Wyoming Elk Feedgrounds Management Plan

Wyoming Game and Fish Department

Cheyenne, Wyoming

Proposed DRAFT Plan (6/2023)

Acknowledgments

The Wyoming Elk Feedgrounds Management Plan is a product of efforts from many stakeholders as part of the Elk Feedgrounds Public Collaborative. The Wyoming Game and Fish Department recognizes the dedication and hard work of those who served on the feedgrounds public collaborative during the development of this plan. This group included:

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The Elk Feedgrounds Public Collaborative was facilitated by Tara Kuipers of Tara Kuipers Consulting LLC based in Cody, Wyoming.

The internal Wyoming Game and Fish Department's Elk Feedgrounds Steering Committee developed and provided technical information and oversight to the Elk Feedgrounds Public Collaborative and drafted the Wyoming Elk Feedgrounds Plan. Members include Dr. Samantha Allen (State Wildlife Veterinarian); Raymond Bredehoft (Habitat and Access Branch Supervisor); Hank Edwards (Wildlife Health Labratory Supervisor-retired); Scott Edberg (Wildlife Division Deputy Chief-retired); Mark Gocke (Jackson-Pinedale Region Public Information Specialist); Gary Hornberger (Elk Feedgrounds Supervisor); Brad Hovinga (Jackson Region Wildlife Supervisor); Dave Hyde (Elk Feedgrounds Manager); Jordan Kraft (South Pinedale Game Warden); John Lund (Pinedale Region Wildlife Supervisor); Janet Milek (Casper Region Public Information Specialist); Jared Rogerson (Pinedale

Region Wildlife Disease Biologist); Brandon Scurlock (Pinedale Region Wildlife Management Coordinator); Cheyenne Stewart (Jackson Region Wildlife Management Coordinator); and Ben Wise (Jackson Region Wildlife Disease Biologist).

The Wyoming Game and Fish Elk Feedgrounds Steering Team consulted with local representatives from partnering Federal agencies. Those representatives included: Frank Durbian (Refuge Manager, National Elk Refuge, U.S. Fish and Wildlife Service); Eric Cole (Senior Wildlife Biologist, National Elk Refuge, U.S. Fish and Wildlife Service); Douglas "Gus" Smith (Division Lead Science and Resource Management, Grand Teton National Park, National Park Service); James Wilder (Forest Wildlife Biologist, Bridger-Teton National Forest, U.S. Forest Service); Mark Thonoff (Wildlife Biologist, Pinedale Field Office, Bureau of Land Management).

Special assistance in the Wildlife Disease Shared Learning session was provided by Dr. Jennifer Malmberg, previously Assistant Professor at the University of Wyoming and Disease Pathologist at the Wyoming State Veterinary Laboratory, currently Supervisory Research Biologist, CWD Project Leader with USDA APHIS Wildlife Services.

Message from the Director

Message from the Wyoming Game and Fish Department Director, Brian Nesvik

Wyoming is blessed with incredible wildlife resources, vast landscapes and some of the healthiest big game herds in the world. The same species that existed 1,000 years ago still roam their historic home ranges. For well over a century, Wyomingites have dedicated their lives to conserving wildlife and protecting natural resources. This dedication served as the catapult to initiate the first elk feedground. Severe winters from 1909-11 took a toll on elk and resulted in severe mortality. Leaders at that time, with the best tools and technology available, established the first elk feedground to address the needs of starving elk and prevent damage to haystacks. Today, we continue to live with the positive and negative consequences of their decisions. As is the case with many wildlife management challenges, natural systems and human interaction with wildlife evolve over time creating needs for on-the-ground management to adapt.

The complexities of feedground management in western Wyoming create a situation where our challenges today are much more difficult than they were in the early 1900s. Wildlife and domestic animal diseases, land ownership patterns and jurisdictions, actions by courts, differing values among stakeholders as well as habitat fragmentation are issues bearing on the growingly difficult challenges of elk and feedground management.

Our current policies and the current state of the ecosystem evolved for more than 100 years. When supplemental feeding began in the early 1900s in Jackson Hole, Grand Teton National Park did not exist. The National Elk Refuge was in its infancy. Federal statutes like the National Environmental Policy Act and the Endangered Species Act did not exist. Brucellosis was new to the country and chronic wasting disease was not known to exist. Agriculture was an important land use as it is today, but the manner in which domestic livestock was produced was different. It is important for all to note the fact that the actions and decisions that resulted in our current state are measured in decades rather than years. As we evolve this system for the future, it is not reasonable or responsible to force quick, large-scale policy changes. Historic timeframes and transitions will continue to define the course.

This plan is intended to chart a long-range path for feedground management. It is not a feedground closure plan. It is a road map to identify a responsible set of actions that will guide the manner in which all involved make decisions to deal with current and emerging challenges and conflicts. This plan creates a process and venue to discuss and analyze ways to reduce our reliance on supplemental feeding in places where it's feasible, and in a way that protects the values and objectives feedgrounds achieve today. We all have a goal to protect domestic livestock from diseases that are transmitted from wildlife, protect private property, provide elk hunting and viewing opportunities and mitigate interspecies competition. These goals are important today and will be in the future. This plan was developed with significant input by stakeholders and takes a responsible and reasonable approach to feedground management by using the best and newest science.

The plan is broad and offers an all-encompassing approach for all areas of western Wyoming where supplemental feeding occurs. It was developed to be intentionally broad. The actions that will occur as a result of this plan are meant to be localized and include input from local stakeholders. It will

require a more targeted, in-depth and site-specific analysis. This plan is intended to create the framework for future analyses, discussions and decisions.

I am hopeful interested parties and stakeholders will continue to provide input and perspective as we work together to solve the challenges that are before us today. The Wyoming Game and Fish Department is acting in good faith to carry out its mission and statutory mandates to meet the expectations of Wyoming's citizens. It would be irresponsible for us to do otherwise or to ignore the facts we have before us. Wyoming has a long-standing, successful track record of handling complex problems in an inclusive manner informed by science. The Wyoming way worked before and it can work again as we attempt to make good decisions for the future of feedground management.

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Executive Summary

The Wyoming Elk Feedgrounds Management Plan (Plan) provides direction for the Wyoming Game and Fish Department (Department) in the management of elk feedgrounds over both the near and long terms. This Plan was developed through the "*Elk Feedgrounds: A Challenge We Can Take On*" public collaborative process. Common themes that emerged from stakeholders during the process are addressed, including; the Plan is adaptable and multi-faceted with a long-term approach, decision authority remaining at the local and state level, and the Plan includes guidelines to develop feedground-specific or feedground-complex-specific actions.

The Plan stemmed from the statewide public collaborative process to develop the Department's 2020 Wyoming Chronic Wasting Disease (CWD) Management Plan. Due to the complexities surrounding elk feedgrounds and their management, the CWD Working Group determined a separate process would be most effective in addressing CWD management in elk populations that utilize feedgrounds.

The Plan provides important context on the history, guiding policy and statutes, elk ecology and management, federal land status, social and economic ties, disease management, and habitat as it relates to feedgrounds in Wyoming. Given the context, the following sideboards were established; maintain publically supported elk population objectives, maintain hunting opportunity, limit any increase in damage to private property, limit any increase in disease transmission to livestock, and limit any increase in interspecies competition to other wildlife species.

This plan was developed under the North American Model of Wildlife Conservation tenant that scientific management is the proper means for wildlife conservation. The best available science relevant to the topic is voluminous and generally corroborative with existing management. However, current management practices have artificially bolstered elk densities, which has current and future negative consequences for wildlife health due to elevated disease transmission.

The management direction includes goals and strategies for elk harvest, public communication, CWD and other disease management, research, increasing native elk winter range, livestock producer and partner organization coordination, reducing wildlife-vehicle collisions, feedground management alterations, habitat enhancements, and feedground phase-outs. Swift and deliberate actions are necessary to limit future CWD transmission. When CWD is detected on a feedground, the Department will increase local CWD surveillance, target and lethally remove elk showing signs of infection and reduce elk densities in response to prevalence thresholds.

