review of proposals to the Bureau of Land Management on Wild Horse and Burro sterilization or contraception, a letter report. Committee for the review of proposals to the Bureau of Land Management on Wild Horse and Burro Sterilization or Contraception. Appendix B in: BLM, 2016, Mare sterilization research Environmental Assessment DOI-BLM-OR-B000-2015-0055-EA, BLM Burns District Office, Hines, Oregon.
Nelson, K. J. 1980. Sterilization of dominant males will not limit feral horse populations. USDA Forest Service Research Paper RM-226.
Nock, B. 2013. Liberated horsemanship: menopause…and wild horse management. Warrenton, Missouri: Liberated Horsemanship Press.
Nock, B. 2017. Gelding is likely to cause wild horses undo suffering. Unpublished record of opinion.
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., 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., 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.
O'Farrell, V., and E. Peachey. 1990. Behavioural effects of ovariohysterectomy on bitches. Journal of Small Animal Practice 31:595–598.
Pader, K., L. J. Freeman, P. D. Constable, C. C. Wu, P. W. Snyder, and T. B. Lescun. 2011. Comparison of Transvaginal Natural Orifice Transluminal Endoscopic Surgery (NOTES®) and Laparoscopy for Elective Bilateral Ovariectomy in Standing Mares. Veterinary Surgery 40:998–1008.
Payne, R. M. 2013. The effect of spaying on the racing performance of female greyhounds. The Veterinary Journal 198:372–375.
Pearce, O. 1980. Libidinous behaviour in a gelding. Veterinary Record 106:207–207.
Prado, T., and J. Schumacher. 2017. How to perform ovariectomy through a colpotomy. Equine Veterinary

Education 13: doi: 10.1111/eve.12801
Ramsey, D. 2005. Population dynamics of brushtail possums subject to fertility control. Journal of Applied Ecology 42:348–360.
Ramsey, D. 2007. Effects of fertility control on behavior and disease transmission in brushtail possums. Journal of Wildlife Management 71:109–116.
Ransom, J. I., and B. S. Cade. 2009. Quantifying Equid Behavior--A Research Ethogram for Free-Roaming Feral Horses. Publications of the US Geological Survey. U.S. Geological Survey Techniques and Methods 2-A9.
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.
Reichler, I. M. 2009. Gonadectomy in Cats and Dogs: A Review of Risks and Benefits. Reproduction in Domestic Animals 44:29–35.
Rios, J. F. I., and K. Houpt. 1995. Sexual behavior in geldings. Applied Animal Behaviour Science 46:133–133.
Roelle, J. E., F. J. Singer, L. C. Zeigenfuss, J. I. Ransom, L. Coates-Markle, and K. A. Schoenecker. 2010. Demography of the Pryor Mountain Wild Horses, 1993–2007. pubs.usgs.gov. U.S. Geological Survey Scientific Investigations Report 2010-5125.
Röcken, M., G. Mosel, K. Seyrek-Intas, D. Seyrek-Intas, F. Litzke, J. Verver, and A. B. M. Rijkenhuizen. 2011. Unilateral and Bilateral Laparoscopic Ovariectomy in 157 Mares: A Retrospective Multicenter Study. Veterinary Surgery 40:1009–1014.
Roelle, J.E. and S.J. Oyler-McCance. 2015. Potential demographic and genetic effects of a sterilant applied to wild horse mares. US Geological Survey Open-file Report 2015-1045.
Roessner, H. A., K.A. Kurtz, and J.P. Caron. 2015. Laparoscopic ovariectomy diminishes estrus-associated behavioral problems in mares. Journal of Equine Veterinary Science 35: 250–253 (2015).
Rowland, A.L., K.G. Glass, S.T. Grady, K.J. Cummings, K. Hinrichs, and A.E. Watts. 2018. Influence of caudal epidural analgesia on cortisol concentrations and pain-related behavioral responses in mares during and after ovariectomy via colpotomy. Veterinary Surgery 2018:1-7. DOI: 10.1111/vsu.12908
Rubin, C., A. S. Turner, S. Bain, C. Mallinckrodt, and K. McLeod. 2001. Low mechanical signals strengthen long bones. Nature 412:603–604.
Rutberg, A. 2011. Re: Modified decision record, WY-040-EA11-124. Unpublished record of opinion.
Salter, R. E. Biogeography and habitat-use behavior of feral horses in western and northern Canada. In Symposium on the Ecology and Behaviour of Wild and Feral Equids 129–141 (1979).
Saltz, D., M. Rowen, and D. I. Rubenstein. 2000. The effect of space-use patterns of reintroduced Asiatic wild ass on effective population size. Conservation Biology 14:1852–1861.
Saunders, G., J. McIlroy, M. Berghout, B. Kay, E. Gifford, R. Perry, and R. van de Ven. 2002. The effects of induced sterility on the territorial behaviour and survival of foxes. Journal of Applied Ecology 39:56–66.
Scholz-Ahrens, K. E., G. Delling, P. W. Jungblut, E. Kallweit, and C. A. Barth. 1996. Effect of ovariectomy on bone histology and plasma parameters of bone metabolism in nulliparous and multiparous sows. Zeitschrift für Ernährungswissenschaft 35:13–21.
Schoenecker K.A., S.R.B. King, and T. Messmer. 2021. The Wildlife profession's duty in achieving science ‐ based sustainable management of free ‐ roaming equids. Journal of Wildlife Management 85:1057 ‐ 1061.
Schumacher, J. 1996. Complications of castration. Equine Veterinary Education 8:254-259.
Schumacher, J. 2006. Why do some castrated horses still act like stallions, and what can be done about it?

Compendium Equine Edition Fall: 142–146.
Scott, E. A., and D. J. Kunze. 1977. Ovariectomy in the mare: presurgical and postsurgical considerations. The Journal of Equine Medicine and Surgery 1:5–12.
Scully, C.M., R.L. Lee, L. Pielstick, J. Medlock, K.M. Patton, G.H. Collins, and M. Kutzler. 2015. Comparison of chemical and surgical vasectomy on testicular activity in free-roaming horses (*Equus caballus*). Journal of Zoo and Wildlife Medicine 46:815-824.
Searle, D., A.J. Dart, C.M. Dart, and D.R. Hodgson. 1999. Equine castration: review of anatomy, approaches, techniques and complications in normal, cryptorchid and monorchid horses. Australian Veterinary Journal 77:428-434.
Seidler, R. G., and E. M. Gese. 2012. Territory fidelity, space use, and survival rates of wild coyotes following surgical sterilization. Journal of Ethology 30:345–354.
Shoemaker, R., Bailey, J., Janzen, E. and Wilson, D.G., 2004. Routine castration in 568 draught colts: incidence of evisceration and omental herniation. Equine Veterinary Journal, 36:336-340.
Shoemaker, R. W., E. K. Read, T. Duke, and D. G. Wilson. 2004. In situ coagulation and transection of the ovarian pedicle: an alternative to laparoscopic ovariectomy in juvenile horses. Canadian Journal of Veterinary Research 68:27-32.
Sigrist, I. M., C. Gerhardt, M. Alini, E. Schneider, and M. Egermann. 2007. The long-term effects of ovariectomy on bone metabolism in sheep. Journal of Bone and Mineral Metabolism 25:28–35.
Sigurjónsdóttir, H., M. C. Van Dierendonck, S. Snorrason, and A. G. Thorhallsdóttir. 2003. Social relationships in a group of horses without a mature stallion. Behaviour 140:783–804.
Smith, J. A. 1974. Proceedings: Masculine behaviour in geldings. The Veterinary Record 94:160–160.
Thompson, D. L., Jr, B. W. Pickett, E. L. Squires, and T. M. Nett. 1980. Sexual behavior, seminal pH and accessory sex gland weights in geldings administered testosterone and (or) estradiol-17. Journal of Animal Science 51:1358–1366.
Turini, L., F. Bonelli, I. Nocera, V. Meucci, G. Conte, and M. Sgorbini. 2021. Evaluation of different methods to estimate the transfer of immunity in donkey foals fed with colostrum of good IgG quality: a preliminary study. Animals 2021(11):507. doi.org/10.3390/ani11020507
Twigg, L. E., T. J. Lowe, G. R. Martin, A. G. Wheeler, G. S. Gray, S. L. Griffin, C. M. O'Reilly, D. J. Robinson, and P. H. Hubach. 2000. Effects of surgically imposed sterility on free-ranging rabbit populations. Journal of Applied Ecology 37:16–39.
Tyler, S. 1972. The behaviour and social organisation of the New Forest ponies. Animal Behaviour Monographs 5:85–196.
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.
Van Dierendonck, M. C., H. De Vries, and M. B. H. Schilder. 1995. An analysis of dominance, its behavioural parameters and possible determinants in a herd of Icelandic horses in captivity. Journal of Zoology 45:362–385.
Van Dierendonck, M. C., H. Sigurjónsdóttir, B. Colenbrander, and A. G. Thorhallsdóttir. 2004. Differences in social behaviour between late pregnant, post-partum and barren mares in a herd of Icelandic horses. Applied Animal Behaviour Science 89:283–297.
Van Dierendonck, M. C., H. De Vries, M. B. H. Schilder, B. Colenbrander, A. G. Þorhallsdóttir, and H. Sigurjónsdóttir. 2009. Interventions in social behaviour in a herd of mares and geldings. Applied Animal Behaviour Science 116:67–73.
Vinke, C. M., R. van Deijk, B. B. Houx, and N. J. Schoemaker. 2008. The effects of surgical and chemical castration on intermale aggression, sexual behaviour and play behaviour in the male ferret (Mustela putorius furo). Applied Animal Behaviour Science 115:104–121.
Webley, G. E., and E. Johnson. 1982. Effect of ovariectomy on the course of gestation in the grey squirrel (Sciurus carolinensis). Journal of Endocrinology 93:423–426.
WebMD. 2014. Women’s Health: Endometrial Ablation. http://www.webmd.com/women/endometrial-ablation-16200. Accessed July 1, 2021.
Wright, S. 1931. Evolution in Mendelian populations. Genetics 16:97-159

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

Effects of Intrauterine Devices (IUDs)

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

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

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

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

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

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

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

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

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

Literature Cited: Intrauterine Devices (IUDs)

Baldrighi, J.M., C.C. Lyman, K. Hornberger, S.S. Germaine, A. Kane, and G.R. Holyoak. 2017. Evaluating the efficacy and safety of silicone O-ring intrauterine devices as a horse contraceptive through a captive breeding trial. Clinical Theriogenology 9:471.

Daels, P.F, and J.P. Hughes. 1995. Fertility control using intrauterine devices: an alternative for population control in wild horses. Theriogenology 44:629-639.

Environmental Protection Agency (EPA). 2020. M009 Device determination review. Product name: Y-shaped silicone IUD for feral horses. October 28 letter to BLM.

Freeman, C.E., and S.K. Lyle. 2015. Chronic intermittent colic in a mare attributed to uterine marbles. Equine Veterinary Education 27:469-473.

Gradil, C.M., C.K. Uricchio, and A. Schwarz. 2019. Self-Assembling Intrauterine Device (Upod) Modulation of the Reproductive Cycle in Mares. Journal of Equine Veterinary Science 83: 102690.

Gradil, C., C. Joonè, T. Haire, B. Fowler, J. Zinchuk, C.J. Davies, and B. Ball. 2021. An intrauterine device with potential to control fertility in feral equids. Animal Reproductive Science. doi.org/10.1016/j.anireprosci.2021.106795

Holyoak, G.R., C.C. Lyman, S. Wang, S.S. Germaine, C.O. Anderson, J.M. Baldrighi, N. Vemula, G.B. Rexabek, and A.J. Kane. 2021. Efficacy of a Y-design intrauterine device as a horse contraceptive. Journal of Wildlife Management 85:1169-1174.

Hoopes, K.H., C.M. Gradil, D.K. Vanderwall, H.M. Mason, B.A. Sarnecky and C.J. Davies. 2021. Preliminary study of the contraceptive effect of a self-assembling intrauterine Reproduction Science doi:https://doi.org/10.1016/j.anireprosci.2021.106881

Joonè, C.J., C.M. Gradil, J.A. Picard, J.D. Taylor, D. deTonnaire, and J. Cavalieri. 2021. The contraceptive efficacy of a self-assembling intra-uterine device in domestic mares. Australian Veterinary Journal. doi: 10.1111/avj.13055

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.

Klabnik-Bradford, J., M.S. Ferrer, C. Blevins, and L. Beard. 2013. Marble-induced pyometra in an Appaloosa mare. Clinical Theriogenology 5: 410.

Lyman, C.C., J.M. Baldrighi, C.O. Anderson, S.S. Germaine, A.J. Kane and G. R. Holyoak. 2021. Modification of O-ring intrauterine devices (IUDs) in mares: contraception without estrus suppression. Animal Reproduction Science doi:https://doi.org/10.1016/j.anireprosci.2021.106864

Nie, G.J., K.E., Johnson, T.D. Braden, and J. G.W. Wenzel. 2003. Use of an intra-uterine glass ball protocol to extend luteal function in mares. Journal of Equine Veterinary Science 23:266-273.

Turner, R.M., D.K. Vanderwall, and R. Stawecki. 2015. Complications associated with the presence of two intrauterine glass balls used for oestrus suppression in a mare. Equine Veterinary Education 27:340-343.

APPENDIX XIII

Pancake Complex Herd Management Area Plan

INTRODUCTION

The Bureau of Land Management (BLM), Bristlecone and Tonopah Field Office proposes in this Herd Management Area Plan (HMAP) to establish management goals and objectives for the Pancake Complex. The overriding objective is to maintain a thriving natural ecological balance and multiple-use relationship.

The Pancake Complex HMAP would establish short- and long-term management and monitoring objectives for wild horse herd and their habitat. These objectives would guide management within the complex. The primary purpose of the plan is to outline and implement management actions necessary to achieve and maintain a thriving natural ecological balance and multiple-use relationships. These actions would include conducting gathers and removals of excess wild horses and/or implement population growth suppression measures, outline habitat goals, monitoring methods, and insure genetic diversity of the horses for the Complex.

The Pancake Wild Horse Complex (Complex) includes the Pancake and Sand Springs West Herd Management Areas (HMAs), the Monte Cristo Wild Horse Territory (WHT) and the Jakes Wash Herd Area (HA). Under the 2008 Ely District Resource Management Plan (Ely RMP), no wild horses are to be managed within the Jakes Wash HA based on the BLM's analysis of monitoring data and its determination about habitat suitability, which indicated (and currently indicates) that the HA has insufficient forage, water, space, cover, and reproductive viability to maintain healthy wild horses and rangelands over the long-term. For that reason, the Jakes Wash HA will not be analyzed in the Herd Management Area Plan (HMAP).

The goal for the Pancake Complex with regards to wild horse management is to "Manage and maintain healthy wild horses and herds inside HMAs in a thriving natural ecological balance within the productive capacity of their habitat while preserving multiple use relationships."

RELATIONSHIP TO STATUTES, REGULATIONS, POLICIES, OR PLANS

See section 1.3 and 1.4 of the Environmental Assessment.

Implementation of the HMAP update is consistent with the authority provided in 43 CFR 4700 and the 1971 Wild Free-Roaming Horses and Burros Act (WFRHBA). The HMAP is needed to manage wild horses within the Pancake Complex to maintain the wild horse herd as a self-sustaining population of healthy animals in balance with other uses and the productive capacity of their habitat and attain the objectives within this document.

CURRENT CONDITIONS

A Pancake Complex Herd Management Area Plan Evaluation Report was made available to interested individuals, agencies and groups for a 30-day public review and scoping period that opened on June 12, 2024, and closed on July 15, 2024. The report can be found in APPENDIX XIV.

APPROPRIATE MANAGEMENT LEVEL (AML)

The AML is defined as the number of wild horses that can be sustained within a designated HMA which achieves and maintains a thriving natural ecological balance in keeping with the multiple-use management concept for the area. The Pancake Complex currently has a cumulative AML range of 361-638 wild horses which has been established through land use plans, Final Multiple Use Decisions, and a Wild Horse Territory Management Plan. This population range was established at a level that would maintain healthy wild horses and rangelands over the long-term based on monitoring data collected over time as well as an in-depth analysis of habitat suitability.

The range of AML for the Pancake HMA is 240-493 wild horses and was established through prior decision-making processes then affirmed through the 2008 RMP.

The Sand Springs West AML of 49 wild horses was established through a stipulated agreement (Consent Decision) between BLM, E. Wayne Hage, Colvin and Son Cattle Co., and Russell Ranches through the Department of the Interior Office of Hearings and Appeals, Hearings Division, and subsequently confirmed in the Tonopah RMP. The Tonopah RMP stated that adjustments to AML would be based on monitoring and grazing allotment evaluations. At present, existing and historical monitoring data do not indicate that an increase or decrease of the existing AML is warranted. However, achieving and maintaining AML is critical for the conservation of rangeland resources and healthy wild horses. The wild horses from Sand Springs West HMA travel back and forth across the Pancake HMA boundary lines, mixing with the wild horses from the Pancake HMA. The population within these HMAs can fluctuate depending on the seasonal movement of these wild horses.

The Monte Cristo Wild & Free Roaming Horses Management Plan established a baseline AML of 72–120 wild horses, with an average of 96 head to be maintained. These numbers were based on proper use studies conducted on the natural horse concentration areas. The baseline AML was adjusted to 72–96 through the Humboldt National Forest Land & Resource Management Plan in 1986. Range conditions had not improved with the number of horses occupying the area. The population within this WHT can fluctuate depending on the seasonal movement of the wild horses.