Each elk feedground, feedground-complex, and herd present unique situations that necessitate customized management. Each potential management action will not work on all feedgrounds, and the most effective management strategy is to develop site-specific management actions. Thus, the Plan outlines the process for developing elk herd level Feedground Management Action Plans (FMAP). The goals of the FMAPs are to maintain cervid health by limiting disease transmission while providing supplemental feed and reduce or eliminate reliance of elk on supplemental feed over the long term. For each of the six elk herds containing feedgrounds, Department personnel will identify the obstacles and work with stakeholders to determine potential solutions specific to each feedground. Progress will be reported annually in the Job Completion Report for each respective elk herd for internal and external tracking and accountability.

Goals and Purpose

The Wyoming Elk Feedgrounds Management Plan (Plan) stemmed from the statewide public collaborative process to develop a Wyoming Chronic Wasting Disease (CWD) Management Plan for the Wyoming Game and Fish Department (Department). Due to the complexities surrounding elk feedground management, the collaborative CWD Working Group determined elk feedgrounds would require a separate public collaborative process to be effective in managing CWD and other diseases in elk populations that utilize feedgrounds. The Department's CWD management plan directed the Department to initiate the *"Elk Feedgrounds: A Challenge We Can Take On"* public collaborative process with the goal of creating a durable, long-term, and publicly-supported feedgrounds management plan to guide Department management into the future.

This Plan provides overarching long-term guidance and direction for the Department to manage elk populations that utilize winter feedgrounds in western Wyoming. The Plan and forthcoming individual Feedground Management Action Plans (FMAP) will provide the Department with direction to continue to look for opportunities that allow elk to winter away from feedgrounds. This, in turn, will reduce their reliance on supplemental feeding to manage the distribution and prevalence of CWD and other diseases of elk attending winter feedgrounds. This vision must include processes whereby all private, state, and federal land managers work together in a unified approach to maintain publicly supported elk population objectives and hunter opportunities without causing unacceptable conflict with humans, livestock, or other wildlife species.

This Plan is designed to be long-term and adaptable while allowing the Department to address short-term opportunities to meet goals. Wildlife managers should not wait to take meaningful actions when opportunities arise that can benefit future objectives. This Plan will drive the development of individual herd unit FMAPs that will be developed collaboratively with all stakeholders and the interested public on a localized scale. These herd unit-level management plans will drive meaningful long-term changes in feedground management, connecting the Department's brucellosis management action plans and CWD management plans.

It is incumbent upon wildlife managers to explore ways to make meaningful changes in how we manage elk that rely on feedgrounds in the face of current and future wildlife diseases. The practice of controlling elk distributions in western Wyoming utilizing supplemental feeding is likely not sustainable. As the Department looks toward our long-term objectives to combat disease, we must constantly look for opportunities to incorporate new ideas and current science into elk management in a way that will allow for the conservation of elk populations while reducing disease impacts. Securing opportunities for elk to winter away from feedgrounds will be a goal for Department employees. Still, it must be done collaboratively with stakeholders and the public.

Wyoming Elk Feedgrounds

History of Elk Feedgrounds in Western Wyoming

Wyoming began feeding elk in the Jackson area in the winter of 1909-1910 (there was no Department in 1909). The federal government became involved in 1912 with the creation of the National Elk Refuge (NER). While efforts to reduce elk starvation were the initial driving force, using feedgrounds to reduce damage to private property later became a management tool and was a major factor in the expansion of feedgrounds throughout the Jackson and Pinedale areas of western Wyoming. In 1929, the Wyoming legislature passed legislation making the Wyoming Game and Fish Commission (Commission) financially liable for elk damage to hay and private property. While maintaining elk numbers and damage prevention was the basis for implementing supplemental feeding, the value of providing separation between livestock and elk for disease prevention (namely brucellosis) became recognized in later years.

In 1929, storage sheds were built in the Gros Ventre River drainage, in the Upper Green River drainage near the mouth of Roaring Fork, and at the forks of Big and Little Grey's rivers. Hay and cottonseed cake were stored in these sheds and fed if it was deemed necessary to prevent elk starvation (Dean 2016). In the late 1940s and particularly in the 1950s and 1960s, the number of elk feedgrounds in Sublette County increased. A total of 14 feedgrounds were created during this period, two of which, Reardon Canyon and Deer Hills, were later terminated. Elk were also fed at several locations in the Blackrock/Moran area in Teton County from the early 1930s through 1972, when feeding was terminated. However, from 1973 through 2020, elk were occasionally fed in Buffalo Valley on an 'emergency' basis to facilitate elk-cattle separation for disease and damage concerns. Additionally, moose and deer were fed at several locations in Teton, Sublette, and Lincoln counties from the early 1930s through the mid-1990s. Elk have also been periodically fed on an 'emergency' basis in Star Valley at several locations (Dean 2016).

Management of elk feedgrounds has evolved as changes in equipment, personnel, public awareness, disease, and damage issues have occurred. The feeding frequency, length of the feeding season, and the amount fed/elk have all changed over time. In the early years of feedgrounds, elk were not fed on a daily basis, feeding seasons consisted of a few days and the caloric intake provided (hay fed) was inadequate. There were gradual adjustments until feeding was conducted daily, and the feeding season length increased. Elk were held in certain areas to control distribution, reduce conflicts, and feed was provided based on the nutritional needs of elk.

The Department now operates 22 winter elk feedgrounds in Teton, Lincoln, and Sublette counties on state, federal, and private lands. The United States Fish and Wildlife Service (USFWS) operates the NER in Teton County (Figure 1). The goals of providing supplemental feed to elk during winter remain similar to when feedgrounds were initially established; feedgrounds reduce the potential for the starvation of elk (especially calves), elevate elk numbers beyond what available native winter ranges could support and help control elk distribution during winter to reduce damage to stored crops, elk-cattle co-mingling occurrences, and elk-vehicle collisions. The most recently established feedground is Forest Park (1980), and the most recently terminated feedground was Alkali in the Gros Ventre River drainage (2020). Elk that were formally fed at the Alkali feedground are now fed at nearby feedgrounds (Patrol Cabin and Fish Creek), and the North Piney feedground has only been used in recent years as a staging area to gather animals in December; these elk then migrate to Bench Corral elk feedground where feeding seasons are generally shorter.

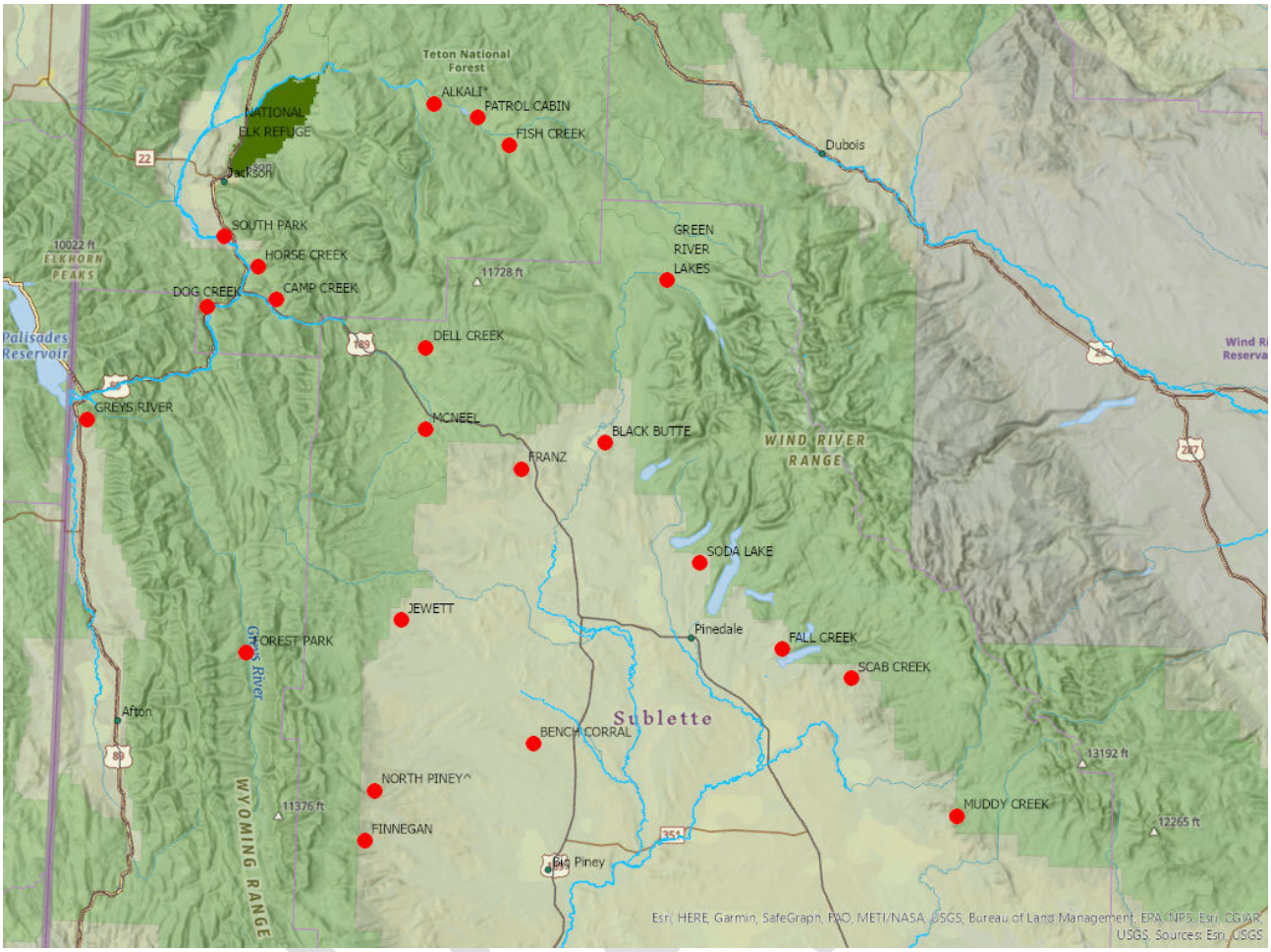

Figure 1. Winter elk feedground locations in Wyoming.
**The Alkali feedground was converted to emergency feeding only 2020-2024 and then will be terminated.*

Native grass and alfalfa hay has been the primary feed since the inception of feedgrounds, although concentrates of various forms have been used periodically. Before the development of baling machines in the 1930s, hay was harvested and fed in loose form. The feeding of baled hay prevails today. The NER fed loose or baled hay from 1912 until 1972, when the switch to pelleted alfalfa occurred due largely to the ease of feeding with large machinery and reductions in feeding times and disease transmission rates (Dean 2016).

The source of hay has gradually changed over time. In the early years, due to limitations with transportation, hay was secured from producers who lived near individual feedgrounds. Beginning in the 1990s, local hay production declined, necessitating hay being purchased out of state and hauled into Wyoming. The Department has also produced limited quantities of hay on Wildlife Habitat Management Areas for feeding elk. In 1975, the Department acquired the rights from the National Wildlife Refuge System near Fontenelle Reservoir to farm the Seedskadee Wildlife Unit. However, the price of hay from the private sector was generally lower than production costs at Seedskadee, and operations were terminated in 1988 (Dean 2016).

Small square bales of hay are preferred for feeding on Department feedgrounds because they can be manually loaded on a sleigh pulled by a team of draft horses. However, over time small bales have become less available and more expensive, and large hay bales are now utilized more frequently. The

large size of these bales requires a tractor for loading, creating difficulties with maintenance issues in the remote settings of many feedgrounds.

Draft horse teams remain the primary method used to distribute hay on feedgrounds. The majority of feedgrounds are in remote locations without utilities, and feeders with horse teams distributing small hay bales remain an efficient method to feed elk daily. Draft horses pulling a sleigh can be operated by one person and can manage deep snow better than a wheeled tractor. However, with less small bale production and increased costs, heavy equipment is becoming necessary to handle and load large bales on the sleighs. Tractors should be stored in a heated garage or use diesel-powered engine block heaters to start daily. Hay bale processors have been utilized for several years with success. Most recently, a tracked tractor and 3-point attached hay bale processor was purchased and has demonstrated the ability to negotiate deep snow, allowing for increased hay distribution across the landscape.

Feeding Alterations: History

- Creep feeders: Early in the 1950s, it was reported that most of the elk that died on feedgrounds were calves, and the Department elected to construct a creep feeder at the South Park feedground to reduce calf mortality. A creep feeder was constructed from an elk-proof fence that was 200 feet by 60 feet with 20 openings measuring 12 inches by 42 inches, small enough that only calves could enter. Second crop of alfalfa hay was fed inside the feeder, but the calves would not leave the main herd and would only enter the feeder after all the outside hay was gone. Calves only used the feeder at night and early morning when the main herd was close, and there was no disturbance in the area. Only one calf died on the feedground that winter, but unfortunately, the creep feeder tended to concentrate animals, increasing the possibility of disease transmission. The creep feeder was never used again, and it was speculated that if good alfalfa hay was fed at all times, this should provide the nutrients necessary to maintain desired growth (Anderson 1951).

- Hay bunks: Hay bunks were used once during the spring of 1989 when about 80 elk found a log bunk containing hay at the Horn Ranch near the Fish Creek feedground. Several cows were able to stick their heads through the openings in the bunk and reach hay, but that access was limited, and calves could not access the hay. Toward the end of the winter, the elk became very malnourished and moved to the Fish Creek feedground, where many calves died. Some local outfitters believed that the elk were not fed enough at the feedground during the winter, and calves starved to death as a result. The Department attempted to mediate the situation and placed feed bunks on the feedground. Hay was kept in them and available even after formal feeding had ended. These bunks were never used again and still remain at the feedground (Dean 2016).

- Square bale spinner: The Department currently uses bale processors that mount on the 3-point hitch of a tractor. These processors are currently being used on four feedgrounds, where they efficiently provide for low-density feeding and increase the size of the feeding area. Bale processors are cost-effective and require very little maintenance. Unfortunately, bale spinners must be mounted on a tracked tractor to negotiate deep snow and steep terrain.

Feedgrounds have always been controversial, and their management options are complex. The response by the public and government agencies in the early 1900s ultimately set the stage for

feedgrounds to be part of elk management in the Jackson and Pinedale areas. Criticisms of the practice followed and generally contended that elk numbers should not exceed the ability of native ranges to support them. While few managers prefer feedgrounds over native elk winter range, feedgrounds have historically become an integral part of elk management in Western Wyoming.

Feedground Legislation, Statutes, Policy, Budget, and Personnel

The Department is statutorily charged with managing and protecting all Wyoming wildlife (W.S. 23-1-103) and the Commission is directed and empowered to make suitable provisions for the feeding of elk as may be deemed necessary (W.S. 23-1-302(a)(ix)). While the Commission has the statutory authority to feed elk, the Department is directed not to develop and operate any additional feedgrounds without pre-approval. The supplemental feeding of elk and wild bison is outlined in Commission policy (***Wyoming Game and Fish Commission Policy VII D July 13, 2006).*** Temporary feeding is also addressed in policy and may occur when Department managers identify an emergency and agreement is reached by the Department Director and Commissioner(s) for the area(s) where the emergency exists.

Under W.S. 23-1-305, feedgrounds can only permanently cease operations upon order of the Governor. To close a feedground, the Commission is required to concurrently provide its recommendation to the Governor and Wyoming Livestock Board. Under this statute, the livestock board will provide its opinion to the governor on whether the board believes the closure of the elk feedground is appropriate. At least one public meeting will be held in a location that fosters the most public participation by the people directly impacted by the proposed closure. Public comments will be provided for the Governor's consideration on whether to issue an elk feedground closure order.