Herd	Total Acres Private/Public land	Appropriate Management Level	2024 population estimate (including net growth in 2023 and 2024)
Pancake	824,000	240-493	1,092
Sand Springs West	157,436	49	156
Monte Cristo WHT	93,640	72-96	145
Total	1,075,076	361-638	1393

The BLM conducted a population census flight in February 2023 to help confirm wild horse numbers within the Pancake Complex. Due to weather conditions during the flight, the wild horses that were observed had moved from higher elevations off the Monte Cristo Wild Horse Territory and into the Pancake HMA and Jakes Wash HA. A map of the recent flight survey can be found in Appendix XI.

The table reflects the total number of adult wild horses. Population inventories are usually conducted in the early spring (March) when very few new foals are born.
See Tables 1 and 2 of Appendix XIV for historic horse inventories and removal data.

Fertility Control was implemented in 1999 and 2006 and the fertility control vaccine PZP-22 was

administered to the Monte Cristo WHT and Sand Springs East/West HMA wild horses.
Gona Con was administered to 18 mares following the 2022 gather.

Genetic Diversity

During the 2022 gather in the Complex, the BLM collected genetic samples for analysis by E. Gus Cothran and Rytis Juras. The BLM received those results on April 22, 2024. In summary, the genetic variability of this the Pancake Complex herd is above or near average. No unique variants were recorded in the samples. The herd ancestry was most similar to light racing and riding breeds, followed by old world Iberian breeds, then 'oriental and Arabian breeds. Cothran and Juras (2024) suggested the herd likely includes some Spanish component based upon this data and the 2001 data, but noted that that similarity could arise from mixed ancestry. Similarity levels show no clear ancestral relationships, other than a herd having highly mixed origins. The analysis found that current variability levels are good for this herd (observed heterozygosity levels were well above the mean) and no immediate action is recommended. The most recent analysis (Cothran and Juras 2024) recommended that long term monitoring should be continued and re-sampling of the herd should be done by 2028 to check for changes in variation. A west-wide analysis of wild horse herd genetic structure indicated that horses of the Pancake Complex herd are highly similar to a large number of other BLM-managed herds (Cothran et al. 2024).

Genetic testing was completed on the wild horses in the Sand Springs East HMA following gather in 2006 (Cothran 2009) and 2022 for the Pancake HMA (Cothran and Juras 2024). Genetic samples were analyzed by Dr. E. Gus Cothran, Department of Veterinary Science, Texas A&M University. His conclusions and recommendations regarding genetic diversity in the Sand Springs East herd (Cothran 2009) are summarized as follows:

2006 SUMMARY

Genetic variability diversity of this herd is high. No unique variants were recorded in the samples. The values related to allelic diversity in particular suggest a herd with highly mixed ancestry. Genetic diversity was well above the mean for feral horses. This view is consistent with the similarity values seen and the heterozygosity measures. The herd ancestry was highly mixed, is impossible to decipher at this pointwith high levels of similarity to a large number of breed types. Cothran (2009) recommended no further action was needed at the time, with respect to genetic diversity management actions.

RECOMMENDATIONS

No action is needed at this time due to the high variability genetic diversity and relatively high AML.

As a part of periodic sampling to monitor wild horses' genetic diversity in the Complex, the BLM will collect hair follicle samples from a minimum of 25 horses in the released population. Samples will be analyzed to assess the levels of observed heterozygosity, which is a measure of genetic diversity, within the Complex and may be analyzed to determine relatedness to established breeds and other wild horse herds.

2022 SUMMARY

Genetic variability diversity of this herd is near average. No unique variants were recorded in the samples. The herd ancestry was most similar to light racing and riding breeds, followed by old world Iberian breeds, then 'oriental and Arabian breeds. Cothran and Juras (2024) suggested the herd likely includes some

Spanish component based upon this data and the 2001 data. Similarity levels show no clear ancestral relationships.

RECOMMENDATIONS
Current variability diversity levels are good for this the Pancake complex herd and no immediate action is required. Long
term monitoring should be continued. Re-sampling of the herd should be done by 2028 to check
for changes in variation.

HERD MANAGEMENT AREA PLAN
The Pancake Complex HMAP adopt and implement a management strategy which would incorporate a number of habitat and monitoring objectives. Under this strategy, wild horses would be managed under the LUP and HMAP objectives and goals and for the life of the plan Under this strategy, wild horses and their habitat will be managed over the life of the plan.

No Action Alternative: Under the No Action Alternative, continue existing management, a gather to remove excess wild horses would not occur. There would be no active management to control population growth rates, the size of the wild horse population or to bring the wild horse population to AML. See Management Objectives with Proposed Alternatives

Proposed Action (Alternative A). See Management Objectives with Proposed Alternatives

- Implement HMAP with a management strategy which would include several population growth suppression methods.
- Establish an AML range for Sand Springs West HMA of 28-49 wild Horses.
- The Complex will be managed for 336-638 wild horses.
- Excess animals will be removed to the low-range of the AML upon a determination that excess wild horses exist.
- Immediately gather and remove excess animals in order to reach low AML as expeditiously as possible through an initial gather, and if necessary, a follow-up gather or gathers, in order to achieve and maintain the population within AML range. Follow-up gathers to remove excess animals to achieve low AML shall be conducted as promptly as appropriate to allow sufficient time for the animals to settle after a helicopter gather and to provide for a safe, efficient, and effective follow-up gather operation. [7]
- Apply fertility control methods (vaccines and/or intrauterine devices) to released mares
- Maintain a sex ratio adjustment of 60% male and 40% female; and
- Population inventories and routine resource/habitat monitoring would continue to be completed every two to three years to document current population levels, growth rates, and areas of continued resource concerns (horse concentrations, riparian impacts, over-utilization, etc.)
- Once AML is achieved selective removal would occur and horses that are 10+ years old; that display good conformation and a variety of colors will be selected first to be placed back in the complex.
- Wild horses from the Complex will be sampled for genetic diversity. If genetic diversity declines, a few mares from another HMA will be introduced to the Complex.
- Fertility controls may be used as directed through the most recent direction of the National Wild Horse and Burro Program. The use of any fertility controls will use the most current best management practices and humane procedures available for the

[7] While the BLM's plan would be to immediately remove all excess animals above low AML and include enough mare fertility control treatments to slow population growth, it is possible that a single gather would not achieve this because of limitations such as on gather efficiency, logistics, space capacity for holding removed animals, or contractor availability. The result would be a need to conduct a follow-up gather or gathers to achieve low AML.

implementation of the controls.

- The existing water development projects within the Pancake Complex will be maintained as needed to ensure that water availability is adequate to disperse wild horse use. The development of new water projects will be considered as needed. Additional NEPA compliance would be completed for any new projects.
- When AML is achieved and maintained it will be re-evaluated, if needed, based upon the collection of monitoring data such as actual use, forage utilization, use pattern mapping, range condition and trend.
- The Pancake HMAP will remain in effect until superseded by another document.

Alternative B: Alternative B is the same as Alternative A but would manage a non-reproducing population of geldings. See Management Objectives with Proposed Alternatives

Alternative C: Under Alternative C, Implement HMAP with management strategy, gather and remove excess animals to within the AML range without fertility control, sex ratio adjustments or geldings. See Management Objectives with Proposed Alternatives

MANAGEMENT ACTIONS

- Future gather operations will be conducted in accordance with the SOPs described in and outlined in appendices of the Pancake Complex E.A. and/or the National Wild Horse Gather Contract.
- Future gather operations will be conducted in accordance with the most current direction and policies from the Washington Office and Nevada State Office.
- Wild horse gathers will be conducted during the gather season from July1- March 1 except in unforeseen emergency, to reduce stress on the younger animals. The helicopter drive method and helicopter assisted roping from horseback will be the primary gather methods used although water and or bait trapping may be used in some circumstances for isolated issues that may arise.
- To the extent possible gather sites (traps) will be located in previously disturbed areas.
- During gathers, when space and funding allow an attempt will be made to gather all of the excess wild horses within the Complex to achieve a population within the range of AML. All horses residing outside of the HMA boundary will also be gathered and removed.
- An Animal and Plant Inspection Service (APHIS) or other licensed veterinarian will be on-site as needed during gathers, to examine animals and make recommendations to BLM for the care and treatment of the wild horses. Decisions to humanely euthanize animals in field situations will be made in conformance with BLM policy.
- Once AML is achieved or for fertility control purposes, animals will be removed using a selective removal strategy. Selective removal criteria for the Pancake Complex include:
(1) First Priority: Age Class Four Years and Younger
(2) Second Priority: Age Class Eleven to Nineteen Years Old
(3) Third Priority: Age Class Five to Ten Years Old
(4) Fourth Priority: Curly, and medicine paint horses as well as horses 10+ years and older.
- Data including sex and age distribution, condition class information (using the Henneke rating system), color, and other information may be recorded (for animals being released).

- Hair samples will be acquired every regularly scheduled gather, to determine whether current management is maintaining acceptable genetic diversity (avoiding inbreeding depression).
- Any horses gathered and determined, with consultation between BLM and Nevada Livestock Board brand inspectors, to be domestic animals will be turned over to the local brand inspector in accordance with state law.

Management Objectives with Proposed Alternatives.
Specific management, monitoring and implementation objectives are summarized below:

Management Objective(s)	Monitoring Objective(s)	Implementation Objective(s)
Proposed Action Alternative A o Implement HMAP with a management strategy which would include several population growth suppression methods. o Establish an AML range for Sand Springs West HMA of 28-49 wild horses. o The Complex will be managed for 336-638 wild horses. o Excess animals will be removed to the low-range of the AML upon a determination that excess wild horses exist. o Manage a portion of the population as non-reproducing geldings (approximately 138) o Immediately gather and remove excess animals in order to reach low AML as expeditiously as possible through an initial gather, and if necessary, a follow-up gather or gathers, in order to achieve and maintain the population within AML range. Follow-up gathers to remove excess animals to achieve low AML shall be conducted as promptly as appropriate to allow sufficient time for the animals to settle after a helicopter gather and to provide for a safe, efficient, and effective follow-up gather operation. [8] o Apply fertility control methods (vaccines and/or intrauterine devices) to released mares o Maintain a sex ratio adjustment of 60% male and 40% female; and o Population inventories and routine resource/habitat monitoring would continue to be completed every two to three years to document current population levels, growth rates, and areas of continued resource concerns (horse concentrations, riparian impacts, over-utilization, etc.) o Once AML is achieved selective removal would occur and horses that are 10+ years old; that display good conformation and a variety of colors will be selected first to be placed back in the complex. o Wild horses from the Complex will be sampled for genetic diversity. If genetic diversity declines, a few mares from another HMA will be introduced to the Complex. o Fertility controls may be used as directed through the most recent direction of the National Wild Horse and Burro Program. The use of any fertility controls will use the most current best management practices and humane procedures available for the implementation of the controls. o The existing water development projects within the Pancake Complex will be maintained as needed to ensure that water availability is adequate to disperse wild horse use. The development of new water projects will be considered as needed. Additional NEPA compliance would be completed for any new projects. When AML is achieved and maintained it will be re-evaluated, if needed, based upon the collection of		

[8] While the BLM's plan would be to immediately remove all excess animals above low AML and include enough mare fertility control treatments to slow population growth, it is possible that a single gather would not achieve this because of limitations such as on gather efficiency, logistics, space capacity for holding removed animals, or contractor availability. The result would be a need to conduct a follow-up gather or gathers to achieve low AML.

Management Objective(s)	Monitoring Objective(s)	Implementation Objective(s)
monitoring data such as actual use, forage utilization, use pattern mapping, range condition and trend.		
<u>A. Control Population Numbers</u> Manage wild horse populations within the established AML range to protect the range from deterioration associated with overpopulation.	Conduct population inventories a minimum of once every 3 years. Conduct gathers and additional inventories as funding and time allow. Determine wild horse herd size.	Schedule gathers to remove excess wild horses when the total wild horse population exceeds the Upper AML for the HMA (about every 5-6 years), when animals routinely reside on lands outside the Pancake Complex boundary (i.e. use is more than seasonal drift), or whenever animal health/condition is at risk.
<u>B. Additional Population Control Measures</u> **Objective 1:** When AML is achieved consider population control methods as needed. **Objective 2:** Adjust the sex ratio of the breeding population slightly in favor of males.	Monitor annual population growth rate. Document the number of stallions/mares released following each gather.	Manage a population of 336-638 animals within the Complex. New population control vaccines and/or population growth suppression methods may be used within the HMA as directed through the most recent direction of the National Wild Horse and Burro Program. The use of any new fertility controls and/or population growth suppression methods would use the most current best management practices and humane procedures available for the implementation of the new controls. Within the population, achieve a sex ratio of 60 males to 40 females immediately following gathers.
<u>C. Age Distribution</u> Assure all age classes are represented post-gather.	Monitor post-gather results.	Manage wild horses to achieve the following relative age distribution following gathers: • 20% Young Age Class (Ages 0-4) • 50% Middle Age Class (Age 5-10) • 30% Old Age Class (Age 11+)
<u>D. Additional Selective Removal Criteria</u> After achieving AML maintain or improve animal conformation and color.	Monitor herd health and genetics during gather. Monitor wild horses released back into the Complex.	Selective removal criteria after achieving AML. (1) First Priority: Age Class Four Years and Younger (2) Second Priority: Age Class Eleven to Nineteen Years Old (3) Third Priority: Age Class Five to Ten Years Old

Management Objective(s)	Monitoring Objective(s)	Implementation Objective(s)
		(4) Fourth Priority: Curly, and medicine paint horses as well as horses 10+ years and older.
Alternative B: Same as Alternative A with gelding component: Alternative B is the same as Alternative A but would release a small non-reproducing component of males (up to 138 geldings) that brings the population to mid-AML.		
Objective 3: Manage a Portion of the population as a non-reproductive herd.	Monitor and document the population with a portion being a nonreproductive herd.	Release a portion of geldings into the Pancake complex to slow population growth rates.
Alternative C: Under Alternative C, gather and remove excess animals to within the AML range without fertility control, sex ratio adjustments, or geldings.		
Gate Cut removal	Monitor and document the population of wild horses for range capacity of TNEB.	Capture and remove all horses to AML. Implementation of fertility control, sex ratio adjustments or non-reproductive component would not take place.
Alternative A, B, and C		
E. Assure Genetic Diversity Maintain adequate levels of genetic diversity within the herd, so as to avoid excessive levels of inbreeding.	Collect hair samples every other gather to detect any changes in observed heterozygosity (H_o=0.431 in 2000).	If genetic diversity declines, wild horses may be introduced from similar complexes.
F. Sustain Healthy Populations of Wild Horses Manage wild horses to achieve an average body condition class score of 3+.	Visually observe wild horse body condition (Henneke Condition Class Method) throughout the year. Record average body condition and document during periodic gather and population inventory operations.	Maintain existing water developments to assist in limiting the distance horses trail to and from water sources. Conduct emergency removals when needed if animal body condition is less than Henneke Condition Class Score 3 due to lack of forage, water, drought, wildfire, or unplanned/unforeseen event.
G. Rangeland Health **Objective 1.** Achieve	Locate additional key monitoring areas within the	Achieve and maintain AML. Continue to assess and work on Rangeland Health

Management Objective(s)	Monitoring Objective(s)	Implementation Objective(s)
and maintain current AML361-638 wild horses. **Objective 2.** Assess rangeland health on BLM administered lands. **Objective 3.** Limit utilization by all herbivores to 50% of the current year's above ground primary production for key species.	Complex as needed. Measure forage utilization at key areas for Wild horses, with use pattern mapping Bi-annually.	Assessments. Analyze rangeland health through the collection of vegetative trend, cover, precipitation, forage utilization and use pattern mapping periodically. Establish additional site-specific resource management objectives for key areas, as needed. Based on above, re-adjust AML or identify management actions to address/resolve rangeland health issues, as needed/appropriate. Re-adjustments in AML will be based on vegetation monitoring, herd monitoring and water availability as the limiting factors.
H. Riparian Area Health Achieve and maintain AML, Maintain / Improve riparian condition throughout the Complex.	Re-evaluate riparian functionality. Use the Proper Functioning Condition (PFC) method on heavily impacted areas within the complex.	Gather horses to within the AML range to reduce users and maintain existing water sources or develop new water sources as needed to lessen wild horse use of the riparian areas.
No Action Alternative Under the No Action Alternative, a gather to remove excess wild horses would not occur. There would be no active management to control population growth rates, the size of the wild horse population or to bring the wild horse population to AML.		
I. Under the No Action alternative BLM would not comply with the WFRHBA and would not meet the purpose and need for the HMAP or E.A,. No gather would occur horse populations would continue to grow at an estimated 20%.	Conduct wild horse inventories. Rangeland Health Assessment.	Wild horse population and health inventories would continue every 3 years. Rangeland Health would continue to be monitored and assessed.