Under most conditions, the Commission discourages the private, intentional feeding of big and trophy game animals. In order to maintain established elk herd unit population objectives in the Jackson and Pinedale region, the Commission directs the Department to provide supplemental feed for elk as provided in this policy. The Commission recognizes the importance of supplying supplemental feed to elk at existing State feedgrounds and the NER and recognizes that without such feeding, the elk populations would have to be decreased to levels that could be supported by the limited native range forage.

The Commission directs the Department to provide adequate supplemental feed to support healthy and productive elk at State-operated feedgrounds and work cooperatively with the USFWS to provide adequate feed to support healthy and productive wintering elk/wild bison on the NER. It is recognized that the Commission-approved elk herd unit population objectives exceed established total feedground quotas for each herd unit due to the presence of some elk wintering on native range. Recognizing that elk population objectives for each herd unit exceed the number of elk to be maintained on feedgrounds and the unpredictability of elk distribution considering habitat conditions, weather, and other factors that may influence the distribution of elk on Department-operated feedgrounds, the Commission directs the Department to strive to manage feedgrounds for the total feedground elk quotas for each elk herd unit as listed in Table 1.

Table 1: Elk herd units, quotas, and individual feedground quotas.

Herd Unit	Quota	Elk Feedground	Quota Distribution
Afton	1,750	Greys River	1,000
		Forest Park	750
Piney	2,150	Bench Corral	250
		Finnegan	400
		Franz	450
		Jewett	650
		North Piney	400
		McNeel*	600
Fall Creek	3,950	Camp Creek	900
		Horse Creek	1,250
		Dog Creek	800
		South Park	1,000
Green River	1,975	Black Butte	500
		Green River	675
		Soda Lake	800
		Dell Creek*	400
Jackson	2,450	Alkali**	800
		Fish Creek	1,000
		Patrol Cabin	650
Pinedale	1,800	Fall Creek	700
		Muddy Creek	600
		Scab Creek	500

*The Dell Creek and McNeel feedgrounds were part of the Hoback elk herd dissolved in 2022. Feedground quotas were added to the Herd Unit objectives in the Piney and Green River elk herd units

**The Alkali feedground was converted to emergency use only 2020-2024 and then will be terminated.

The number of elk on the NER is to be maintained in accordance with a mutually agreed upon number established cooperatively by the Commission through the Department and the U.S. Fish and Wildlife Service.

Elk feedgrounds program annual budget and personnel

The Department's elk feedgrounds program is comprised of two full-time employees charged with operating 22 feedgrounds in western Wyoming. During 2022 the annual budget of the feedgrounds program was $2,700,000, with the majority of that total spent on hay. About 16 private contractors are hired annually to feed elk, with some contractors feeding elk on more than one feedground. Several private contractors are hired annually to produce and haul hay to each feedground during the summer. Hayshed and other facility and road access maintenance are budgeted and managed by the Habitat and Access program in the Department with an approximate budget of $400,000.

Elk Herd Ecology and Management

Historical winter range and elk migrations

Numerous sources indicate that before the settlement of western Wyoming, some elk likely wintered at low elevations in the Snake, Gros Ventre, Hoback, Grey's, and Green River valleys. Elk also likely migrated south to portions of the Red Desert, similar to present-day migrations of mule deer and pronghorn (Preble 1911, Allred 1950, Cromley 2000). Upon settlement and associated human development, conversions of native habitats to crops, and the importation of domestic livestock all likely contributed to the cessation of long-distance migrations of elk in western Wyoming by the early 1900s.

Presently, during years of low snow accumulations, habitats around Fall Creek, Scab Creek, Muddy Creek, Bench Corral, Green River Lakes, and Soda Lake elk feedgrounds can support elk wintering on native ranges. Since the reintroduction of grey wolves to the Greater Yellowstone Ecosystem (GYE), some elk that typically wintered on native winter ranges in the Gros Ventre and upper Green River have been displaced off winter ranges to feedgrounds, sometimes complicating feedground management. Most elk migrations today are movements from high-elevation summer ranges to lower elevations, and elk attending feedgrounds spend approximately one month less time on summer ranges than elk utilizing native winter ranges (Jones 2014).

Feedground elk herd information

All elk herd units in the Jackson and Pinedale regions with elk feedgrounds are managed by objective using annual winter trend counts. These trend-based objectives use a three-year average (+/- 20%) to account for variable winter conditions and elk distributions. Trend counts include classifications on the ground at feedgrounds during February when elk attendance is presumed greatest and concurrent aerial counts to document elk on native winter ranges. The six elk herd units containing feedgrounds in the Jackson and Pinedale regions were within 2022 management objectives. Field managers review all Wyoming big game herd population objectives every five years. If an objective change is proposed, public meetings are held in the region, and then Commission approval will be sought.

Large carnivore relationship and reliance on elk populations

Since the reintroduction of grey wolves into the GYE in 1994, their interaction with and impacts on elk populations have been of considerable interest to wildlife managers throughout western Wyoming. Wolves frequent elk feedgrounds during winter months, and variable levels of predation are documented annually. Wolves can displace elk to and from feedgrounds. In some cases, this displacement is temporary, while in others, it has been a long-term trend. For example, elk have historically frequented three feedgrounds in the Gros Ventre drainage. Increased wolf presence since the early 2000s resulted in elk abandoning two feedgrounds and only frequenting one feedground in large aggregations during some winters. In the event of a large shift in elk distribution, it can be expected that wolves will likely follow their prey base. A change in elk and wolf distribution could complicate private livestock operations with additional predation on livestock in the vicinity. Elk and wolf movement to lower elevations may also result in increased wolf harvest by hunters.

Elk harvest strategies

Wildlife managers are responsible for setting and maintaining elk population objectives in their respective regions, and hunting has been the primary management tool used to meet population objectives. Managers are able to employ a variety of methods to achieve the desired harvest, such as developing annual license quotas, reduced-price cow/calf licenses, and flexible hunting season dates. In some herds, maintaining objectives can be difficult due to various challenges such as hunter access, weather, etc. Large ranches with limited hunter access can become refuge areas for elk, resulting in poor hunter harvest on adjacent public lands. Elk harvest is directly correlated with snowfall, and warm, dry fall conditions can result in difficult hunting conditions and poor harvests. Currently, landowners who allow access are eligible to receive payments via landowner coupons when animals are harvested on their property, and they are eligible for payment for damage to their property caused by big game animals. The Department's Access Yes program provides monetary incentives for landowners willing to enroll their property and allow hunting access.

Federal Land Management

Bureau of Land Management (BLM)

Six of the Department's twenty-two elk feedgrounds are permitted on BLM lands through a Memorandum of Understanding, including Bench Corral, Finnegan, Franz, North Piney, Fall Creek, and Scab Creek feedgrounds. The BLM's mission is to sustain the health, diversity, and productivity of public lands for the use and enjoyment of present and future generations. The BLM manages habitat within land-use capabilities and is consistent with BLM's Planning System. The BLM places special management emphasis on public lands mutually established as being of unique importance to winter elk feeding programs. These public lands are used to meet the Department's elk population objectives through winter feeding to provide sustained harvest at levels compatible with habitat capabilities. The Pinedale BLM Resource Management Plan guides management in and adjacent to elk feedgrounds to maintain and improve habitat quality and ensure the continued viability of the elk feedgrounds.

United States Forest Service (USFS)

There are seven Department-operated elk feedgrounds permitted on USFS lands on the Bridger Teton National Forest (BTNF) through special use permits, including Upper Green, Dog Creek, Muddy Creek, Fall Creek, Fish Creek, Forest Park, and Dell Creek feedgrounds. The primary USFS considerations for these permits are the potential effects on USFS lands and any potential conflicts the operation may have with other public uses and Forest programs. The 1990 Bridger-Teton Land and Resource Management Plan (Forest Plan) guides management direction and decision-making on the BTNF and provides for multiple uses and sustained yield. The Forest Plan ensures that feedground operations are consistent with relevant goals, objectives, and standards.

United States Fish and Wildlife Service (USFWS)

The USFWS operates a winter elk feeding program on the NER. The NER was established in 1912 as a winter game reserve for elk. Over time, the NER purpose has been legislatively broadened to include refuge and breeding grounds for birds and other big game animals, the conservation of fish and wildlife, and the protection of natural resources and conservation of threatened and endangered

species. The NER winter elk feeding program is currently guided by the 2019 Bison and Elk Management Step-Down Plan, which is a structured framework for reducing the reliance of elk and bison on supplemental feeding over a five-year period. The plan involves joint management and coordination with Grand Teton National Park (GTNP) and the Department due to elk that winter on the NER, including the Yellowstone, GTNP, Teton Wilderness, and Gros Ventre elk herd segments. The specific management goal of the 2019 Step-Down Plan is to work towards reducing the average number of elk on feed to 5,000 while maintaining the Department's Jackson elk herd population objectives and to work towards reducing the winter population of bison to the Department recommended, and 2007 Bison and Elk Management Plan (BEMP) adopted objective of 500.

National Park Service (NPS)

Grand Teton National Park actively assists in managing the Jackson elk herd through the GTNP elk reduction program. The laws, regulations, and policy guiding GTNP on wildlife management have a purpose to conserve the scenery, the natural and historic objects, and the wildlife therein, to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations. The GTNP elk reduction program is a controlled joint effort between the Department and GTNP utilizing hunters licensed by the State of Wyoming and deputized as rangers by the Secretary of the Interior for the proper management and protection of the elk. The GTNP has four policy goals related to elk management within the 2007 Bison and Elk Management Plan: 1) Restore and perpetuate natural ecosystem functioning in the park, restore and maintain native habitats. 2) Perpetuate natural processes and interactions of bison and elk with natural environmental fluctuations influenced by fire, vegetation succession, weather, predation, and competition. 3) Contribute to Department objectives for the Jackson elk and bison herds to the extent compatible with Goals one and two. 4) Work with the Department to reduce the prevalence of brucellosis in bison and elk populations in order to protect the economic interest and viability of the livestock industry and reduce the risk of adverse effects of or from other non-endemic diseases not currently found in the Jackson bison and elk populations. The 2007 BEMP also recommends GTNP work in close cooperation with the Department; existing conditions, trends, new research findings, and other changing circumstances will provide the basis for developing and implementing a dynamic framework for decreasing the need for supplemental food on the refuge.

Current Social and Economic Values Related to Elk Feedgrounds

Elk populations in western Wyoming are managed with the use of elk feedgrounds to support current population numbers. The current social and economic benefits of feedgrounds are of value to all wildlife interests. However, disease impacts on elk populations in the future have the potential to negatively affect wildlife interests in western Wyoming, specifically relating to elk numbers and diverse age class. These social and economic values must be thoroughly considered in the future management of western Wyoming elk.

Hunting (hunter numbers and recreation days)

Hunting is one of the most popular outdoor recreational activities in Wyoming. The USFWS (2011)

estimated that 140,000 individual hunters pursued big game species that year. During 2021, 56,691 hunters pursued elk and tallied 465,236 total recreation days (WGFD 2021). In Sublette County alone, elk hunting generated a total of 55,862 hunter days in 2015, while Teton County generated an additional 28,719 hunter days. (Taylor and Foulke 2016). Within the Pinedale and Jackson elk herd units during 2021, there were 9,450 resident elk hunters and 2,495 nonresident elk hunters, generating 87,857 total hunter days (WGFD 2021).

Outfitters and guides (number of outfitters, use days)

A total of 31 outfitters are authorized to hunt elk in the Jackson and Pinedale regions. Individual outfitters ranged from serving 1-38 hunters annually, and the average number of clients per outfitter ranged from 5-18. The average cost of a public-land, professionally outfitted elk hunt was approximately $5,000 in 2021, generating between $930,000 and $1,235,000 in gross revenue annually for local outfitters (McWhirter et al. 2022).

Agricultural Operations (damage, elk/cattle co-mingling, and disease transmission concerns)

Wyoming Statute § 23-1-901 and Commission Regulations, Chapter 28, require that the Department investigate and consider damage to land, growing agricultural crops, stored crops, seed crops, extraordinary damage to grass and/or improvements such as fences and windbreaks caused by big game animals, and provide a means to compensate landowners for verified damage claims. Wyoming statute defines elk as a big game animal. Department personnel dedicate a significant amount of time to reducing and/or preventing damage caused by elk and co-mingling of elk and cattle. Brucellosis transmission concerns related to elk/cattle co-mingling are precisely addressed and strictly prohibited during winter months in local producers USDA APHIS VS livestock herd management plans and thus require immediate Department mitigation and is a greater concern than traditional crop damage. These efforts include designing hunting seasons to target population segments responsible for damage, hazing, and/or lethal removal of animals in conflict situations, providing fencing materials for hay stackyards, and working with landowners to find additional solutions to minimize damage risk, such as adjusting cattle feeding locations, times, etc.

When elk damage does occur, significant resources, including manpower, equipment, and associated costs, can be directed at mitigating the situation. Methods employed include hazing elk away from the damage/co-mingling situation (sometimes to a nearby elk feedground), emergency feeding of the offending elk to provide separation between elk, livestock, and livestock feed, and lethal removal of offending elk. Wyoming state statute and Commission regulation require the Department to pay for any verified elk damage.

Many of the elk feedgrounds have eight-foot tall, woven wire, elk-proof fencing or are strategically located in areas to control elk distribution away from private property. For example, the Grey's River elk feedground has an exclusionary elk fence from Alpine to the south to Stewart Creek to discourage elk occupancy on private lands and co-mingling with livestock on lower elevation lands in the northern reaches of Star Valley. This fence also reduces the number of elk-vehicle collisions on the highway.

Elk damage claims in the Jackson and Pinedale regions are relatively uncommon. From 2011 to 2021, only six damage claims totaling $4,600.63 (averaging $418.24/year) were claimed in the Jackson

region. Within the Pinedale region, damage claims associated with elk were submitted in 7 of the last 11 years, totaling $28,285.10 (range $0 to $18,311.35) and averaging $2,571.37/year. Maintaining the number and extent of elk damage claims to a minimum requires substantial personnel time, equipment, and in the case of emergency feeding, substantial financial costs. The costs of operating feedgrounds are somewhat offset by a reduction in the number and total costs of elk damage claims.

Economic Impact on the Department (hunting license revenue)

Hunting license sales are the primary revenue generator for the Department, with big game license sales comprising nearly 48% ($29+ million) of annual license revenue in 2020, contributing over 30% of all revenue sources for the Department (WGFD 2021). Elk license sales alone generated $11,470,177 state-wide in 2021 (WGFD 2021). During 2021, residents purchased 1,179 limited quota elk licenses and 2,194 cow/calf elk licenses, and nonresidents purchased 366 limited quota elk licenses and 606 cow/calf elk licenses in all elk herd units containing feedgrounds in the Jackson and Pinedale regions (Table 2). License fees for these licenses generated a total of $624,654 in 2021. General licenses are also valid in most of the feedground elk herd units, yet revenue from general licenses is difficult to track due to the ability of hunters to pursue elk anywhere in Wyoming with a general season.

Table 2. Elk license revenue for the Pinedale and Jackson Herd Units 2021.

2021	Resident Type1-Type 5	Resident Type 6-Type 8	Resident General	Nonresident Type 1-Type 5	Nonresident Type 6-Type 8	Nonresident General	Elk Special Management Permit
Avg # Licenses	1179	2194	Unknown	366	606	Unknown	10,770
License $	$57	$43	$57	$692	$288	$692	
	$25 Youth	-$20 - Youth	$25 - Youth	$275 – Youth	$100 - Youth	$275 - Youth	
				$1,268 - Special		$1,268 - Special	
License $ Total	$88,628	$62,359		$303,087	$170,580		$166,935

Grand Total for 2021 Pinedale and Jackson Elk Herd Units License Sales with Elk Special Management Permit = $791,589

Economic Impact on Communities (total expenditures – food, gas, lodging, etc.)