MONITORING PLAN

Population Management Monitoring				
Monitoring Item	**How**	**Who**	**When**	**Actions to Take (Adaptive Management)**
Manage wild horse populations within the established AML range to protect the range from further deterioration associated with overpopulation.	Population Inventories through aerial flights following established protocols. Determine population number and annual growth rate.	BLM WH&B Specialist, with assistance from State and National WH&B Staff and other Field Office Staff	Conduct Population Inventories in the HMA a minimum of every three years. Schedule flights in February- April when possible, to utilize snow cover to obtain better tracking conditions and complete counts before foaling moratorium.	Schedule gathers to remove excess wild horses when the total population exceeds the Upper AML, when animals permanently reside outside the Pancake Complex, or when animal health/condition is at risk.
Assure all age classes are represented post gather.	Record ages of animals released post-gather.	BLM WH&B Specialist	Every gather.	Adjust age class distribution during future gathers if a relatively even age distribution cannot be achieved during the current gather.
Maintain genetic diversity (avoid inbreeding depression).	Hair follicle samples would be collected during regularly scheduled gather to detect any changes from the baseline genetic diversity, and to determine whether BLM's management is maintaining acceptable genetic variability (avoiding inbreeding depression).	BLM WH&B Specialist	Every regularly scheduled gather.	If needed, introduce mares from another Nevada HMA displaying similar or desired characteristics of the horses within the complex to improve the genetic diversity.
Manage wild horses to achieve an average Henneke body condition class score of 3+.	Visually observe wild horse body condition (Henneke condition class method). Record average body condition and document other health conditions (i.e. lameness, clubfoot etc.) during periodic	BLM WH&B Specialist	Annually, at key water locations particularly during periods of hot weather/drought. Every gather and population inventory.	Conduct emergency removals when needed if animal body condition is less than Henneke body condition score 3 due to drought, wildfire, or other unplanned/unforeseen event.

Population Management Monitoring				
Monitoring Item	**How**	**Who**	**When**	**Actions to Take (Adaptive Management)**
	gather operations.			
Following achievement of AML, apply population growth suppression, adjust the sex ratio of the breeding population slightly in favor of males following future gathers.	Document population growth suppression and the number of stallions/mares released following each gather. Monitor individual and herd behavior following the gather.	BLM WH&B Specialist	Following achievement of AML every gather.	Apply population growth suppression to animals being released. Adjust the sex ratio to 60 males / 40 females following future gathers pending monitoring results.

Habitat Management Monitoring				
Monitoring Item	**How**	**Who**	**When**	**Actions to Take (Adaptive Management)**
Assess Rangeland Health approximately every 10 years on BLM administered lands with the objective to meet the Rangeland Health Standards.	Assess rangeland health using procedures outlined in the rangeland health technical reference adopted by the local district office. Re-evaluate riparian functionality using the Proper Functioning Condition (PFC) method.	BLM WH&B Specialist Range Specialist and or and BFO ID team.	Approximately every 10 years	Monitor existing key areas, establish new key areas as needed. Based on the above, re-adjust AML or identify additional management actions to address/resolve identified rangeland health issues, as needed/appropriate.
Limit utilization by all herbivores to 50% of the current year's above ground production for key species.	Measure utilization at key areas.	BLM WH&B Specialist	Annually, in the spring prior to the growing season.	Maintain the wild horse population within the AML range.
Maintain or improve vegetative trend within the HMA.	Evaluate vegetative trend.	BLM WH&B Specialist	Evaluate overall health every approximately 5-10 years with data collected.	Adjust AML, as needed, pending evaluation of monitoring results.
Monitor/assess annual project maintenance needs.	Site visits at water sources.	BLM WH&B Specialist	As needed, throughout the year.	Schedule and complete any necessary maintenance work. Document maintenance activities.

TRACKING LOG/PROJECT IMPLEMENTATION SCHEDULE

Population Management Actions					
Description	**Who**	**Where**	**When**	**Completed**	**Remarks**
Conduct wild horse population inventories.	BLM	Pancake Complex	Every 2-3 years. Winter or early spring, as funding allows.		
Schedule gathers to remove excess wild horses when the total wild horse population exceeds the Upper AML for the Complex.	BLM	Pancake Complex	Gathers to remove excess wild horses would be dependent on funding, space availability and national gather schedule. Once Low end of AML is achieved it is anticipated Every 4-5 or as soon as possible once population exceeds High AML		
Gather within the AML range and apply population growth suppression to any animals being released back into the complex. Adjust the sex ratio of the breeding population slightly in favor of males. Manage a Portion of the population as a	BLM	Pancake Complex	When post gather population is within the AML range.		

Population Management Actions					
Description	**Who**	**Where**	**When**	**Completed**	**Remarks**
non-reproductive herd.					
Assure all age classes are represented post-gather.	BLM	Pancake Complex	Every gather.		
Prioritize euthanasia/ removal of any injured, sick, and/or lame horses from the herd.	BLM	Pancake Complex	Every gather.		
Collect hair follicle samples to determine whether BLMs management is maintaining acceptable genetic diversity (avoiding inbreeding depression).	BLM	Temporary holding facility and/or short-term holding facility.	Collected as needed during gather from a minimum of 25 animals, preferably from those animals that are being released back into the Complex.		
Gather within the AML range and apply population growth suppression to any animals being released back into the complex. Selectively release animals post-gather in a ratio of 60 males / 40 females.	BLM	Temporary holding facility.	Every gather.		

Habitat Management Actions					
Description	**Who**	**Where**	**When**	**Completed**	**Remarks**
Collect forage utilization data / conduct use pattern mapping.	BLM	Pancake Complex	Every other year.		
Assess the Complex for Conformance with the Rangeland	BLM	Pancake Complex	Approxima tely every		

Habitat Management Actions					
Description	**Who**	**Where**	**When**	**Completed**	**Remarks**
Health Standards.			10 years.		
Maintain existing water sources and develop new water sources.	BLM	Throughout Pancake Complex	Annually.		

HERD MANAGEMENT AREA PLANNING MONITORING AND EVALUATION

Proven mitigation and monitoring are incorporated through standard operating procedures (SOPs) that have been developed over time. These SOPs represent the "best methods" for reducing impacts associated with gathering, handling, transportation, and herd data collection. The Pancake Complex will be monitored bi-annually as outlined in the Monitoring Plan. Management may be adjusted when monitoring data and/or other information indicates a need. In addition to monitoring, long-term evaluations will continue at roughly ten-year intervals, or as needed, based on the results of bi-annual evaluations. Monitoring objectives are outlined in the Monitoring Plan. Monitoring is designed to answer two primary questions:

"Did we do what we said we were going to do?"
"Was what we did effective in meeting/moving toward our objectives?"

The objective for the long-term evaluation is to determine:

"Are our objective(s) still current…or do they need to be modified?"
"Is our management on track…or do we need to make some changes?"

Significant changes needed as a result of annual or long-term evaluations may require appropriate NEPA analysis and documentation prior to implementation.

CONSULTATION AND COORDINATION

The consultation and coordination conducted in preparing this herd management area plan is summarized in the Pancake Complex Wild Horse Herd Management Area Plan and Gather Plan Environmental Assessment. Please refer to that environmental assessment for additional information and appendices.

List of Preparers

Ben Noyes Wild Horse Specialist, BFO

APPENDIX XIV

Pancake Complex Herd Management Area Plan
Management Evaluation
May 2024

INTRODUCTION

The Pancake Wild Horse Complex (Complex) includes the Pancake and Sand Springs West Herd Management Areas (HMAs), the Monte Cristo Wild Horse Territory (WHT) and the Jakes Wash Herd Area (HA). Under the 2008 Ely District Resource Management Plan (Ely RMP), no wild horses are to be managed within the Jakes Wash HA based on the BLM's analysis of monitoring data and its determination about habitat suitability, which indicated (and currently indicates) that the HA has insufficient forage, water, space, cover, and reproductive viability to maintain healthy wild horses and rangelands over the long-term. For that reason, the Jakes Wash HA will not be analyzed in the Herd Management Area Plan (HMAP).

The Complex is located approximately 50 miles west of Ely, Nevada, within portions of White Pine and Nye Counties, and lies within the Ely and Battle Mountain BLM Districts as well as the United States Forest Service (USFS) Humboldt-Toiyabe National Forest. The Complex is approximately 1,075,076 acres in size.

The Complex is located within the Great Basin physiographic region, characterized by a high, rolling plateau underlain by basalt flows covered with a thin loess and alluvial mantle. On many of the low hills and ridges that are scattered throughout the area, the soils are underlain by bedrock. Elevations within the Complex range from approximately 5,000 feet to 11,000 feet. Annual precipitation ranges from approximately 5 inches or less on some of the valley bottoms to 20 inches on the mountain peaks. Most of this precipitation comes during the winter and spring months in the form of snow, supplemented by localized thunderstorms during the summer months. Temperatures range from greater than 90 degrees to 98 degrees Fahrenheit in the summer months to minus 20 degrees in the winter. The area is also utilized by domestic livestock and numerous wildlife species.

WILD HORSES

Wild horses can be found throughout the Pancake Complex at different times of the year. Typically, horses remain at the upper elevations during the summer as long as the forage and water last. As these resources are depleted, or when snow drives them down (as early as September in some years), they move off the mountains and into the valleys. Here they exist on grasses such as Sandberg bluegrass (*Poa Secunda*), Needle-and-thread grass (*hesperostipia comata*), and Indian ricegrass (*Achnatherum hymenodes*). In addition to grasses, horses in the region have adapted to a diet of some shrubs including winterfat (*Krascheninnikovia lanata*) and saltbush (*Atriplex sp.*) Water is very limited throughout the Complex. Primary sources include springs and livestock wells. In eastern Nevada, wild horses foal in the spring, mostly during the months of April or May. This coincides with spring green-up affording the most nutritious forage to nursing mares and foals.

The Egan RMP (1987 Ely District) designated the Monte Cristo and Sand Springs East HMAs for the long-term management of wild horses. These HMAs were later combined into the Pancake HMA in the Ely RMP. The decision to combine was based on the historical interchange of wild horses between the two HMAs and an in-depth analysis of habitat suitability and monitoring data. The Pancake HMA is nearly identical in size and shape to the original Herd Areas representing where wild horses were located in 1971. Some fences exist within the Pancake HMA but do not restrict wild horse movement as they are open ended drift fences. Currently, management of HMAs and wild horse populations within the Ely District is guided by the Ely RMP. The BLM evaluated each HMA for five essential habitat components and herd characteristics: forage, water, cover, space, and reproductive viability. Through this analysis, the BLM established the boundaries of the Pancake HMA to ensure sufficient habitat for wild horses. The BLM set the AML at a level that would achieve a thriving natural ecological balance and rangeland health. The Appropriate Management Level (AML) range for the Pancake HMA is 240-493 wild horses.

The Sand Springs West HMA AML of 49 wild horses was established through a stipulated agreement (Consent Decision) between the BLM, E. Wayne Hage, Colvin and Son Cattle Co., and Russell Ranches through the Department of the Interior Office of Hearings and Appeals, Hearings Division, and subsequently confirmed in the Tonopah Resource Management Plan (Tonopah RMP) approved October 6, 1997. The Tonopah RMP outlined that adjustments to AML would be based on monitoring and grazing allotment evaluations. At present, monitoring data indicates that changing the AML is not warranted. However, achieving and maintaining AML is critical for the conservation of rangeland resources and healthy wild horses. The wild horses from the Sand Springs West HMA travel back and forth across the Pancake HMA boundary lines, mixing with the wild horses from the Pancake HMA. The population within these HMAs can fluctuate depending on the seasonal movement of these wild horses.

The Monte Cristo Wild & Free Roaming Horses Management Plan established a baseline AML range for the WHT of 72–120 wild horses, with an average of 96 head to be maintained. AML was based on proper use studies conducted on the natural horse concentration areas. The baseline AML was adjusted to 72–96 through the Humboldt National Forest Land & Resource Management Plan in 1986. Range conditions had not improved with the number of horses occupying the area. The population within this WHT can fluctuate depending on the seasonal movement of the wild horses.

The following table indicates the approximate wild horse population and removals within the Complex prior to the Ely RMP where the Sand Springs East HMA and Monte Cristo HMA were combined. Table 1 reflects the total number of the estimated wild horse population. This information was created using formal wild horse population inventory data, as well as ground-based observations and gather operations that were completed.

Table 1: Estimated Wild Horse Population and Removals Before 2008

Estimated Wild Horse Population by Year 1985-2007								
Sand Springs East HMA AML 257 386,776 Acres			**Sand Springs West HMA AML 49** 157,436 Acres			**Monte Cristo WHT& HMA AML 72-120** 228,940 Acres		
Year	**Population Estimate**	**Removal**	**Year**	**Population Estimate**	**Removal**	**Year**	**Population Estimate**	**Removal**
1985			1985			1985	253	185
1987		408	1987			1987		
1988	507		1988	49		1988		
1989	788		1989	154		1989	392	
1990			1990			1990		
1991	936		1991	193		1991	725	
1992	1,061		1992	218		1992	780	
1993	555		1993	184	261	1993	691	
1994	531		1994	210	262	1994	697	118
1995		701	1995	135	21	1995		749
1996			1996		125	1996		
1997	519		1997	97	9	1997	626	
1998	724		1998	82		1998	696	
1999		268	1999	48		1999	455	311
2000	327	200**	2000	56		2000	429	
2001			2001			2001		
2002			2002			2002	836	586
2003	182		2003			2003	519	
2004	218		2004			2004	623	
2005	295		2005	239	1	2005	306	
2006	145	227	2006	48	245	2006	145	220
2007	175		2007	56		2007	175	

Fertility Control was implemented in 1999 and 2006 and the fertility control vaccine PZP-22 was administered to the Monte Cristo WHT and Sand Springs East/West HMA wild horses.

Table 2: Estimated Wild Horse Population and Removals Since 2008

Estimated Wild Horse Population by Year 2008-2024								
Pancake HMA AML 240-493 (2005-2008 Monte Cristo and Sand Springs West) 824,000 Acres			**Sand Springs West HMA AML 49** 157,436 Acres			**Monte Cristo WHT AML 72-96** 93,640 Acres		
Year	**Population Estimate**	**Removal**	**Year**	**Population Estimate**	**Removal**	**Year**	**Population Estimate**	**Removal**
2008*	350		2008	48		2008		
2009	897		2009	246		2009		
2010	1,076		2010	246		2010		
2011*	1,291		2011	285		2011	163	
2012	1,005	648/125**	2012	200	119	2012		
2013	1,081		2013	120		2013		
2014*	1,111		2014	149		2014		
2015	1,400		2015	187		2015		
2016*	1,800	293**	2016	230		2016	85	
2017	1,800		2017	213		2017	102	
2018*	2,160	89**	2018	287		2018	123	
2019	2,503		2019	333		2019	147	
2020	3,004		2020	386		2020	232	
2021*	2,237		2021	144		2021	88	
2022	705	1,751	2022	85	125	2022	122	34
2023*	1,212		2023	70		2023	90	
2024	1,092		2024	156		2024	145	
Average	**1,454**			**199**			**130**	

*Notes years that an inventory flight was conducted for the Complex. Due to reporting numbers at the first of the year and flying later, the inventory numbers from the flights are generally represented the following year.
**Emergency gathers due to lack of water.

Population inventory flights have been conducted in the Complex every two to three years. These population inventory flights collect information about population numbers, foaling rates, distribution, and herd health. Due to the wild horse movement within the Complex and depending on the conditions on the ground when the flight is performed, wild horse numbers increase or decrease from year to year in each individual HMA.

RELATIONSHIP TO STATUTES, REGULATIONS, POLICIES, OR PLANS

The current RMPs, laws, regulations, and policies, as outlined below, set forth management goals and objectives and reaffirm AML for the HMAs and WHT within the Complex.

2008 Ely RMP:

- **Goal:** "Maintain and manage healthy, self-sustaining wild horse herds inside herd management areas within appropriate management levels to ensure a thriving natural ecological balance while preserving a multiple-use relationship with other uses and resources."
- **Objective:** "To maintain wild horse herds at appropriate management levels within herd management areas where sufficient habitat resources exist to sustain healthy populations at those levels."

1997 Tonopah RMP:

- **Objective**: "To manage wild horse and/or burro populations within Herd Management Areas at levels which will preserve and maintain a thriving natural ecological balance consistent with other multiple-use objectives."

1986 Humboldt National Forest Land and Resource Management Plan:

- **Goal # 20**: "Manage the Cherry Springs, Monte Cristo, and Quinn Wild Horse Territories in accordance with the Wild Horse and Burro Act and the approved territory plans."
- **Standards and Guidelines:** "Manage wild free-roaming horses and burros to population levels compatible with the resource capabilities and needs."

Federal Land Policy and Management Act of 1976 (FLPMA):

FLPMA generally requires that an action under consideration be in conformance with the applicable BLM land use plan(s), and be consistent with other federal, state, and local laws and policies to the maximum extent possible.

WFRHBA

The statute requires the BLM to protect the range from deterioration associated with overpopulation (16 U.S.C. § 1333(b)(2)) and defines excess animals as wild and free-roaming horses and burros that must be removed from an area in order in order to preserve and maintain a thriving natural ecological balance and multiple-use relationship in that area (16 U.S.C. § 1332(f)). It also directs the BLM to maintain a current inventory of wild free-roaming horses and burros on public lands. The purpose of the inventory shall be to: make determinations as to whether and where an overpopulation exists and whether action should be taken to remove excess animals; determine appropriate management levels or wild free-roaming horses and burros on these areas of public land; and determine whether appropriate managements should be achieved by the removal or destruction of excess animals, or other options (such as sterilization, or natural control on population levels) (16 U.S.C. § 1333(b)(1)).

BLM Regulations at 43 C.F.R. Part 4700

- 43 C.F.R. § 4700.0-6 (a): 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).
- 43 C.F.R. § 4710.4: Management of wild horses and burros shall be undertaken with the objective of limiting the animals' distribution to herd areas. Management shall be at the minimum level necessary to attain the objectives identified in approved land use plans and herd management area plans.

- 43 C.F.R. § 4720.1: Upon examination of current information and a determination by the authorized officer that an excess of wild horses or burros exists, the authorized officer shall remove the excess animals immediately…
- 43 C.F.R. § 4720.2: Upon written request from a private landowner……the Authorized Officer shall remove stray wild horses and burros from private lands as soon as practicable.
- 43 C.F.R. § 4740.1(a): Motor vehicles and aircraft may be used by the authorized officer in all phases of the administration of the Act, except that no motor vehicle or aircraft, other than helicopters, shall be used for the purpose of herding or chasing wild horses or burros for capture or destruction. All such use shall be conducted in a humane manner. (b) Before using helicopters or motor vehicles in the management of wild horses or burros, the authorized officer shall conduct a public hearing in the area where such use is to be made.

USFS Regulations at 36 C.F.R. Part 222

- 36 C.F.R. § 222.60 (a) Authority. The Chief, Forest Service, shall protect, manage, and control wild free-roaming horses and burros on lands of the National Forest System and shall maintain vigilance for the welfare of wild free-roaming horses and burros that wander or migrate from the National Forest System. If these animals also use lands administered by the Bureau of Land Management as a part of their habitat, the Chief, Forest Service, shall cooperate to the fullest extent with the Department of the Interior through the Bureau of Land Management in administering the animals.
- 36 C.F.R. § 222.61 (a) (1) Administer wild free-roaming horses and burros and their progeny on the National Forest System in the areas where they now occur (wild horse and burro territory) to maintain a thriving ecological balance considering them an integral component of the multiple use resources, and regulating their population and accompanying need for forage and habitat in correlation with uses recognized under the Multiple-Use Sustained Yield Act of 1960 (70 Stat. 215; 16 U.S.C. 528-531)
- 36 C.F.R. § 222.64 (a) Prior to using helicopters in capture operations and/or using motor vehicles for the purpose of transporting captured animals, a public meeting will be held in the proximity of the territory where the capture operation is proposed. (b) Helicopters may be used in all phases of the administration of the Act including, but not limited to, inventory, observation, surveillance, and capture operations... (c) Fixed-wing aircraft may be used for inventory, observation, and surveillance purposes necessary in administering the Act… (d) Motor vehicles may be used in the administration of the Act except that such vehicles shall not be used for driving or chasing wild horses or burros in capture operations. Motor vehicles may also be used for the purpose of transporting captured animals…
- 36 C.F.R. § 222.66 Owners of land upon which wild free-roaming horses and burros have strayed from the National Forest System may request their removal by calling the nearest office of either the Forest Service or Federal Marshall.
- 36 C.F.R. § 222.69 (a) The Chief, Forest Service, shall, when he determines over-population of wild horses and burros exists and removal is required, take immediate necessary action to remove excess animals from that particular territory. Such action shall be taken until all excess animals have been removed so as to restore a thriving natural ecological balance to the range and protect the range from deterioration associated with over-population.

In *Animal Protection Institute*, 118 IBLA 63, 75 (1991), the Interior Board of Land Appeals found that under the WFRHBA, the BLM is not required to wait until the range has sustained resource damage to reduce the size of the herd. Instead, proper range management dictates removal of "excess animals" before range conditions deteriorate in order to preserve and maintain a thriving natural ecological balance and multiple-use relationship in that area.

GENETIC DIVERSITY

During the 2022 gather in the Complex, the BLM collected genetic samples for analysis by E. Gus Cothran and Rytis Juras. The BLM received those results on April 22, 2024. In summary, the genetic variability of this herd is near average. The herd ancestry likely includes some Spanish component based upon this data and the 2001 data. Similarity levels show no clear ancestral relationships. The analysis found that current variability levels are good for this herd and no immediate action is recommended. The analysis recommended that long term monitoring should be continued and re-sampling of the herd should be done by 2028 to check for changes in variation.

As a part of periodic sampling to monitor wild horses' genetic diversity in the Complex, the BLM will collect hair follicle samples from a minimum of 25 horses in the released population. Samples will be analyzed to assess the levels of observed heterozygosity, which is a measure of genetic diversity, within the Complex and may be analyzed to determine relatedness to established breeds and other wild horse herds.

The 2013 National Academies of Sciences report included other evidence that shows that wild horses in the Pancake HMA (i.e. when it was Sand Springs East HMA) and in herds very close to the Complex are not genetically unusual, with respect to other wild horse herds. Specifically, Appendix F of the 2013 NAS report is a table showing the estimated "fixation index" (Fst) values between 183 pairs of samples from wild horse herds. Fst is a measure of genetic differentiation, in this case as estimated by the pattern of microsatellite allelic diversity analyzed by Dr. Cothran's laboratory. Low values of Fst indicate that a given pair of sampled herds has a shared genetic background. The lower the Fst value, the more genetically similar are the two sampled herds. Values of Fst under approximately 0.05 indicate virtually no differentiation. Values of 0.10 indicate very little differentiation. Only if values are above about 0.15 are any two sampled subpopulations considered to have evidence of elevated differentiation (Frankham et al. 2010). Pairwise Fst values for Sand Springs East HA were less than 0.05 with over 120 other sample sets. These results suggest that herds in and near the Complex were extremely similar to a third to two thirds of other BLM-managed herds, supporting the interpretation that the Pancake Complex horses are components in a highly connected metapopulation that includes horse herds in many other HMAs.

Since 2008 when the Ely RMP was approved, the average population for the Complex has been 1,783 wild horses. The AML for the Complex is 361-638 wild horses. Rangeland conditions continue to deteriorate due to the chronic overpopulation of excess wild horses within the Complex. That overpopulation, coupled with a lack of sufficient forage and water, has led to a number of emergency gathers.

FORAGE UTILIZATION AND USE PATTERN MAPPING

The BLM has collected utilization data for Complex over the last 10 years. The key forage species monitored at that time include: Indian ricegrass (*Achnatherum hymenoides*), winterfat (*Krascheninnikovia lanata*), Squirreltail grass (*Elymus elymoides*) and Needleandthread grass (*Hesperostipa comata*).

Year	Slight (1-20%)	Light (21-40%)	Moderate (41-60%)	Heavy (61-80%)	Severe (81-100%)	Site lost
2011	32%	20%	24%	18%	6%	0
2014	13%	31%	28%	24%	4%	0
2016	7%	22%	36%	31%	4%	0
2019	0	7%	29%	36%	26%	0
2021	0	19%	22%	36%	19%	2%
2023	5%	17%	42%	18%	11%	7%

RANGELAND HEALTH STANDARDS

Rangeland resources have been and are currently being impacted within the Pancake HMA due to the over-population of wild horses. The BLM has determined that wild horses are contributing factors to not meeting the Rangeland Health Standards. Resource monitoring data for the South Sand Springs Valley Use Area – an area that has not been grazed by cattle for the past 20 years – has shown wild horses and drought as the contributing factors for not meeting the Standards. Based on Rangeland Health Standards, the majority of the Pancake HMA is not meeting the uplands standard for vegetation due to shrub dominance, lack of native vegetation cover, the risk of invasive species spread, and heavy or severe utilization at times from grazers, the soil resources lack much resiliency or capability to maintain or improve. The risk of erosion and loss of soil structure in this use area after repeated disturbance without rest is greater than other use areas without horse presence. The BLM has prepared standards determination documents and rangeland health evaluations that identify wild horses as a contributing factor for non-achievement of some standards for rangeland health and management objectives.

OTHER RESOURCES

Tribal

The Pancake HMA is within the Duckwater Shoshone Tribe Reservation. In 2016 the BLM transferred 31,123.85 acres to the Bureau of Indian Affairs (BIA) for the expansion of the reservation. Due to that transfer, the boundaries of the Pancake HMA have been adjusted. However, the expansion of the reservation has not been completely fenced and so wild horses reside on the reservation.

Mining

<u>Pan Mine</u>

Mining activity has taken place in the general region since 1876; however, exploration of the Pan deposit did not occur until Lyle Campbell’s discovery in 1978. These exploration activities have resulted in existing surface disturbance in the Pan Mine area, some of which has been reclaimed. The Pan deposit has been explored by several exploration and/or mining companies since 1978. The BLM authorized exploration activities in 2004 and a plan of operations in 2013 that covers over 3300 acres.

Gold Rock Mine (previously Easy Junior)
Mining has taken place in the general region since the 1860s. Earth Resources Co. first staked the project area in 1979. Since then, several mining and exploration companies have explored the Gold Rock property. The Easy Junior Mine began operations in 1989 and it was expanded in 2018 to cover over 3900 acres.

Wildlife
The Complex provides habitat for many species of wildlife, including large mammals like mule deer, pronghorn antelope, Rocky Mountain elk, and desert bighorn sheep. Yearlong habitat for mule deer occurs throughout the Complex. A large area of crucial summer range occurs in the upper elevations of the Monte Cristo WHT, and small areas of crucial winter range occur in the Pancake HMA. The majority of the complex outside of the White Pine Range is yearlong pronghorn antelope habitat. The White Pine Range in the Monte Cristo WHT is Rocky Mountain elk yearlong habitat. There is occupied desert bighorn sheep habitat in the south end of the Monte Cristo WHT, the Duckwater Hills and Pancake Range in the Pancake HMA.

Predominant habitat types within the Complex that are likely to support migratory birds include: aspen, mountain riparian, mountain shrub, sagebrush, pinyon/juniper, salt desert scrub, playa and cliffs/talus habitat types. There are small inclusions of coniferous forest and mountain mahogany habitat types included in the upper elevations of the Pancake Range. The migratory bird nesting season is from March 1 through July 31 (including raptors).

Wildfire
Fire history within the Pancake HMA is characterized by relatively low occurrence with few large fires. This is characteristic of its rural location and sparse vegetation types. There have been 47 reported ignitions for a total of 40.6 acres over the last 20 years. The median fire size is 0.1 acres with the largest being 21 acres. Over that last 20 years there have been no fires over 300 acres.

Fire Regime Condition Class analyses was completed for the Newark and Huntington Watersheds Restoration EA which covered the northern 13.4% of the Pancake HMA. Fire Regime Condition Class represents the departure of the vegetation from the reference condition (condition prior to European Influence) into 3 classes. Fire Regime Condition Class 1 is categorized as being within the historic disturbance regime relating to the reference condition. As a vegetation community progresses towards FRCC 2 and 3 the departure from reference condition increases as does the risk to key ecosystem components and the risk of disturbances (wildfire) occurring outside of the historic disturbance regime. The analysis categorized vegetation by Biophysical Setting Model (BpS) within the overall watersheds. Sagebrush, Salt Desert Scrub and Pinyon/Juniper woodland BpS’s that represent the majority of the landscape covered by the analyses within the Pancake HMA were categorized as FRCC 2 which places them at moderate risk.

EXISTING CONDITIONS

Since the passage of the WFRHBA, management knowledge regarding wild horse population levels has increased. For example, it has been determined that wild horses are capable of increasing their numbers by 15% to 25% annually, resulting in the doubling of wild horse populations about every 4 years (NRC 2013). This has resulted in the BLM shifting program emphasis beyond just establishing AML and conducting wild horse gathers to include a variety of management actions that further facilitate the achievement and maintenance of viable and stable wild horse populations and a thriving natural ecological balance. Management actions include increasing fertility control, adjusting sex ratio, and collecting genetic baseline data to support genetic health assessments.

The AML is defined as the number of wild horses that can be sustained within a designated HMA which achieves and maintains a thriving natural ecological balance in keeping with the multiple-use management concept for the area. The Complex has a cumulative AML range of 361-638 wild horses which has been established through decisions as outlined in this document.

Range resources

As outlined in the 2008 SDD for Duckwater Allotment, the allowable use level is 50% for key grasses of the current year's growth by weight for yearlong use of these species. Utilization will be measured at established key grazing areas or other sites representative of the dominant vegetation in the allotment. The allowable use level is 50% of the current year's growth by weight for key riparian grasses, shrubs at riparian systems. Examples of key riparian grasses or grass-like species are sedge, rush, spike-rush, bluegrass species, redtop (bentgrass) and timothy.

Over the last decade our utilization for wild horse use has shown declining trend moving to heavy and severe use on key species. In 2011, utilization levels showed 24% of the sites were at moderate use, 18% heavy, and 6% severe. In 2023, utilization levels showed that 42% of the monitoring sites were moderate 18% heavy and 11% severe. In 2023, 7% of our original monitoring sites have been lost with not enough key forage species to perform utilization analysis.

Range improvements (water developments)

Water available for use by wild horses within the Pancake HMA is limited to a few perennial sources. Ike Spring, Moody Spring and Indian Spring tend to produce water year-round. As water supplies become depleted at other smaller water sources, wild horses tend to concentrate around these primary water sources causing negative effects to riparian resources. These water sources are monitored throughout the summer to make sure water is available for wild horses. The Young Florio Spring water development has been damaged by excess numbers of wild horses as they search for water. During the summer months this spring only produces a trickle of water. This water development has been fixed several times with repairs to the pipeline. Following each repair, the wild horses have damaged the water development by pawing and breaking the pipeline. Young Florio Well is an ephemeral water source which, depending on the year's precipitation level in the area, may or may not produce water. If the source produces water during summer months helps relieve pressure from Young Florio Spring. However, it is not a reliable source of perennial water. At Martiletti Spring, a development of pipeline and trough system installed in 2015 has helped contain the water that the spring produces, however the flow changes seasonally and all but dries up in the hot summer months. Moody Spring had a fence exclosure put around the spring to protect the spring source while allowing the water to seep out and fill a catch pond below it. In 2014 two wildlife guzzlers were installed at two locations on the east bench of Sand Springs Valley to help provide additional water for the wild horses. Although there is some seasonal use at these guzzlers, they have not attracted very large groups of horses or had consistent use.

In 2012, 2016 and 2018, the BLM conducted emergency gathers at Ike, Moody and Martilletti Springs to reduce the number of horses that were relying on these drying up water sources. Wild horses also rely on springs located on the USFS lands within and outside the Monte Cristo WHT. The remaining springs within the Pancake HMA might have water in early spring depending on precipitation but are not reliable perennial water sources.

Water in the Sand Springs West HMA is limited to man-made water-haul sites developed for grazing livestock. One site (Etcheverria Well) has a small reservoir that seasonally holds run-off water which is available to wild horses. This water accumulates from winter precipitation and snow melt, only to dry up during the hot summer months. Water is available to wild horses temporarily at water haul sites while domestic livestock are grazing; however, they are not reliable sources. Some water hauls sites have small depressions or tanks that may temporarily hold water from natural precipitation; however, they are not consistent or dependable sources. No known natural springs occur on the HMA except along Nevada State Highway 6, at which horses are rarely observed. Many of the wild horses from the Sand Springs West HMA travel into the Pancake HMA to areas outside of the Sand Springs West HMA in search of water sources. Concentrations of wild horses and cattle around the limited water sources during the summer months increases competition with wildlife for water resources and negatively affect the associated range resources.

The Monte Cristo WHT wild horses generally utilize the Vanover, Monte Cristo, Birch, Emigrant, and Allen Springs. During the summer months the horses will rely on catch ponds and perennial springs for water. During the winter months most years, the majority of the horses will move into lower elevations onto BLM-managed public lands due to heavy snow in the higher elevations.

<u>Livestock grazing</u>
The Complex includes portions of serval livestock grazing allotments. Permitted livestock grazing use in the HMAs, HA, and WHT include both cattle and sheep. Some livestock grazing occurs during all seasons. Permitted livestock grazing use has generally been reduced from historical grazing levels over the past decades in a majority of the allotments. This has been in part due to persistent drought, competition with wild horses for forage, and the needs of livestock operations. The BLM continues to evaluate allotments for achievement of rangeland health standards, and adjustments to livestock grazing are implemented as appropriate, as grazing term permits are renewed or through annual coordination between BLM and grazing permit holders. Livestock grazing is administered through the regulations at 43 C.F.R. Part 4100 and must be consistent with multiple use allocations set forth in RMPs. Changes to livestock grazing cannot be made with a wild horse management decision.

Livestock grazing in the Complex has averaged approximately 72% percent of permitted use over the last ten years. In the charts below, Animal Unit Month (AUM) means the amount of forage necessary for the sustenance of one cow or its equivalent for a period of 1 month (43 C.F.R. § 4100.0-5).