Hunting and fishing are important components and drivers of the recreation-based economy in Wyoming. Past investigations into this contribution have estimated the total positive impact on the Wyoming economy from big game hunters alone generated $303,588,073 in 2015 (Southwick and Associates 2017). Their activities also supported 3,100 jobs, $85.6 million in personal income, and $28.2 million in state and local taxes (Southwick and Associates 2017). Individually, resident big game hunters were estimated to spend from $91 - $148 per day, while non-residents spend $551 - $580 daily while hunting (Taylor and Foulke 2016, Southwick and Associates 2017). Big game hunters generated a total of $8.4 million in Teton County and $15.5 million in Sublette County in 2015 (Taylor and Foulke 2016). When extrapolated to hunter data in the Pinedale and Jackson regions

in 2021, both resident and non-resident hunters generated $12.6 - $25.2 million in expenditures (Table 3).

Table 3. Hunter expenditures per hunter and per day for the Pinedale and Jackson herd units (102-108), 2021.

Herd Units (102-108)	**Pinedale and Jackson**
Year	**2021**
Avg. Resident Expenditures[a]	$11,850,300.00
Avg. Nonresident Expenditures[b]	$13,392,186.95
Avg. Resident Expenditures[c]	$1,093,283.66
Avg. Nonresident Expenditures[d]	$1,769,117.01
Avg. Resident Expenditures[e]	$1,784,417.88
Avg. Nonresident Expenditures[f]	$2,584,257.74
TOTAL	$12,636,747.75 - $25,242,486.95

a - Resident $1254/hunter (USFWS 2011)
b - Nonresident $5367.61/hunter (USFWS 2011)
c - Resident $90.91/day (Taylor and Foulke 2016, USFWS 2011)
d - Nonresident $396.93/day (Taylor and Foulke 2016, USFWS 2011)
e -Resident $148.38/day (Taylor 2018, Southwick Associates 2017)
f - Nonresident$579.82/day (Taylor and Foulke 2016, USFWS 2011)

Wildlife Related Tourism (wildlife touring, watching, and other non-consumptive uses*)*

Tourism in Wyoming is an important financial resource in Wyoming, and wildlife-related tourism is no exception, especially in western Wyoming. Wildlife-related tourism brings substantial funding and jobs to Wyoming (Taylor 2017). When combined with hunting and fishing, wildlife-related tourism contributes an estimated 9,600 jobs, $788 million in expenditures, and a total economic benefit of up to $1 billion in business activity (Taylor and Foulke 2016). Wildlife-related tourism accounts for about half of the aforementioned revenue and jobs added to the state's economy.

Elk Feedground Disease Management

Overview of pathogen, environment, and animal health

Biologically, the benefit of artificial feeding of free-ranging elk is reducing winter mortality due to malnutrition, which is especially true in areas without adequate available winter range. However, the prolonged congregation of wildlife, repeated over time, increases the likelihood and risk of infectious disease transmission and potentially increases stress. For this management document, we will be focusing on "infectious" diseases, particularly those of current concern (brucellosis, CWD, necrobacillosis, psoroptic mange) and one due to potential risk that is not currently found in Wyoming's elk populations (bovine tuberculosis 'bTB').

Disease is defined as "any impairment that interferes with or modifies the performance of normal functions", it is a relative state, the middle between absolute health and death (Wobeser 2006). Typically, every disease process will have an energetic cost on an individual. There is only a finite amount of energy available, and infectious disease processes can incur large amounts of energy, so while a disease may not outright kill an animal, it can leave them susceptible to malnutrition, predation, and other maladies.

Several factors can play a role in the transmission and occurrence of disease. The three main areas to know and understand are the host, agent/pathogen, and the environment (Figure 2.). These areas are not equal across time and space and can all interact to contribute to the prevention or development of disease. Conditions encountered on feedgrounds are different than those found in native winter range settings; fully understanding factors that can play a role in disease occurrence and transmission is critical for effective management. Some pathogens may be very infectious depending on the time of year (e.g., *Brucella abortus*), and others are heavily dependent on environmental factors (e.g., necrobacillosis).

While host and agent/pathogen are critically important, the area of environment and its impacts cannot be dismissed and will continue to be a critical factor regarding disease management on feedgrounds, especially in the future. Environmental change can create stress in an individual and population, and depending on how quickly that change occurs will determine what kind of stress is produced. Acute stress can be adaptive and helpful (e.g., a winter storm pushing animals to a new area), whereas chronic or repeated stress is typically harmful (Wobeser 2006). This is important because any changes that are made on feedgrounds need to be done in a thoughtful and consistent manner, factoring in other large-scale environmental changes.

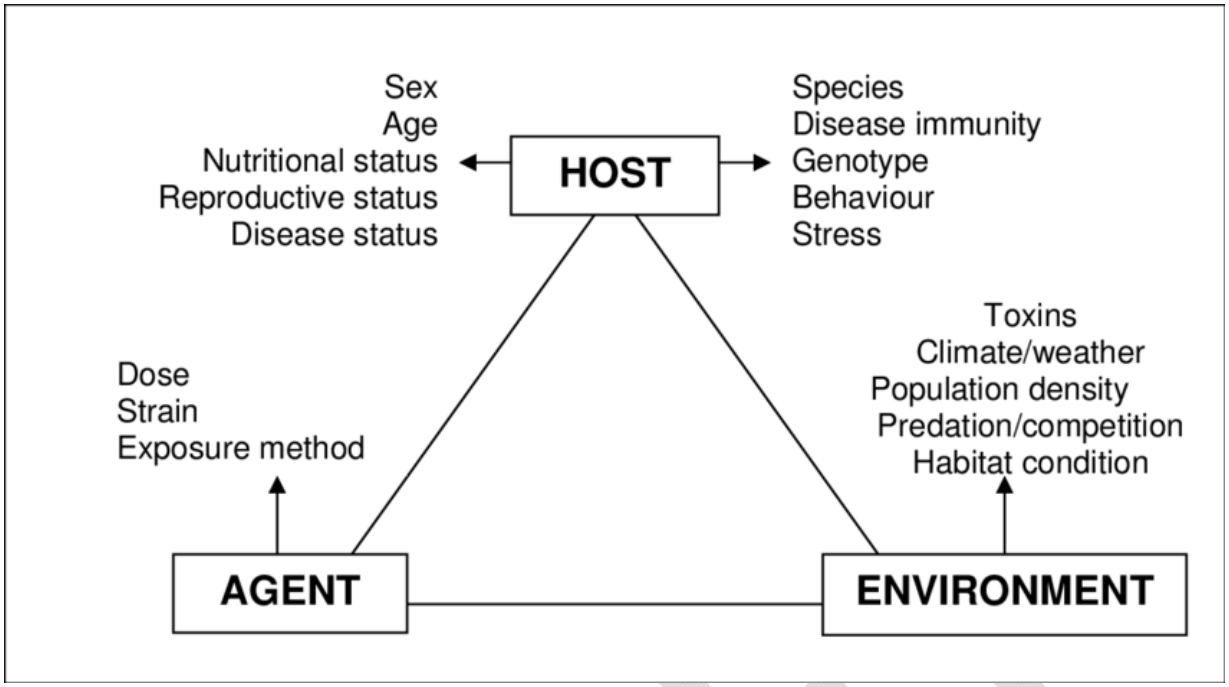

Figure 2. Interactions among host, agent, and environment (Fraser and Parmley 2009).

This very brief introduction on how the complex interactions of pathogen, host, and environment all work together in disease is important to understanding how diseases can (or cannot) be managed on feedgrounds. Managers may be able to influence some of these factors (i.e., environmental alternations like drainage, vaccination, reducing density, etc.), but other factors may be uncontrollable (i.e., climate, pathogen, and strain type, etc.). Feedgrounds present a unique and daunting disease control challenge given the current logistical design (i.e., animal densities).