Table 3. Pancake Complex Grazing Allotments

HMA/WHT	Allotment	Season of Use	% of Allotment in HMA/WHT	Permitted Use	Ten Year Average AUM Use	Percent Actual Use of Permit
Pancake HMA	Duckwater	Cattle and Sheep 3/1 to 2/28	100%	23,667	6,858	29%
Pancake HMA	Monte Cristo	Cattle 6/21 to 9/18	100%	1,129	74	7%
Pancake HMA	Pancake Black Point	Cattle 6/01 to 2/28	17%	609	588	97%
Pancake HMA	Six Mile	Cattle 4/15 to 10/31; Sheep 11/1 to 4/15	96%	1,209	552	46%
Pancake HMA	South Pancake	Sheep 11/1 to 4/15	100%	1,155	832	72%
Pancake HMA	Newark	Cattle and Sheep 3/1 to 2/28	15%	9,709	3,069	32%
Sand Springs West HMA	Sand Spring	Cattle 3/1 to 2/28; Sheep 11/1 to 3/31	100%	7,843	5,624	72%
Monte Cristo WHT	Blackrock	Cattle 6/21 to 9/30	73%	540	504	90%
Monte Cristo WHT	Treasure Hill	Cattle 6/16 to 10/15	63%	2,198	2,010	93%
Monte Cristo WHT	Illipah	Cattle 6/16 to 10/15	2%	895	823	99%
Monte Cristo WHT	Tom Plain	Cattle 6/11 to 10/10	17%	2,647	2,089	80%

Wild horses

Population growth suppression measures include the administration of fertility control measures (i.e. PZP vaccines, GonaCon or newly developed vaccine formulations, IUDs) to released mares and adjustment of sex ratios to achieve a 60 % male to 40% female ratio. In addition to bringing the wild horse population to low AML, up to 138 gelded horses – that would otherwise be excess animals permanently removed from the range and sent to off-range corrals for adoption/sales or off-range pastures – may be returned to the range and managed as a non-breeding population of geldings, so long as the geldings do not result in the population exceeding mid-range AML.

The fertility control component will reduce the total number of wild horses that would otherwise be permanently removed from the range. Including some fertility control-treated mares and some geldings in the herd at mid-AML herd size would allow for management of a total wild horse population within the Complex that would be larger than low AML, while still reducing population growth rates compared to those of an untreated herd and achieving a thriving natural ecological balance.

Primary gather methods include helicopter drive and/or bait and water trapping. While it is the BLM's goal to immediately gather excess wild horses and/or gather wild horses for fertility treatment in a single gather, it is expected that not all horses can be captured because gather efficiencies rarely exceed 80-85% especially in larger Complexes. As a result, a proportion of wild horses (15-20%+) in the Complex may not be captured or treated over the 10-year period of the Proposed Action. During a gather, horses are identified for removal or release based on age, gender, and/or other characteristics. Mares identified for release would be aged, microchipped and freeze-marked for identification prior to being released to help identify the animals for future treatments/boosters and assess the efficacy of fertility control treatments.

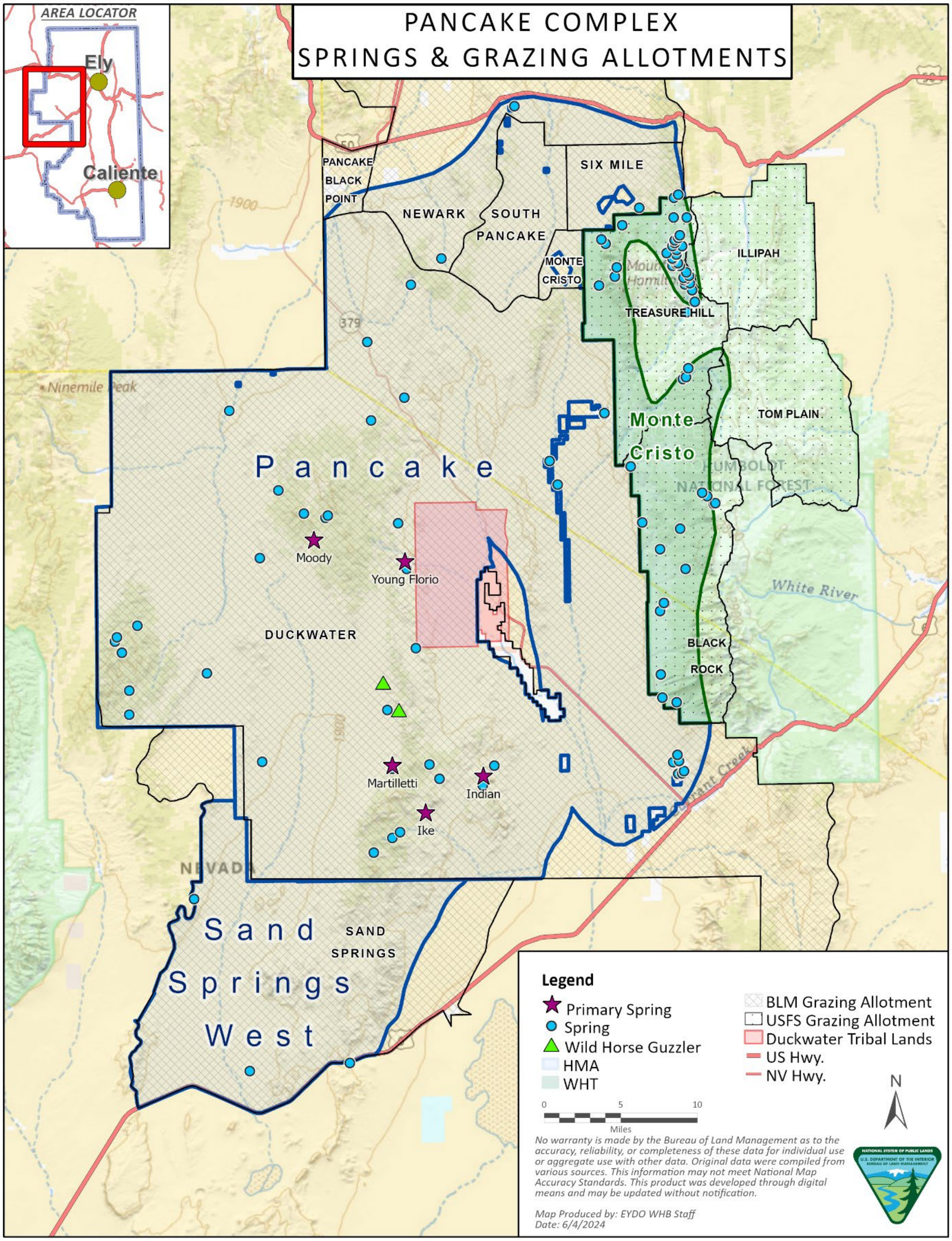
Fertility control was applied within the Complex in 1999 and 2006 and mares were treated with PZP-22. During the 2012 gather, 125 mares were treated with PZP-22 and released back to the complex with 162 stallions. In 2022, 18 mares were treated with GonaCon and 6 stallions were released back to the range. Management objectives are to achieve and maintain AML within the Complex. Once AML is achieved, the BLM's goal is to implement population growth suppression fertility control vaccines, manage a portion of the population as non-reproducing geldings, and maintain a sex ratio of 60 % males to 40% females. Gather operations would utilize the helicopter drive trap and/or water/bait trapping were feasible.

MANAGEMENT ISSUES
The key components for maintaining a healthy wild horse population are forage, water, cover, and space. Cover and space are plentiful for wild horses in the Complex. Forage and water availability is generally a limiting factor and is particularly limited in preferred wild horse use areas and during extended periods of severe drought coinciding with high wild horse numbers.

FUTURE MANAGEMENT
The BLM and USFS intend to prepare the Pancake Complex HMAP to guide management of the wild horses and their habitat into the future. The HMAP will address the following management objectives:

- Manage wild horses within HMAs and WHT at AML
- Assure rangeland and riparian health
- Utilize all population growth suppression methods
- Maintain and ensure genetic diversity
- Maintain Greater Sage-Grouse habitat
- Other issues as identified

Map 1.


PANCAKE COMPLEX
SPRINGS & GRAZING ALLOTMENTS
AREA LOCATOR
Ely
Caliente
PANCAKE BLACK POINT
NEWARK
SOUTH PANCAKE
SIX MILE
MONTE CRISTO
ILLIPAH
TREASURE HILL
TOM PLAIN
Monte Cristo
HUMBOLDT NATIONAL FOREST
White River
Pancake
Ninemile Peak
Moody
Young Florio
DUCKWATER
BLACK ROCK
Martilletti
Indian
Ike
NEVADA
Sand Springs West
SAND SPRINGS
Legend
Primary Spring
Spring
Wild Horse Guzzler
HMA
WHT
BLM Grazing Allotment
USFS Grazing Allotment
Duckwater Tribal Lands
US Hwy.
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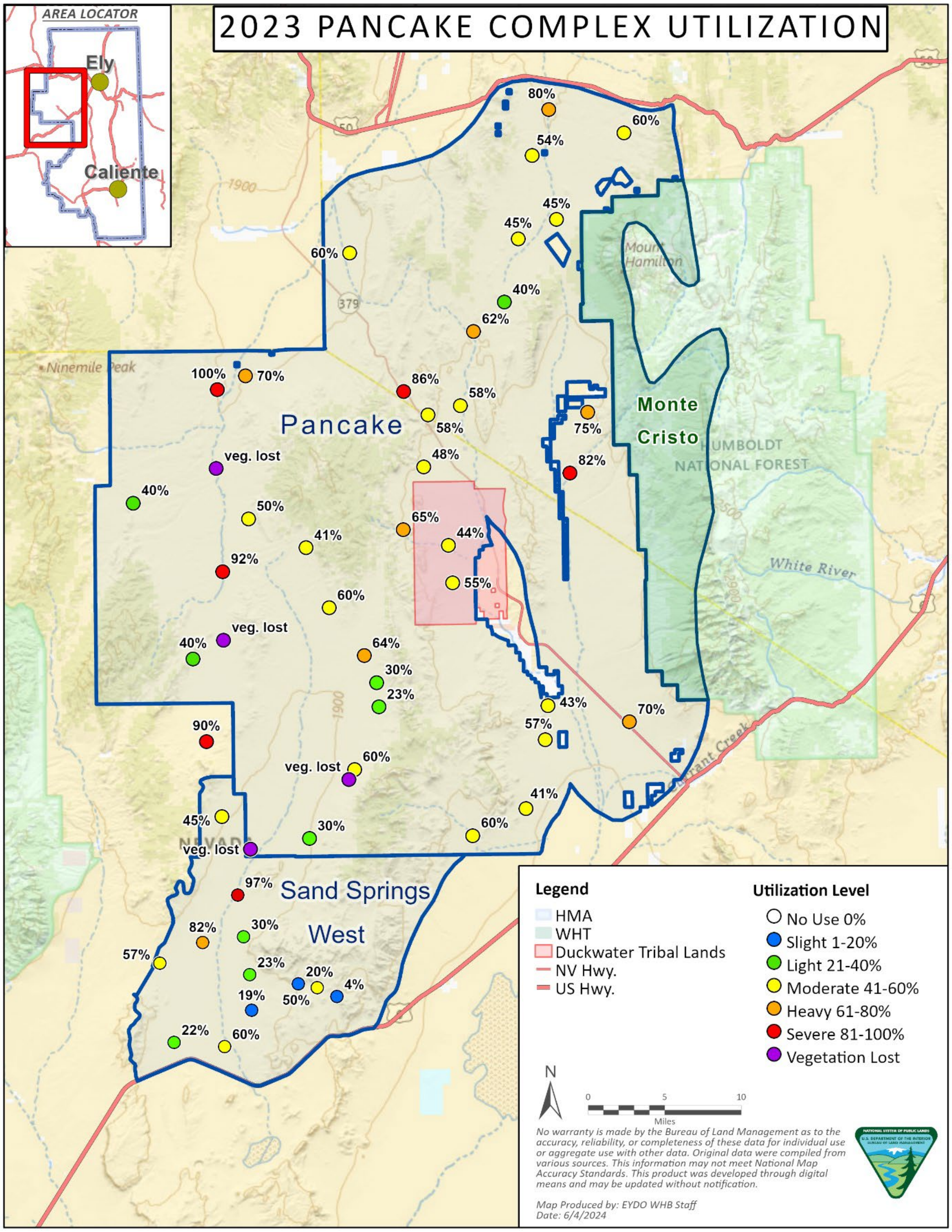
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.
Map Produced by: EYDO WHB Staff
Date: 6/4/2024

Map 2.



2023 PANCAKE COMPLEX UTILIZATION
AREA LOCATOR
Ely
Caliente
Pancake
Monte Cristo
HUMBOLDT NATIONAL FOREST
White River
Sand Springs West
Mount Hamilton
Ninemile Peak
Legend
HMA
WHT
Duckwater Tribal Lands
NV Hwy.
US Hwy.
Utilization Level
No Use 0%
Slight 1-20%
Light 21-40%
Moderate 41-60%
Heavy 61-80%
Severe 81-100%
Vegetation Lost
N
0 5 10
Miles
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.
Map Produced by: EYDO WHB Staff
Date: 6/4/2024

Comments and Responses

A Pancake Complex Herd Management Area Plan Management Evaluation Report was made available to interested individuals, agencies and groups for a 30-day public review and scoping period that opened on June 12, 2024, and closed on July 15, 2024. Scoping comments were received from approximately 6,000 individuals (primarily as form letters) or organizations, and agencies. Many of these comments contained overlapping issues/concerns which were consolidated into 121 distinct topics. Below is a detailed summary of the comments received.

No.	Commenter	Comment	BLM Response
Support			
1.	Nevada Association of Conservation Districts	NvACD supports the management objectives of the referenced document and request that this support be added to the record.	Support noted. Thank you for your comment
2.	White Pine County Commission	The county supports a management plan that utilizes all methods necessary to ensure wild horse numbers are kept within AML	Support noted. Thank you for your comment
3.	N-4 Grazing Board	The Board reviewed the Management Evaluation Report for the Pancake Complex dated May 2024. The Board completely agrees with the BLM's conclusion that "…no wild horses are to be managed within the Jakes Wash HA based on the BLM's analysis of monitoring of data and its determination about habitat suitability…" (page 1). Any horses remaining in the Jakes Wash HA should be removed as soon as possible	Support noted. Thank you for your comment
4.	N-4 Grazing Board	In the short term, this Board strongly advocates for the BLM to develop an HMAP that emphasizes large gathers of horses to the low range of AML as soon as possible. Once low AML is met, then the Board advocates for implementing fertility control, smaller maintenance gathers and any other means of staying within the AML in the long term (i.e. implementation of the Path Forward Plan).	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
5.	Nevada Farm Bureau Federation	We note that the documentation indicates that the rangeland conditions continue to deteriorate because of the overpopulation of wild horses. This is in spite of the number of emergency gathers that have been stimulated by the overpopulation and lack of sufficient forage and water.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
BLM Regulations			

6.	Nevada Association of Conservation Districts	The 1971 Wild horse and Burro act should be enforced and enacted.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
7.	Little Paris Sheep Co.	The Little Paris Sheep Company supports the Bureau of Land Management Ely District, Bristlecone Field Office in the management of the wild horse population in the Pancake Complex. The Federal Land Policy and Management Act of 1976, and The Wild Free-Roaming Horses and Burros Act of 1971, has directed the Bureau of Land Management to manage the wild horse population and the range. Also, the Bureau of Land Management needs to protect the range and natural resources from overuse. The horse population has rapidly exceeded the AML during several years of severe drought. This has resulted in the degradation of the range due to a stressed resource and an over population of wild horses. The BLM has the responsibility to manage the wild horse population. They, however, cannot manage drought. It's in the best interest of the public that the BLM manage what is in their power and what they have been given responsibility over.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
8.	Numerous Wild Horse Education (WHE) American Wild Horse Campaign Rewilding America Now	An Environmental Impact Statement (EIS) must be created instead of a lesser Environmental Assessment for this HMAP. There has been no landscape-level assessment of wild horses in the Pancake Complex for 50 years. Existing data must be available for review, along with an analysis of science-based management options. The lack of landscape-level analysis is long overdue.	As explained in the NEPA regulations at 40 CFR 1508.1(j), an EA is a concise public document, for which a Federal agency is responsible, for an action that is not likely to have a significant effect or for which the significance of the effects is unknown, that is used to support an agency's determination of whether to prepare an EIS or a FONSI. The BLM is following that direction by preparing an EA, but if the BLM determines that the action is likely to have a significant environmental effect, it will move forward with preparation of an EIS.
9.	Friends of Animals Western Watersheds	The "heart" of the National Environmental Policy Act (NEPA) is	The BLM will consider alternatives in accordance

	Project	mandatory agency consideration of reasonable alternatives before commencing federal action.29 The EIS should "[r]igorously explore . . . all reasonable alternatives" and "[d]evote substantial treatment to each alternative" with "detail."30 NEPA does not excuse BLM from its obligation to consider reasonable alternatives because such alternatives may require further action by the agency or others.	with NEPA.
10.	Eileen Hennesse Friends of Animals The Cloud Foundation	The Wild Free-Roaming Horse and Burros Act clearly states that wild equines are to be managed as the PRINCIPAL users of their own legally-designated herd areas which must be "devoted principally but not necessarily exclusively to their [wild horses'] welfare..."	The law's language stating that public lands where wild horses and burros were found roaming in 1971 are to be managed "principally but not necessarily exclusively" for the welfare of these animals relates to the Interior Secretary's power to "designate and maintain specific ranges on public lands as sanctuaries for their protection and preservation" - which are, thus far, the Pryor Mountain Wild Horse Range (in Montana and Wyoming), the Nevada Wild Horse Range (located within the north central portion of Nellis Air Force Range), the Little Book Cliffs Wild Horse Range (in Colorado), and the Marietta Wild Burro Range (in Nevada). The "principally but not necessarily exclusively" language applies to specific Wild Horse Ranges, not to HMAs in general. The Code of Federal Regulations (43 CFR Subpart 4710.3) describes herd management areas (§4710.3-1) and wild horse and burro ranges (§4710.3-2). In delineating each HMA, the authorized officer shall consider the appropriate management level (AML) for the herd, the habitat requirements of the animals, the relationships with other uses of the public and

			adjacent private lands, and the constraints contained in §4710.4. HMAs may also be designated as wild horse or burro ranges to be managed principally, but not necessarily exclusively, for wild horse or burro herds. The Pancake Complex has not been designated as a wild horse "range" and therefore must consider the factors described above in the management of the Complex.
11.	Friends of Animals	The WHBA only authorizes BLM to remove "excess" wild horses in limited circumstances. In making such a management decision, BLM must make a determination that: (1) "an overpopulation [of wild horses] exists on a given area of the public lands," and (2) "action is necessary to remove excess animals." In addition, a determination to remove wild horses must be based on, among other things, "the current inventory of lands within [its] jurisdiction	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
12.	The Cloud Foundation	the Proposed Action is in conformance with the 2008 Ely District ROD and Approved RMP (August 2008) and the Tonopah Resource Management Plan (RMP) and subsequent Record of Decision dated October 1997. This statement is false, as nothing in these RMPs authorizes the creation of a non-reproducing portion of the population.	Please see the Ely District Record of Decision and Approved Resource Management Plan. WH-8: Manage sex ratios, phenotypic traits, reproductive cycles, and other population dynamics on a herd management area basis. The WFRHBA specifically authorizes the use of sterilization as a population management measure.
13.	The Cloud Foundation	The ER and Land Use Plans (LUPs) fail to address that "Wild horses and burros shall be considered comparably [similar] with other resource values in the formulation of land use plans." (43 CFR § 4700.0-6) The EA cites land use plans that range from 15 to 45 years old; relying on these land use plans, which fail to authorize resources "principally" or "comparably" for wild horses is clearly not in conformance with existing laws and statutes.	This comment pertains to land-use planning, which has already been completed following an extensive public decision-making process that resulted in a decision to manage at the Appropriate Management Level within the Pancake Complex. BLM is required to manage wild horses consistent with an existing land-use plan. Regulations at 43 CFR 4170.1 require that management actions

			conform to the existing land-use plan. Land use plans are developed over a period of many years, are subject to regulations at 43 CFR Part 1600, and are intended to govern management of public lands over an extended period of time that can span decades. There is no basis, at this time, for modifying the AMLs for the Pancake Complex.
Population Growth Suppression			
14.	Rewilding America Now	The impact to foaling season applies to any type of fertility control Vaccine or IUD. As regards to GonaCon, it's application has never been analyzed to address it's impact on foaling season.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP. Possible effects of fertility control vaccine on foaling phenology are noted in Appendix XII.
15.	Form Letter1	Implement Fertility Control: Utilize humane, scientifically studied, and reversible fertility control initiatives to humanely manage the herd, without resorting to removals.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
16.	Form Letter 3	BLM needs to determine if fertility control is even needed here for these horses. If it is, based on science, then a specific type of fertility control must be identified that has been specifically analyzed for use in the complex; also needed is a humane protocol for application and a clearly outlined plan that identifies monitoring. BLM must stop using birth control that cannot be monitored, like IUD's and ones that can not only harm them but sterilize them forever like Gonacon. This experimenting has gotten out of control when the BLM does not even understand these forms well-enough to use them wisely- ESPECIALLY IF THEY ARE NOT EVEN NEEDED AT ALL. It is cruel and unnecessary (it is a total waste of taxpayer money too).	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP. BLM is not considering any experimental study as a part of management actions analyzed in this EA. Any use of contraceptive techniques would be in a management application capacity. Effects of IUDs, have been analyzed (see Appendix XII for summary of possible effects of fertility control methods), the IUDs to be used are not experimental; they have been shown to be safe and effective. The citation to the study by Holyoak et al. (2021) has been updated to show that it has been published at the Journal of Wildlife Management. The potential

			application of IUDs in mares from the Pancake complex would not constitute an experiment; it would be an application of procedures that were tested and found safe and effective in pasture trials (Holyoak et al. 2021).
17.	Nevada Association of Conservation Districts	NvACD requests that efforts to impose fertility controls become a primary tool only after AML has been met. Fertility Control, gelding, and implementing a higher male to female ratio will facilitate numbers within the range of AML longer.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
18.	Eileen Hennesse	Dangerous, risky pesticides, such as Gonacon, OGF and others, must be banned as a means of fertility control as they destroy ovaries and natural "wild" behaviors, causing permanent sterilization with as few as 3 injections", and have not been proven to be reversible after 3 or more applications. Wild horses live in extreme temperatures and on rugged terrain, relying on natural hormones for survival. Natural hormone production impacts many aspects of mammalian biology - including personality, actions, social behaviors, psychology, physiology, and overall welfare, which must be preserved to achieve a "healthy" individual.	Opinion noted. See comment 16.
19.	Coalition for Healthy Nevada Lands, Wildlife, and Free-Roaming Horses	BLM ideally will utilize the latest most effective fertility inhibiters for mares after reducing horse populations to within caring capacity (AML) and, as a result, reduce the frequency of gathers necessary to maintain AML	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
20.	Friends of Animals	The adverse effects of fertility treatment, both to the individual animals and the herds as a whole, are abundantly clear and known to BLM. Fertility treatment will have an unnatural effect on both the reproductive capacity of the individual animal, but also the social structure of the larger herd for the current herd and future generations. When developing the Pancake Complex HMAP, BLM should take a hard look the adverse effects of fertility treatment and consider only those alternatives that	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP. Appendix XII includes a review of possible effects of various fertility control methods.

		do not implement such a program	
21.	American Wild Horse Campaign	As the agencies consider appropriate methods of managing wild horse populations, they should forgo selecting implementing actions that utilize roundups as the main method of controlling this wild horse population, and instead focus their attention on expanding the use of responsible PZP 3 fertility control programs	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
22.	American Wild Horse Campaign	Other methods of fertility control contemplated by this proposed action are impractical and/or poorly understood in wild equines – and therefore further planning should abandon plans to use these methods. For example, the SOPs for GonaCon are far more complicated than those for PZP and this will likely lead to more errors in the application of GonCon. Similarly, the limited research of IUD treatment demonstrates that retention of the device by mares is extremely inconsistent – thereby undermining the very purpose of application	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
23.	Form Letter1	Abandon the use of unproven population control methods, including sex ratio skewing, gelding, and intrauterine devices (IUDs).	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP. Appendix XII includes a review of possible effects of various fertility control methods.
24.	Form Letter 2	Prohibit fertility control methods such as Gonacon, OGF, and others that destroy reproductive organs (e.g. ovaries), destroy natural "wild" behaviors, and cause permanent sterilization with as few as 3 injections. No data shows Gonacon or OGF is reversible after 3 or more applications. Wild horses live in extreme temperatures and on rugged terrain and rely on natural hormones for survival. Natural hormone production impacts many aspects of mammalian biology - including personality, actions, social behaviors, psychology, physiology, and overall welfare - and must be preserved to achieve a "healthy" individual.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
25.	Form Letter 2 Eileen Hennesse	Prohibit releasing castrated stallions as a portion of the AML. Horses	Comment Noted. Consideration will be given to

		taken from holding facilities should be released in repatriated Herd Areas and should NEVER replace genetically contributing individuals in a herd.	the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
26.	Form Letter 3 Advocates for Wild Equines	The agency fails to identify Foaling Season on a site–specific basis as the agency manipulates foaling times of year with fertility control and fails to monitor deviations. On the HMA sites in question here, since these are genetically important herds to the Native American Culture Traditionally, is it possible to start looking at foaling season here using real data, if and only if removals are indeed done? This would mitigate unnecessary injuries, deaths, and loss of a genetic herd entirely.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
27.	Form Letter 3 Numerous	Americans have many voices, and all The People matter as stakeholders of these HMAs, as well as the BLM, so please listen to them and follow actual data without being biased, if possible, to do these special horses justice for future generations, instead of eliminating them with unfair AMLs and unsafe and unnecessary Birth Control method-experiments. Cutting off their testicles in not acceptable either, gelding them later is a loss as well of their special genes.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
28.	Friends of Animals	There is considerable evidence to support that BLM should take a hard look at the adverse effects of using fertility treatment as a management tool. It is well established that use of fertility treatment can cause stress and alter the behavior of the animal subject to the treatment and the social health of the herd as a whole.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP. Appendix VI models the projected effects of various gather and fertility control effects on herd dynamics, and appendix XII includes a review of possible effects of various fertility control methods.
29.	The Cloud Foundation	implementing regulations of the WHA require that "wild horses and burros shall be managed as self-sustaining populations of healthy animals in balance with other uses and the productive capacity of their habitat." 43 C.F.R.§ 4700.0-6(a). Additionally, "activities affecting wild horses and burros shall be undertaken with the goal of	All indications, including monitoring and scientific studies, are that a herd of wild horses that is no lower in size than low AML, even with potential fertility control treatments, will continue to be self-sustaining. Many wild horse herds are sub-populations within a larger,

		maintaining free roaming behavior." Id. at § 4700.0-6(c). Sterilization destroys those aspects of wild horse behavior, developed over millions of years of evolutionary history in North America and as such does not honor the purpose illustrated by these implementing regulations.	connected metapopulation, and connections be-tween herds can also augment ge-netic diversity. As noted in the literature re-view about the potential ef-fects of gelding, there is no reason to suppose that ani-mals treated with fertility control methods would lose their free-roaming nature. The notion that sterilization is counter to the WFRHBA can-not be squared with the text of the WFRHBA itself, which expressly authorizes steriliza-tion as a component of wild horse management.
30.	The Cloud Foundation	Castration (gelding) and Gonacon shut down the natural production of hormones cause changes to wild horses' natural behaviors.	The WFRHBA includes no language specifying that BLM ensure that individual wild horses maintain their so-cial standing within any given harem or band. Nonetheless, BLM is aware of no scientific evidence concluding that ani-mals treated with GonaCon-Equine, or gelded, would cease to interact with other wild horses, or to graze and rely on water sources. Availa-ble studies indicate that ani-mals treated with GonaCon-Equine do not have decreased survival rates.
31.	The Cloud Foundation	The NAS determined "preserving natural behaviors is an important criterion" for wild horse management. Therefore, the following should be precluded from management actions: • castration that alters the animal's ability to produce natural hormones; • Gonacon (or any fertility control) that alters the production of natural hormones or destroys the ovaries; and • sex ratio skewing which causes stallion aggression due to the unnatural ratio of males to females.	All of the potential actions noted in this comment were reviewed in the NAS (2013) report, which did not establish any BLM policy or regulation, and additional scientific information has been made available since 2013 to further inform BLM's analyses of potential actions.
32.	The Cloud Foundation	"Original, natural condition" implies unaltered by sterilization or fertility control that would change the animals' natural, wild behaviors. These wild behaviors are the basis	The BLM must manage self-sustaining herds of wild horses, but it is not required to ensure that every wild horse on the range is fertile,

		for the rich and complex natural social structure of wild horses. Without them, the BLM would just be managing "freeroaming" horses. Free-roaming simply means the animals are free to move about at will and could include castrated or sterilized domestic horses. The fact that Congress titled the Act with both words, "Wild" and "Free-Roaming" is a clear indication that they are separate but equally important concepts, and the BLM must treat them as such.	establishes a harem, maintains a harem, or has surviving offspring. The commenter appears to be trying to redefine what constitutes a wild horse. Other individuals may have their own conception of the characteristics that lead a horse to have federal protections under the WFRHBA, but BLM must follow the existing law in this regard. Congress made clear the definition of what is a wild horse in the WFRHBA (as amended): "…"wild free-roaming horses and burros" means all unbranded and unclaimed horses and burros on public lands of the United States;" And: "(d) Loss of status as wild free-roaming horses and burros; exclusion from coverage Wild free-roaming horses and burros or their remains shall lose their status as wild free-roaming horses or burros and shall no longer be considered as falling within the purview of this Act- (1) upon passage of title pursuant to subsection (c) except for the limitation of subsection (c)(1) of this section, or (2) if they have been transferred for private maintenance or adoption pursuant to this Act and die of natural causes before passage of title; or (3) upon destruction by the Secretary or his designee pursuant to subsection (b) of this section; or (4) if they die of natural causes on the public lands or on private lands where maintained thereon pursuant to section 4 and disposal is authorized by the Secretary or

			his designee; or (5) upon destruction or death for purposes of or incident to the program authorized in this section." Under current federal regulations, "(l) *Wild horses and burros* means all unbranded and unclaimed horses and burros that use public lands as all or part of their habitat, that have been removed from these lands by the authorized officer, or that have been born of wild horses or burros in authorized BLM facilities, but have not lost their status under section 3 of the Act. Foals born to a wild horse or burro after approval of a Private Maintenance and Care Agreement are not wild horses or burros. Such foals are the property of the adopter of the parent mare or jenny. Where it appears in this part the term *wild horses and burros* is deemed to include the term *free-roaming*." Based on the above definitions from the law, a gelded wild stallion clearly remains a wild horse. Despite the commenter's opinion, it is the case that the BLM must manage herds of wild horses, not individual animals. It is not the BLM's role to ensure social standing of any given individual animal. Congress specifically considered that BLM may sterilize animals in order to manage populations. Sterilization, by definition, precludes an animal's ability to have any additional offspring. Thus, Congress intended for such management actions to be included in the range of available actions by which

			BLM may manage herds of wild horses and burros.
33.	The Cloud Foundation	Experts state and data shows that releasing a castrated wild stallion to the range would change natural behaviors that are imperative to his status as a wild horse. (Attachments 2, 3) BLM's stated interest to release geldings to the range is to reduce reproduction rates,	The notion that gelding wild stallions will cause them to become docile is speculative, particularly if the gelding occurs in post-pubescent adults. Opinions about behavioral effects of gelding by Drs. Nock or Kirkpatrick are speculative, given that neither of them conducted a study on the topic. It is unlikely that a reduced testosterone. Appendix XII includes a literature review on possible effects of gelding, including a study that assessed behavioral outcomes of having geldings in a herd of wild horses (King et al. 2022). Section 2.3.1 of the EA states that "Including some fertility control-treated mares and some geldings in the herd at mid-AML herd size would allow for management of a total wild horse population within the Complex that would be larger than low AML, while still reducing population growth rates compared to those of an untreated herd, and achieving a thriving natural ecological balance." Section 2.3.2.4 notes that "In order to reduce the total number of excess wild horses that would otherwise be permanently removed from the Complex, a portion of the male population would be managed as geldings."
34.	The Cloud Foundation	Currently, there is insufficient scientific data available to support the use of IUDs in free-roaming horses without the necessary scientific study with acceptable protocols. The EA fails to consider the likely negative effects and short- and long-term implications for mares.	Consideration will be given to the comment moving forward with the Pancake Complex HMAP. The potential application of IUDs in mares from the Pancake complex would not constitute an experiment; it would be an application of procedures that were tested and found safe and effective in pasture trials (Holyoak et

			al. 2021).
35.	The Cloud Foundation	The Proposed Action fails to specify which type (marble, metal, soft, hard, etc.) of IUD would be utilized – therefore meaningful comments on the specific IUD cannot be provided. An EIS is required in order to more thoroughly evaluate this precedent-setting application.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP The EA notes that flexible IUDs have been used in management applications. Appendix XII clarifies that glass and metallic IUDs are known to pose unacceptable health risks; it is not expected that the BLM would use such methods.
Livestock Grazing			
36.	Nevada Association of Conservation Districts	NVADC opposes conversion of domestic livestock use to wild horse and burro use.	Livestock permits and their associated administrative management is outside the scope of this document. Any increase in authorized grazing use must follow the requirements set forth in the 43 CFR Part 4100 regulations. Any reallocation of forage between wild horses and livestock would require a land-use plan amendment.
37.	Western Watersheds Project Friends of Animals	Please include reasonable alternatives to the proposed action of reducing wild horse numbers within the HMA to AML. One reasonable alternative is to reduce livestock numbers in proportion to the reduction of horses. If the current total amount of combined livestock and wild horse grazing is resulting in overuse, then reducing wild horse numbers but allowing livestock numbers to increase will not remedy overuse. Therefore, permitted use on each allotment that overlaps the HMA should be reduced to the current level of use so that livestock numbers do not increase once wild horse numbers reach AML. If BLM does not adjust permitted livestock use down to current actual use, then increased use on allotments like Duckwater, Monte Cristo, Six Mile, South Pancake, and Sand Spring— Pancake HMAP scoping comments – which are each almost wholly within	BLM is directed by the WFRHBA to "immediately remove excess animals from the range so as to achieve appropriate management levels." 16 U.S.C. § 1333(b)(2)(iv). Here, based on monitoring and population estimates, the BLM has determined that there are excess wild horses within and outside the Pancake Complex and further has determined that it is necessary to remove those excess wild horses from the Pancake Complex following its review of the available monitoring data. The appropriate management action is to remove the excess horses for the health of the range and for their own well-being. To the extent this comment suggests that livestock grazing should be eliminated, even though