Brucellosis

Background and Transmission

Brucellosis is a highly contagious bacterial disease first isolated in cattle in the United States in 1910. Although there are several *Brucella* species, *B. abortus* is one that commonly infects elk, bison, and cattle and is zoonotic (capable of infecting humans). Brucellosis was likely introduced to wildlife in the GYE from infected bison that were transplanted into Yellowstone National Park from a brucellosis-infected cattle ranch. In addition, elk may have contracted brucellosis when they fed on cattle feedlines in the early 1900s.

Infection of the female reproductive tract results in the abortion of the first calf following infection. Fetuses delivered near term often are stillborn or fail to thrive due to an overwhelming *B. abortus* infection. The male reproductive tract (testes, seminal vesicles, prostate) can also be infected. Infection of the bone or joint membranes results in lameness that may make the animal more susceptible to predation. Brucellosis results from ingestion or inhalation of *B. abortus* bacteria associated with abortions (Cheville et al. 1998). Under cool, moist conditions, *Brucella* bacteria can persist for more than 100 days in the environment, and transmission may occur to animals grazing on contaminated pasture or consuming other feedstuffs contaminated by discharges or fetal membranes.

Treatment of brucellosis in animals is generally not practical, as it requires multiple drugs administered daily for several weeks.

Distribution and prevalence

Due to the widespread occurrence of bovine brucellosis in the United States and its importance as a disease of humans, the Cooperative State-Federal Brucellosis Eradication Program was initiated in 1934. This generally successful program has nearly eliminated brucellosis in domestic livestock, but the disease continues to be of large economic and management concern in the GYE, where wildlife serves as the last remaining reservoir of the disease in the country.

The Department tests elk for exposure to brucellosis at approximately 4-6 feedgrounds annually and gathers blood samples from hunter-harvested elk outside of the domestic cattle Designated Surveillance Area (DSA) in populations that do not utilize feedgrounds. While mean *B. abortus* exposure rates (i.e., seroprevalence) vary among feedgrounds, the long-term average is 22% for yearling and older female elk (Scurlock and Edwards 2010). For non-fed elk, seroprevalence in the western portion of the state varies between 0-5% in elk herd units south of the GYE (i.e., South Wind River and West Green River) and between 8-22% in herd units east of the GYE (i.e., Clarks Fork, Gooseberry, Cody, and Wiggins Fork). An increasing trend in brucellosis seroprevalence in non-fed elk herd units east of the Continental Divide in the GYE has been observed since the mid-2000s and may be due to feedground-like elk densities created by burgeoning elk populations and management practices on private lands (Cross et al. 2010).

From 1992-2021, 6,727 samples from the non-endemic brucellosis areas have also been analyzed. In 2012, brucellosis was documented outside the GYE when it was discovered in elk of the northwestern Bighorn Mountains. Since the initial discovery, this disease was sporadically detected in several elk hunt areas along the western slope of the Bighorn Mountains. Intensive sampling efforts of elk in the Bighorns continued through hunter-harvest and elk capture for several years following, and the disease was not documented from 2017 through 2021; however, it was re-discovered in 2022.

Brucellosis Management

The Department has long recognized the challenges presented by brucellosis and the operation of elk feedgrounds, and in 1989 developed a multi-faceted approach to control the disease (Clause et al. 2002). This integrated approach, called the Brucellosis-Feedground-Habitat (BFH) Program, combined ongoing Department programs (feedground elk vaccination, feedground management, habitat enhancement, elk/cattle separation, and education) with the goal of eliminating brucellosis in elk and separation of elk and cattle during potential brucellosis transmission periods. The BFH program was disbanded in 2017 in recognition of the larger role CWD was beginning to play in elk and its potential for enhanced transmission in elk attending feedgrounds, but many of the same management strategies remain.

Feedgrounds remain the primary tool for maintaining elk-cattle separation and preventing disease spillover. Because feedgrounds are not a fail-safe management tool, elk-cattle segregation must periodically be re-established, requiring substantial personnel hours and the use of trucks, snowmobiles, tracked vehicles, helicopters, etc. In 2021, aerial drones were introduced for brucellosis management activities and have proven to be an effective and efficient tool for re-distributing elk. The Department also regularly provides game-proof fencing to cattle producers to protect privately-owned stored crops while eliminating a potential food reward to wintering wildlife, thereby

preventing disease spillover. The Department typically distributes fencing materials for around 20 stack yards to local cattle producers annually.

The Department has focused efforts on habitat improvements and vaccination of elk in the past. Assisting land management agencies with the implementation of habitat enhancements to improve the palatability of native forage to reduce elk dependence on supplemental feed in late winter/early spring has shown utility in redistributing elk and reducing the duration of high elk densities. A 30-year-long vaccination program (1985-2015) was discontinued following the winter of 2015-16 because the vaccine neither demonstrated a measurable reduction in seroprevalence in elk populations nor reduced the abortion rate in seropositive elk (Boroff 2013, Maichak et al. 2017). Additionally, the bio-bullets used to administer the vaccine were no longer available for purchase.

A pilot "test and slaughter" program was implemented during 2006-2010 on three feedgrounds in the Pinedale elk herd. Though it significantly reduced brucellosis seroprevalence, it did not prevent brucellosis transmission, and seroprevalence rebounded immediately after the cessation of the pilot project (Boroff 2013, Scurlock et al. 2010). The test and slaughter program was also very expensive, and the effort was deemed unsustainable.

Predators play both beneficial and complicating roles with respect to disease on elk feedgrounds. Wolves can create an additional elk feedground management dynamic by disrupting feeding operations and increase the potential for elk damage and commingling with cattle (Dean et al. 2003), but can also improve management by moving elk away from elk feedgrounds to spring transitional ranges. Additionally, predators can play an important role in reducing disease transmission by scavenging aborted fetuses and removing a source of brucellosis transmission (Maichak et al. 2009). In recognition of this, the removal of predators such as coyotes and foxes is not permitted on Department elk feedgrounds.

In 2008, the Department introduced low-density (LD) feeding and early feeding end dates as two new research-based feedground management strategies aimed at significantly and sustainably lowering brucellosis prevalence among feedground elk in a cost-effective way by reducing opportunity for elk-elk transmission. LD feeding is a strategy developed with the intent of significantly and sustainably decreasing brucellosis prevalence in feedground elk by reducing elk contact with *Brucella*-induced abortions. Traditional feedlines consist of a linear distribution of hay piles spaced close together, and research has shown that the most significant transmission of *B. abortus* via elk-fetus contact occurs while elk are congregated on feedlines (Maichak et al. 2009). This is likely due to the high density of elk during feeding time and because it encourages elk to walk along the same path. LD feeding is a technique designed to diminish the significance of the disease 'hotspot' on feedgrounds by reducing elk density during feeding and encouraging travel along many paths, thereby mimicking a free-ranging behavior. LD feeding is accomplished by spacing hay in larger piles but at wider intervals along numerous rows in a grid pattern. When viewed from above, the distribution of hay resembles a "checkerboard." Creech et al. (2012) reported up to a 75% reduction in elk-fetus contacts during LD feeding compared to traditional line feeding. When administered consistently throughout the season and across years, significant reductions in brucellosis seroprevalence are expected while also reducing transmission of some other diseases (e.g., necrotic stomatitis).

Ending seasonal feeding as early as possible in late winter/early spring aims to narrow the overlap of the feeding season with the peak abortion period, which relies heavily on the several habitat enhancement projects that have occurred on native ranges associated with feedgrounds. Although mean brucellosis seroprevalence varies among feedgrounds, most of that variation can be explained by the end feeding date (Cross et al. 2007). Supplemental feeding initiates prior to the brucellosis

transmission period, but end feeding dates can range from late February to early May, overlapping to varying degrees with the peak transmission period. Traditional management of feeding termination relies upon elk presence. Scenarios vary, but typically elk attendance at a given feedground declines in spring as the snow recedes and native forage becomes accessible. Feeding continues until few or no elk return. Feedgrounds with a higher perceived risk of elk-cattle commingling are fed an average of 10.5 days later than other feedgrounds (Cross et al. 2007). While snowpack is the most influential component driving end-feeding dates, other management factors can impact when elk leave feedgrounds, including hay type (i.e., alfalfa, grass, or mix), hay quality, the amount of hay fed/elk/day, quantity/quality of available native forage and the type or amount of disturbance at the feedground. Managers have some flexibility to alter these factors to shorten the feeding season. With consistent annual feeding truncation over time, a significant reduction in brucellosis seroprevalence is expected, ultimately decreasing risk to cattle.