		the HMA, but are using a combined average of only 45% of permitted use—will simply counteract the reduction in wild horse use and impacts Cumulative impacts: The EA should address the potential for increases of livestock grazing that would accompany or follow reduction of horses in the HMA. Since the Management Evaluation Report notes that permittees have been grazing less than their permitted use in most allotments, especially those that overlap the HMA most, it is foreseeable that they will increase the numbers of livestock they graze if more forage is available. Therefore, BLM must address the negative impacts that more domestic livestock on the landscape will have on native plant and animal communities	resource damage is directly attributable to the wild horses, livestock grazing can only be reduced or eliminated if the BLM follows regulations at 43 CFR § 4100 and must be consistent with multiple use allocations set forth in the land-use plan. Forage allocations are addressed at the planning level. Such changes to livestock grazing cannot be made through a wild horse gather decision or through 4710.5(a), and are only possible if BLM first revises the land-use plans to allocate livestock forage to wild horses and to eliminate or reduce livestock grazing. Administration of livestock grazing on public lands fall under 43 CFR Subpart D, Group 4100. Additionally, livestock grazing is also managed under each District's respective RMP. Livestock grazing on public lands is also provided for in the Taylor Grazing act of 1934. Removal or reduction of livestock would not be in conformance with the existing RMP, is contrary to the BLM's multiple-use mission as outlined in the FLPMA and PRIA, and would be inconsistent with the WFRHBA, which directs the Secretary to immediately remove excess wild horses when such removal is necessary. Additionally this would only be effective for the very short term as the horse population would continue to increase even further beyond the current overpopulation and would cause range damage even with fewer or no livestock. Eventually the Complex and adjacent lands would become even more degraded and

			would not only not be capable of supporting the wild horse populations, but would also not be able to support wildlife or other multiple uses of the public lands. By law, BLM is required to manage wild horses in a thriving natural ecological balance and multiple use relationship on the public lands and to remove excess immediately upon a determination that excess wild horses exist. BLM cannot use regulations at 43 CFR 4710.5 to manage wild horses and livestock in a manner that is inconsistent with the RMPs. A land-use plan amendment or revision would be necessary to reallocate use in this manner between livestock and wild horses. Livestock adjustments have been made through other actions and documents, after following the required regulatory process for grazing decisions. The purpose of the EA is not to adjust livestock use. There is no requirement of the WFRHBA or the regulations to reduce or eliminate livestock as a means to restore TNEB. Administration of Livestock grazing on public lands fall under 43 CFR Part 4100 regulations. Livestock grazing on public lands is also provided for in the Taylor Grazing act of 1934.
38.	Rewilding America Now Wild Horse Education	BLM needs to determine how it determines the number of livestock grazing permits Issued in comparison to other multiple uses in the project area.	Livestock permits and their associated administrative management is outside the scope of this document. Any increase in authorized grazing use must follow the

			requirements set forth in the 43 CFR Part 4100 regulations.
39.	WildLands Defense	BLM must properly determine carrying capacity NOW in 2024 for BOTH livestock and wild horses, — which is the level of grazing “possible without inducing damage to vegetation or related resources.” 43 C.F.R. § 4100.0–5, 4130.3–1. Wild horses can use a much greater area of this harsh landscape than can cows and often sheep, and this must be fully assessed.	Reallocation between horses and livestock is outside the scope of this document.
40.	Form Letter1	Evaluate Livestock Grazing Impacts: Assess and disclose the extent of livestock grazing within the Complex and the Territory and its impact on the area's land health.	Livestock permits and their associated administrative management is outside the scope of this document. Any increase in authorized grazing use must follow the requirements set forth in the 43 CFR Part 4100 regulations.
41.	Form Letter1	Prioritize wild horses over commercial livestock grazing and reduce the number of cattle and sheep allowed to graze in the complex. If removals are needed to protect the habitat, the BLM and USFS must remove private livestock before wild horses.	Livestock permits and their associated administrative management is outside the scope of this document. Any increase in authorized grazing use must follow the requirements set forth in the 43 CFR Part 4100 regulations. Any reallocation of forage between wild horses and livestock would require a land-use plan amendment.
42.	Form Letter 2 Advocates for Wild Equines	The Herd Management Area Plan must address and include the following: - Adhere to the 1971 Wild Free-Roaming Horses and Burros Act which states that the Pancake Complex (including all original Herd Areas) is to be “devoted principally but not necessarily exclusively to their [wild horses'] welfare...” The HMAP must consider repatriating wild horses to zeroed-out Herd Areas. BLM states, "Nevada has the most public land authorized for [livestock] grazing in BLM; about 43 million acres; Nevada currently permits about 2 Million AUMs" for livestock alone. Given the BLM's predominant allocation of our public lands to livestock, the BLM must use Adaptive Management and amend	Livestock permits and their associated administrative management is outside the scope of this document. Any increase in authorized grazing use must follow the requirements set forth in the 43 CFR Part 4100 regulations. Any reallocation of forage between wild horses and livestock would require a land-use plan amendment.

		Land Use Plans to ensure equity and the majority of AUMs in the Complex are allocated for wild horses.	
43.	Form Letter 2 Numerous The Cloud Foundation	Reduce livestock grazing to provide habitat for wild horses as per 43 CFR § 4710. BLM and USFS have Adaptive Management mandates which should be utilized to address the inequity in AUMs in the Complex. The BLM must reverse its willful mismanagement that jeopardizes the genetic health of wild horses by keeping populations low -- such as the Pancake AML of just 361 wild horses on a 1-million+ acre Complex. The Allowable Management Levels (AMLs) must be increased permanently, through the Land Use Planning process, to ensure AUMs in the Complex are principally allocated to wild horses to fulfill the agencies' legal requirement of healthy herds.	See Response to Comment 37. Maintenance of acceptable levels of genetic diversity is analyzed in the EA as part of the proposed alternative and in section 3.3.
44.	Form Letter 2	Given the limited water in the Complex and poor range conditions, private livestock must be reduced or eliminated before wild horses as per 43 CFR § 4710.	See Response to Comment 37.
45.	Western Watersheds Project	The Management Evaluation Report references rangeland health evaluations and standards determination documents. Please provide all of these as part of the EA. Is the rangeland health determination from 2008? If so, how does BLM know that the conditions remain accurate 16 years later?	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
46.	Western Watersheds Project	For how many of the allotments and grazing permits has BLM completed NEPA analysis and rangeland health evaluations? Which ones? When?	See Appendix VII.
47.	Western Watersheds Project	Do the grazing permits for these allotments have any vegetation utilization standards or other measurable use standards like for bank alteration?	Livestock permits and their associated administrative management is outside the scope of this document.
48.	Western Watersheds Project Rewilding America Now	What methods does BLM use to distinguish between horse and cattle use or wildlife use? Please provide the underlying monitoring data that shows the impacts that each species has caused, and how BLM attributed the use by species	Utilization key areas have some overlap but generally distinguish different areas per user. Where overlap occurs professional judgement and notes distinguish users.
49.	Western Watersheds	How often does BLM monitor	See pg 7. of the Pancake

	Project Rewilding America Now	grazing impacts on the affected allotments? How often does BLM monitor horse impacts?	Complex Herd Management Area Plan Management Evaluation
50.	Western Watersheds Project	Are there areas within the HMA where only horses or only cattle graze, or is their use co-extensive throughout the area?	See 3.7 Livestock Grazing A portion of the Duckwater allotment in Sand Springs valley has been in temporary non-use for cattle grazing since 2001 due to drought and non-achievement of rangeland health standards. See Appendix VII.
51.	Western Watersheds Project	How many of the grazing permits require riders to regularly move livestock or keep them from congregating on sensitive areas?	Livestock permits and their associated administrative management is outside the scope of this document.
52.	Western Watersheds Project	How many AUMs do livestock use versus horses? How many wildlife AUMs does the Ely RMP allocate for this area?	See page 12 table 3 of the Pancake Complex Herd Management Area Plan Management Evaluation. The Ely RMP did not allocate AUMs for wildlife.
53.	Western Watersheds Project	Many livestock grazing permittees are grazing at less than their permitted levels of use. If horses are reduced, will they take more use or full use? How will that affect overutilization and lack of forage?	Livestock permits and their associated administrative management is outside the scope of this document. Any increase in authorized grazing use must follow the requirements set forth in the 43 CFR Part 4100 regulations. Any reallocation of forage between wild horses and livestock would require a land-use plan amendment.
54.	Western Watersheds Project	Has BLM imposed any mandatory (non-voluntary) reductions on livestock grazing permittees?	Livestock permits and their associated administrative management is outside the scope of this document.
55.	Western Watersheds Project	How do livestock fences alter horse movement or concentrate horse use?	Fences within the Pancake Complex are open ended to allow for horse movement within the complex.
56.	Advocates for Wild Equines Numerous	§ 4710.5 Closure to livestock grazing. (a) If necessary to provide habitat for wild horses or burros, to implement herd management actions, or to protect wild horses or burros, to implement herd management actions, or to protect wild horses or burros from disease, harassment or injury, the authorized officer may close appropriate areas of the public lands	Livestock permits and their associated administrative management is outside the scope of this document. Any increase in authorized grazing use must follow the requirements set forth in the 43 CFR Part 4100 regulations. Any reallocation of forage between wild horses and livestock would require a land-use plan amendment.

		to grazing use by all or a particular kind of livestock. (b) All public lands inhabited by wild horses or burros shall be closed to grazing under permit or lease by domestic horses and burros. (c) Closure may be temporary or permanent. After appropriate public consultation, a Notice of Closure shall be issued to affected and interested parties.	
57.	Advocates for Wild Equines	At a minimum from reviewing the Livestock Permits for Bristlecone Field Office there are 192,722 cattle and sheep for a total of 302,571 AUM. This is per RAS data- So if there are "currently" 1,800 wild horses, the total AUM would be 21,600. The BLM needs to provide more justification that shows that it is in fact the horses causing the rangeland damage, 1,800 vs 192,722 cows and sheep. At the same time, the BLM authorizes year-round grazing in the Complex.	Livestock permits and their associated administrative management is outside the scope of this document.
58.	Advocates for Wild Equines	Documentation must be provided for the public to review the number of cattle and sheep permitted to graze in these areas, and what the actual rangeland health looks like. The BLM has said that there is an issue with rangeland health caused by livestock.	See page 12 table 3 of the Pancake Complex Herd Management Area Plan Management Evaluation
59.	WildLands Defense	How many AUMs have been allocated to livestock? Are the cows/sheep currently grazing on the land heavier in weight than when the forage allocation was made? Haven't cattle weights increased significantly in recent decades? What cattle weight was used in allocating "forage" when wild horse vs cattle vs wildlife AUMs were allocated?	See response to comment 76. Livestock permits and their associated administrative management is outside the scope of this document.
60.	Coalition for Healthy Nevada Lands, Wildlife, and Free-Roaming Horses	There should be information on livestock use and impacts. Has livestock use been reduced because of horse impacts or other reasons? Can both uses, livestock and horses, be sustained at current levels? Are both cows and horses overgrazing?	See pg. 7 and 13 of the Pancake Complex Herd Management Area Plan Management Evaluation
61.	Advocates for Wild Equines	This HMAP can modify the grazing allotments awarded to non native grazers to allow for maintenance of wild equines on the land on their	Livestock permits and their associated administrative management is outside the scope of this document. Any

		HMAs. The land damaged by grazing can be remedied through rewilding strategies. An HMAP can effectively prescribe rewilding strategies that with careful planning and monitoring, return horses in holding, and long term holding to the land. (Again saving taxpayers money).	increase in authorized grazing use must follow the requirements set forth in the 43 CFR Part 4100 regulations. Any reallocation of forage between wild horses and livestock would require a land-use plan amendment.
62.	The Cloud Foundation	The TGA provides the government broad discretion to decide whether to allow livestock owners to use public lands. The issuance of a grazing permit does not confer any entitlement or right to use the public lands; rather, it is a privilege that can be taken away, if necessary, to protect the health of the range and/or to protect the wild horses.	Livestock permits and their associated administrative management is outside the scope of this document. Any increase in authorized grazing use must follow the requirements set forth in the 43 CFR Part 4100 regulations. Any reallocation of forage between wild horses and livestock would require a land-use plan amendment.
63.	The Cloud Foundation	The EA must consider that, “Livestock is by far the most frequently identified cause of allotment failure to meet fundamental land health standards nation-wide, and for allotments within HMAs.	Opinion noted.
64.	The Cloud Foundation	The EA must take a hard look at eliminating or greatly reducing livestock grazing in the Complex, including zeroed-out Herd Areas, pursuant to 43 C.F.R. 4710.5(a).	See comment 37.
65.	Western Watersheds Project	The PEA does not discuss whether BLM will increase authorized domestic livestock AUMs following removal of wild horses.	Livestock permits and their associated administrative management is outside the scope of this document. Any increase in authorized grazing use must follow the requirements set forth in the 43 CFR Part 4100 regulations. Any reallocation of forage between wild horses and livestock would require a land-use plan amendment.
66.	Western Watersheds Project	The PEA notably does not address the probable increases of livestock grazing that would accompany or follow reduction of wild horses in the Pancake Complex.	This comment is speculative. Livestock permits and their associated administrative management is outside the scope of this document.
Appropriate Management Level			
67.	Nevada Association of Conservation	It is essential that wild horse and burro numbers be kept at or below	Comment Noted. Consideration will be given to

	Districts	AML on a statewide level and in each HMA. Round ups must be conducted immediately if AML is exceeded regardless of budget concerns. All established solutions to excess numbers must be allowed and followed adoption sale sterilization and humane euthanasia.	the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
68.	Coalition for Healthy Nevada Lands, Wildlife, and Free-Roaming Horses	The EA, if possible, needs to be more detailed on warming temperatures, decreasing water availability, and the impact on vegetation. Can the current AML be sustained?	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
69.	Form Letter 3 Advocates for Wild Equines Eileen Hennesse	AML of 361-638 is absurdly low for a 1.2 million acre complex where exchange of populations is becoming more limited due to livestock and mining threatening any assertions of stability. BLM never disclosed an actual data-based equation for how they set AML. This is not what the law intended. I'd like a disclosure of all data that the BLM used to set this AML I'd also like an evaluation to set a real science-based one. Can this use of actual scientific data be done for these AMLs in the above mentioned HMA's?	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
70.	Form Letter1 Rewilding America Now Wild Horse Education	Revaluate the Appropriate Management Levels of the HMAs in the Complex and Territory based on current ecological conditions.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
71.	Nevada Farm Bureau Federation	Because of the depletion of rangeland quality, we believe that the AML evaluation needs to be redone, considering the conditions now versus the conditions that were in place when AML were established.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
72.	Wild Horse Education Rewilding America Now	The BLM states that they set the AML at a level that would achieve a thriving natural ecological balance and rangeland health. The BLM Appropriate Management Level (AML) range for the Pancake HMA is 240-493 wild horses.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
73.	Western Watersheds Project	What is the carrying capacity for this HMA? Has BLM completed a comprehensive carrying capacity analysis for the area that evaluates how much forage is available in poor, average, and good years, and partitions the available forage	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.

		between wildlife, wild horses, and livestock?	
74.	Friends of Animals	As part of the scope of BLM's analysis in developing the Pancake Complex HMAP, BLM must comply with the WHBA and its own dictates and conduct an updated analysis of the range and wild horse populations. BLM must consider increasing the AMLs for wild horses to accommodate increased AMLs and larger populations, and also minimize the potential threat for future roundups and permanent removal of animals from their native habitat.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
75.	Wild Horse Education	The HMAP is an appropriate and authorized process for setting a data-based, site-specific AMLs, AML adjustments, and scientifically defining what a Thriving Natural Ecological Balance means and data analyses required to evaluate TNEB. The AML may be adjusted (either up or down) through the site-specific environmental analysis that generates data (past and present) and supports a decision process as required under the National Environmental Policy Act of 1970 (NEPA) (P.L. 91-190).	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
76.	The Cloud Foundation	The HMAP EA must take a hard look at and adequately analyze the current AMLs since wild horses are (a) thriving in the HMAs, (b) livestock grazing continues in the HMAs and (c) the Proposed Action is in violation of existing laws and regulations that protect wild horses on these public lands. AML must be in conformance with the 1971 Wild Free-Roaming Horses and Burros Act. Most AUMs or forage allocation within the WHT must be "principally but not necessarily exclusively to wild horses" as outlined in the 1971 Wild, Free-Roaming Horses and Burros Act (WFRHBA).	The WFRHBA requires BLM to remove excess horses when it determines this necessary to ensure a thriving natural ecological balance- regardless of whether some members of the public oppose such removals. The Proposed Action would help minimize the number of excess wild horses that would need to be removed over the next 10 years by implementing fertility controls and a gelding component, along with removal of excess wild horses.
77.	Nevada Association of Conservation Districts	The HMAP should ensure horses are managed to not impinge upon water rights or reduce water availability for native wildlife	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.

78.	Wild Horse Education Rewilding America Now	The HMAP must include water improvement analysis to distribute and sustain wild horse populations and mitigation for loss of resources and habitat from livestock, mining, and other multiple uses.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
79.	Wild Horse Education Rewilding America Now	BLM must apply for and maintain water rights/permits for wild horses and burros and maintain those permits. BLM has repeatedly failed to apply for and renew existing water permits.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
80.	Charlotte Roe Friends of Animals Wild Horse Education	Provide data and analysis including landscape-specific factors to set a viable AML for Jake's Walsh, which has historically provided habitat for wild horses and has always been included in gather plans. There is no justification for extracting wild horses from an historic range by setting a punitive, unscientific zero.	The Ely District Approved RMP (2008) and this EA are in compliance with The Federal Land Policy and Management Act of 1976 As Amended (FLPMA) Declaration of Policy Sec. 102. (7) *"goals and objectives be established by law as guidelines for public land use planning, and that management be on the basis of multiple use and sustained yield unless otherwise specified by law;"* And the WFRHBA of 1971 (Public Law 92-195) section 3. (b 2) "*Where the Secretary determines on the basis of (i) the current inventory of lands within his jurisdiction; (ii) information contained in any land use planning completed pursuant to section 202 of the Federal Land Policy and Management Act of 1976; (ii) information contained in court ordered environmental impact statements as defined in section 2 of the Public Rangelands Improvement Act of 1978; and (iv) such additional information as becomes available to him from time to time, including that information developed in the research study mandated by this section, or in the absence of the information contained in (i-iv) above on the basis of all information currently available to him. That an overpopulation exists on a given area of public*

			lands and that action is necessary to remove excess animals, he shall immediately remove excess animals from the range so as to achieve appropriate management levels…” Through the land-use planning process and 2008 Ely RMP, BLM determined that the Jakes Wash HA should be managed for zero wild horses due to the lack of suitable habitat to sustain healthy wild horses. BLM has also determined, based on the available current monitoring data and information, that it is necessary to remove the excess wild horses from the Jakes Wash HA to protect and restore natural resources within these areas.
81.	Joy Burk Wild Horse Education The Cloud Foundation	The BLMs decision that the Jakes Wash HA does not allow for sufficient forage, water, space, cover, and reproductive viability is questionable. The PCER does not include any proof of this claim. The wild horses were historically found upon the Jakes Wash acreage.	An in-depth analysis was conducted through the 2007 EIS/2008 approved Ely District RMP finding that this HA is not suited for long-term management of wild horses due to inadequate habitat to sustain and manage for healthy wild horses. This is further supported by the presence of animals outside the Jakes Wash HA as well as within the HA, and by the documented heavy and severe use of rangeland resources, which is detrimental to the health of the range for both the well-being of the wild horses themselves, as well as to wildlife that depend on the public lands within and outside of the Jakes Wash HA for their habitat needs.
82.	Form Letter1	Reevaluate the Herd Area as a herd management area, allowing intact wild horses to be relocated into the redesignated HMA.	See Response to Comment 81.
83.	The Cloud Foundation	The ER wrongly states that the Proposed Action is consistent with the Wild Free-Roaming Horses and Burros Act. In fact, the BLM has not provided sufficient justification to zero out	See Response to Comment 80.

		Jakes Wash or that alternative actions	
Fuels/ Fire			
84.	Form Letter 3 Numerous Wild Horse Education	The state has issued high preparedness warnings for wildfire every year in this area. BLM has never addressed how many horses and burros should be on the range so they can perform a beneficial use removing fire fuels. If it is the focus of the BLM to also reduce fires for the public, then can the agency start addressing the data on reductions in wildfires using wild equine? In the new research demonstrating their beneficial use it shows how wild horses are much better at reducing fire fuel (not increasing noxious weeds) than cows or sheep or goats. I thus ask that the AML be analyzed scientifically to address this issue.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
85.	Rhonda Johnson	What is the number of wild horses needed to create a beneficial impact to reduce fire fuels and how can populations be distributed through water improvements to increase that beneficial use?	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
86.	Friends of Animals	Studies demonstrate that wild horses support healthy ecosystems if given sufficient habitat and left alone. For example, wild horses help spread plant seeds over large areas where they roam. Wild horses do not decompose the vegetation they ingest as thoroughly as ruminant grazers, such as cattle or sheep, which allows the seeds of many plant species to pass through their digestive tract intact into the soil that the wild horses fertilize by their droppings. Wild horses also help to prevent catastrophic fires and help to build more moisture-retaining soils. Soil moisture dampens out incipient fires and makes the air coating the earth moister.	Appendix XII includes references to the potential positive ecological benefits that wild horses can effect when present at low densities relative to available natural resources. However, potentially positive effects are generally outweighed by degradation that can result when wild horses are present at levels beyond what fosters a thriving natural ecological balance (i.e., above AML).
87.	Wild Horse Education	BLM has never addressed how many horses should be on the range in Pancake so they can perform a beneficial use removing fire fuels. Therefore, wild horse (and burro) beneficial impacts on fire fuel reduction should be factored into AML evaluations.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
Other			
88.	White Pine County	The current situation in the Pancake	Comment Noted.

	Commission	Complex is inconsistent with the county's Policy Plan in that the overpopulation of wild horses is in fact resulting in adverse impacts to important values and multiple uses.	Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
89.	White Pine County Commission	The HMAP should include an all-tools approach to gather and remove and remove excess wild horses within the pancake complex, and application of fertility control to keep populations within established AML.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
90.	Sherman Swanson	Page 14 MANAGEMENT ISSUES No mention of land health is noted in this section, and it should be prominent since this is the basis for thriving natural ecological balance. Losing the ability to monitor utilization because the perennial plants that form the essence of resilience is an issue and strongly suggests that land health standards are not being met. Probably riparian areas are at the center of this loss of land health and its critical importance to wildlife and landscape scale biological diversity should especially be called out.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP. See. APPENDIX VII Rangeland Health Standards Summary
91.	Sherman Swanson	Use of springs in the FS Monte Christo WHT (Vanover, Monte Cristo, Birch, Emigrant, and Allen Springs), any perennial or intermittent (not ephemeral) springs and their riparian areas on the Pancake Range, and any other riparian areas, lentic and lotic (note springs in Map 1), should be assessed for their riparian functionality as this is part of the land health standards that define thriving natural ecological balance in the glossary of the 2010 BLM WHB Handbook.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP. See. APPENDIX VII Rangeland Health Standards Summary
92.	Form Letter1 Charlotte Roe	Invest in habitat stewardship, such as improving water sources, and reseeding damaged areas.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
93.	Lorna Torrey Palermo	Planning for additional water sources for all native flora and fauna including wild equines, to compensate for the stress created by climate change must be built into any adequate HMAP. This can take the form of enhanced or newly created water sources including guzzlers and solar wells. In some circumstances	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.

		expanding and protecting natural water sheds improving their sustainability can help. Much science exists in the regenerative agriculture community around the creation and maintenance of sustainable riparian areas.	
94.	Wild Horse Education	The Damele curlies and Medicine Hat wild horses and their genetics must be protected and provided for under any AML establishment for the Pancake Complex HMAP (see Ely RMP WH-8).	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex HMAP. The WFRHBA of 1971 and Ely, Tonopah RMP does not indicate that the BLM is required to manage wild horse herds in this complex to attain any specific genetic structure. The RMP goals are to: "Maintain and manage healthy, self-sustaining wild horse herds inside herd management areas within appropriate management levels to ensure a thriving natural ecological balance while preserving a multiple-use relationship with other uses and resources."
95.	Form Letter 3 Numerous	The northern areas of the complex (the Pancake HMA and the Monte Cristo WHT) are prime habitat where the majority of the curlies and medicine hats live. I request an analysis that this area be turned into a Wild Horse Range (like the Pryor Mountains) and industry in the area limited or entirely restricted.	See comments 10 and 94.
96.	Form Letter 3	Every single management plan for any species identifies habitat needs to sustain viability. Water improvements, fence removal, seasonal corridors, are all identified in management planning for every other species. Horses are confined behind boundary lines and other species are not. This makes critical habitat identification and preservation even more important. I ask that critical habitat for horses be identified and seasonal movement identified to create limits on industry (conflicts of interest).	Comment Noted. The Pancake Complex is not designated as a wild horse range and is managed as in accordance with multiple use. See Response to comment 13.
97.	Form Letter 3	Acknowledge and follow the National Academy of Sciences (NAS) recommendation: "Horse and	Comment Noted. Consideration will be given to the comment moving forward

		burro management and control strategies … should ...be responsive to public attitudes and preferences." Public comments and national polls consistently show that most Americans want public lands managed for wild horses over livestock.	with the Pancake Complex Environmental Assessment and HMAP.
98.	Numerous Wild Horse Education	Create a data-based foaling season for the complex. BLM is prohibited from doing helicopter drive-trapping during foaling season and must provide a site-specific analysis.	Peak foaling season of wild horses on public lands occurs in late April and early May. The great majority of foaling happens March through June. As a precaution, unless there is an approved emergency situation, the BLM does not use helicopters to gather wild horses from March through June. Though foals typically grow rapidly and within days are capable of maintaining speed with their mother, the BLM's Comprehensive Animal Welfare Program includes provisions to protect the welfare of foals that are part of gather operations. For example, the rate of movement and herding distance the pilot uses are based on the weakest or smallest animal in the group (i.e., foals or pregnant mares). Other provisions include re-uniting dependent foals that become separated from their mare/jenny and ensuring foals are protected from larger stallions and/or jacks while in a holding corral or during transport.
99.	Advocates for Wild Equines	A current count of horses should be carried out before any gathering is even proposed to remove horses. A recent survey must be completed before any plan can be proposed for these HMAs. Only using a population modeling tool and not an actual count is unacceptable. Foals are not to be counted in the number, that is illegal. Aerial counts should be used not just infrared and then given to the public to see and review as part of the process.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP. Surveys are conducted every 2-3 years see table 2. Page 4 of the Pancake Complex Herd Management Area Plan Management Evaluation

100.	Friends of Animals	BLM must consider the positive impact of wild horses and comply with its obligation to manage wild horses as a self-sustaining population of healthy animals. In developing the Pancake HMAP, BLM must consider the benefits wild horses have on the environment and on the public lands on which they are protected.	Comment Noted. See additional text about potential positive ecological effects of wild horses in Appendix XII; these, however, do not outweigh negative consequences when wild horses are at densities that cause environmental degradation (i.e., over AML). Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
101.	Joy Burk	Under the State of Nevada Division of Water Resources – Chapter 533 – Adjudication of Vested Water Rights: Appropriation of Public Waters: a. NRS 533.0243 – temporary conversion of agricultural water for certain purposes: Legislative declaration, requirements; duration. i. The Legislature hereby finds and declares that it is the policy of this State to allow the temporary conversion of agricultural water rights for wildlife purposes or to improve the quality or flow of water. (https://www.leg.state.nv.us/NRS/NRS-533.html#NRSS433Sec0241) ii. The BLM needs to explore avenues available to them to provide and secure available water sources for wild horses (and other wildlife) on the Complex.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
102.	Scott Beckstead	The BLM should include an assessment of the native carnivores that live in the Pancake Complex, especially mountain lions, which are proven to control wild horse populations in the American west. The BLM's plan should include limits on the artificial suppression of carnivore populations to benefit livestock, and instead allow those populations to thrive and prosper as a means of balancing the ecosystems in this region.	This comment is outside the scope of the Pancake Complex Herd Management Area Plan Management Evaluation Native carnivores are managed by the Nevada Department of Wildlife.
103.	The Cloud Foundation Wild Horse Education	The EA must adequately address the protection of wild horses during all management actions. The BLM's "Comprehensive Animal	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex

		Welfare Program (CAWP)" is woefully inadequate in establishing humane standards for the treatment of wild horses during a roundup. It must go further to ensure the humane treatment and protection of these animals.	Environmental Assessment and HMAP.
104.	The Cloud Foundation	The EA must include meaningful public observation of government activities at wild horse/burro roundups. The current level of public observation provided by the BLM is insufficient under the First Amendment.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP. Thank you for the comment. BLM's public observation policy (BLM IM 2013-058, Wild Horse and Burro Gathers: Public and Media Management).
105.	The Cloud Foundation	The need for BLM to consider and implement the use of cameras during and after roundups of wild horses and burros is particularly acute here because any restrictions that BLM may elect to impose on the public's ability to observe its activities must be narrowly tailored to serve an overriding governmental interest.	See Appendix IV gather operations standard operating procedures.
106.	American Wild Horse Campaign	the agency must consider the future welfare of horses and burros, as well as public health, in its plans to imprison these animals in off-range holding before proceeding with the proposed action.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
107.	Friends of Animals	BLM has issued guidance that in making an excess determination the authorized officer must first analyze:(1) grazing utilization and distribution;(2) trend in range ecological condition;(3) actual use;(4) climate (weather) data;(5) current population inventory;(6) wild horses and burros located outside the HMA in areas not designated for their long-term maintenance; and (7) other factors such as the results of land health assessments which demonstrate removal is needed to restore or maintain the range in a thriving, natural ecological balance. Such determination should be made prior to every removal. Here, BLM has not considered whether removal is necessary based on current	The AML represents "that 'optimum number' of wild horses which results in a thriving natural ecological balance and avoids a deterioration of the range" *Animal Protection Institute*, 109 IBLA 112, 119 (1989) The Interior Board of Land Appeals in *Animal Protection Institute et al.*, (118 IBLA 63, 75 (1991)) found that under the Wild Free-Roaming Horses and Burros Act of 1971 (Public Law 92-195) BLM is not required to wait until the range has sustained resource damage to reduce the size of the herd, instead

		information. Instead, BLM bases the existing AML on extremely outdated land-use plans. In the PEA, BLM fails to consider what qualifies as a self-sustaining, healthy population of wild horses.	proper range management dictates removal of "excess animals" before range conditions deteriorate in order to reserve and maintain a thriving natural ecological balance and multiple-use relationship in that area. Monitoring data as identified in section 1.1, 3.3 and Appendix VII Rangeland Health Standards Summary all support that excess wild horses reside within the Complex and need to be removed to return the population to AML so as to achieve a thriving natural ecological balance and to provide an opportunity for degraded range resources to recover.
108.	Wildlands Defense	Is there a current BLM Travel Plan for the HMA? Please provide full current mapping of all roads, motorized trails and other develops its at the time of the HMA establishment, and at the time AUMs were allocated, in the Pancake Complex. Mining access or energy project access routes can result in significant disturbances to big game, sage-grouse and wild horses, including during critical seasonal periods. Traffic can displace and stress animals from critical seasonal use areas and water or forage, disrupt the TNEB, or cause outright injury or mortality.	There is not a travel management Plan within the Pancake Complex.
109.	The Cloud Foundation	The EA must consider the cumulative impacts of the HMAP alternatives outlined in the EA will have. This includes the permitted and annual actual use of livestock grazing throughout the District Office's jurisdiction; specifically, livestock usage must be compared to AUMs allocated for wild horses and separately burros.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP. See Comment 37.
110.	Wild Horse Education	BLM has never clearly defined what constitutes a determination of excess wild horses at the Pancake	The term "excess animals" is defined as those animals which must be removed from

		Complex	an area in order to preserve and maintain a thriving natural ecological balance and multiple use relationship in that area (16 USC § 1332(f)(2)). This definition underscores the need to remove excess animals before damage to the range begins to occur.
111.	Wild Horse Education	Nevada BLM did not provide a single map of the Pancake Complex in the FMER. Because BLM WHB Program is notorious for providing anecdotal and misleading maps of WHB HMAs/HAs, we request Nevada BML provide high quality mapping for the HMAs, WHT, and HA for public review.	See page 14, 15, Map 1 and Map 2 of the Pancake Complex Herd Management Area Plan Management Evaluation
112.	Wild Horse Education	Data Disclosure/Monitoring Plan Must Be Included in HMAP Specifically for Wild Horses	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
113.	Wild Horse Education	Include economic analyses of tourist interest and economic impacts from domestic and abroad tourism.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
114.	Nevada Association of Conservation Districts	Both action and inaction regarding management of wild horses has impacts to the range conditions and the economic viability of agriculture and lively hoods in rural Nevada.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
115.	Coalition for Healthy Nevada Lands, Wildlife, and Free-Roaming Horses	Are there key wildlife species, i.e. sage grouse, pronghorn, etc. that need to be considered more carefully. Are there non-wildlife areas of critical concern such key plants or pollinators?	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
116.	Coalition for Healthy Nevada Lands, Wildlife, and Free-Roaming Horses	Will BLM address the issue of providing water for horses outside the HMA's? Or on tribal lands? Or will these horses off the BLM and Forest Service lands simply be removed?	BLM and F.S. do not manage for horses outside of a designated HMA or Territory.
117.	Coalition for Healthy Nevada Lands, Wildlife, and Free-Roaming Horses	Establish agreement with the tribe on wild horse use on lands that were formerly BLM and are now Tribal	BLM and U.S.F.S. do not manage for horses outside of a designated HMA or Territory.
118.	Coalition for Healthy	We would like to see more	Comment Noted.

	Nevada Lands, Wildlife, and Free-Roaming Horses	recognition of the vulnerability of BLM owned riparian areas including fencing (with water outside springs for horses and cows.) Sheldon National Wildlife Refuge fenced some springs to protect riparian lands but enabling wildlife to access those areas and providing water for horses outside the fenced area. If previous fencing failed, perhaps the pipe rail fence with cemented in post methods used by NDOW should be used.	Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
119.	Rewilding America Now	The Pancake Complex also provides habitat for other wildlife. The public should be provided available data on the locations where these animals have been reported as well as data establishing the seasons that these animals use the habitat.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
120.	Rewilding America Now	BLM should recognize the value of horse rewilding as one herd management area strategy and as an alternative to be addressed pursuant to NEPA.	Comment Noted. Consideration will be given to the comment moving forward with the Pancake Complex Environmental Assessment and HMAP.
121.	Rewilding America Now Wild Horse Education The Cloud Foundation	The HMAP fails to adequately address the protection of wild horses during the proposed roundup. The BLM's "Comprehensive Animal Welfare Program (CAWP)" is woefully inadequate in establishing humane standards for the treatment of wild horses and burros during a roundup. It must go further in its protection of these animals.	Opinion Noted. The Comprehensive Animal Welfare Policy was developed through coordinated efforts from universities, government. agencies, and independent equine practitioners for the health and safety of gathering and handling wild horses.