Despite the numerous brucellosis management efforts described above, occurrences of brucellosis in cattle herds of Sublette and Teton Counties were linked to elk from nearby feedgrounds in 2003, 2004, 2008 (Rhyan et al. 2013), and 2015, resulting in increased testing requirements, movement restrictions, reduced marketability and economic losses for cattle producers. Debate continues among stakeholders over appropriate management for both species (Galey et al. 2005, Roberts et al. 2012).

Brucellosis Management Action Plans (BMAPs)

In response to brucellosis outbreaks in cattle herds and the loss of Wyoming's brucellosis-free status in 2004, Wyoming Governor Freudenthal established the Wyoming Brucellosis Coordination Team (BCT) in 2005. Charged with developing best management practices and making specific recommendations, the BCT proposed the development of Brucellosis Management Action Plans (BMAPs) for each of the seven elk herd units with feedgrounds as their top recommendation. Brucellosis Management Action Plans were developed in consultation with local cattle producers, land management agencies, and State and Federal veterinarians and were completed in 2006-2007. The BMAPs identified nine management options, many of which the Department had long used as management strategies, that could be considered tools to manage brucellosis on the feedgrounds within each herd unit. Those options included feedground relocation, feedground phase-out, elk population reduction, providing incentives for changes in private cattle operations, game-proof fencing, elk test and slaughter, habitat enhancement, habitat acquisition, and elk vaccination.

Most options were not widely pursued as action items. Habitat enhancement projects and distributing elk-proof fencing materials to private landowners have continued. A one-mile drift fence was also installed on federal and private land near the Muddy Creek feedground. The pilot test and slaughter program implemented during 2006-2010 in the Pinedale elk herd was a direct result of the BMAP, but as implied above, did not provide a long-term solution for brucellosis reduction in the absence of other strategies that could reduce elk density and maintain a low prevalence once achieved, so was not implemented elsewhere. As previously mentioned, elk vaccination was discontinued following the winter 2015-16. The BMAPs were updated every five years, with the final update occurring in 2016. Essentially, little change in elk brucellosis management occurred as a result of BMAP development.

Chronic wasting disease (CWD)

Background and Transmission

Chronic wasting disease is a chronic, 100% fatal disease affecting the central nervous system of members of the deer family (*Cervidae*). At the time of this publication, CWD has been detected in 31 states, four Canadian provinces, Finland, Norway, South Korea, and Sweden. This disease belongs to the group called transmissible spongiform encephalopathies, which includes bovine spongiform encephalopathy in cattle, scrapie in sheep, and Creutzfeldt-Jakob disease in humans. These diseases are caused by abnormally shaped proteins called "prions," that cause a conformational change in the normal cellular protein structure. As prions accumulate, they cause cell death in the nervous system (Forloni et al. 1993). The disease progresses as more nervous system cells are lost, ultimately ending in the death of the animal. There is currently no cure or treatment for CWD or other prion diseases, partly because the immune system of an infected animal does not recognize prions as a source of infection. Therefore, there is no immune response, making the development of a vaccine or other treatments very difficult.

Early in the course of CWD, animals show no apparent clinical signs. As the disease advances, with the accumulation of prion protein, affected animals show weight loss, reluctance to move, lethargy, excessive salivation, droopy ears, increased drinking and urinating. No immunity, recovery, or absolute resistance to CWD has been documented, and deer will die from the disease within 2.5 years of infection, and elk succumbing to the disease in 3-4 years (Miller et al. 2008, Miller et al. 2012). However, natural genetic variation in some deer and elk can impact the length of the incubation period of infected animals. Clinical signs in animals with CWD do not appear until late in the course of the disease, resulting in the majority of hunter-harvested animals that test positive for CWD appearing to be in normal body condition. Infection can be detected in carcasses as well as in live animals, and diagnostic tests have become increasingly reliable as CWD research has progressed (Miller and Fischer 2016). Chronic wasting disease is infectious, and prions are shed from several routes during most of the disease course, exposing other cervids either directly or through environmental contamination. Prions can persist for years in the environment, and their binding to soil elements (e.g., clay) enhances persistence and infectivity (Johnson et al. 2007). The environmental persistence of prions complicates disease management and control, especially once prevalence is high (Miller and Fischer 2016).

All potential modes of transmission of CWD, or their relative likelihood, have not been identified. Evidence suggests the disease can pass directly from an infected animal to an uninfected animal (i.e., directly), or by contact with soil, plants, or feed contaminated with the prion (i.e., indirectly). To date, there is no evidence of CWD transmission to humans or domestic animals, but some studies have shown there could be a risk to non-human primates (Waddell et al. 2018, Pritzkow 2022).

Initial modeling efforts predicted CWD would drive affected cervid populations to extinction (Gross and Miller 2001), and specific recent projections suggest CWD may have significant population-level impacts in Rocky Mountain National Park elk (Monello et al. 2013, Monello et al. 2014), Wyoming white-tailed deer (Edmunds et al. 2016), and Wyoming mule deer (DeVivo et al. 2017). Other research suggests certain populations may be able to survive, bolstered by genetic selection and some level of hunting season restrictions (Robinson 2012, Williams et al. 2014). Regardless, endemic CWD will likely depress some cervid populations at an unknown but potentially significant level. As such, management efforts designed to reduce the spread and prevalence of CWD are warranted.

Current distribution and prevalence in Wyoming

Since the discovery of CWD in southeast Wyoming in a free-ranging mule deer (*Odocoileus hemionus*) in 1985, elk (*Cervus canadensis*) in 1986, white-tailed deer (*Odocoileus virginianus*) in 1990, and moose (*Alces alces*) in 2008, this disease has now been documented throughout most of the state (Figure 3). As of August 2022, CWD had been identified in 34 of 37 (92%) of the state's mule deer herds, in 15 of 36 (42%) of the state's elk herds, and generally wherever white-tailed deer occur in Wyoming. Surprisingly, CWD has not been documented in another moose since the initial discovery in 2008 in Star Valley in western Wyoming.

Prevalence estimates vary among herds, although deer herds generally exhibit significantly higher prevalence than sympatric elk herds. The overall CWD prevalence of mule deer is 15.8% (range: 0%-65.8%), whereas the prevalence for elk is 2% (range: 0-13.7%). In the majority of mule deer herd units where statistically significant sample sizes have been obtained, prevalence has steadily increased since its initial discovery within that herd. However, in some southeastern Wyoming mule deer herds where the disease has long been established, CWD prevalence has either somewhat declined from peak levels and/or has remained relatively static, albeit at levels high enough to likely impact population performance.

Wyoming Statewide CWD Surveillance

The Department has conducted surveillance for CWD since 1997. Surveillance to detect CWD in new areas and monitor prevalence is conducted utilizing three primary sources for testing: hunter-harvested cervids, targeted cervids (animals exhibiting clinical signs of CWD), and road-killed cervids. Targeted and road-killed cervids have a greater likelihood of testing positive for CWD (Krumm et al. 2005) and are therefore valuable in detecting the disease in new areas but are not used to estimate prevalence.

To adequately monitor cervid populations for CWD while balancing the testing capacity of the Department's Wildlife Health Laboratory, the Department has deployed a rotating, 5-year program that focuses surveillance in one or two deer and elk herd units in each Department region annually. Surveillance efforts for each deer and elk herd unit are geared toward collecting a minimum of 200 samples from adult male deer or adult elk within one to three years.

The Department conducts additional CWD surveillance work related to feedgrounds in the Pinedale and Jackson regions. In northwest Wyoming, considerable effort is put into monitoring for CWD. Road-kill, targeted, and hunter-harvested cervids are all tested, in addition to animals that perish on and near elk feedgrounds during the feeding season. Grand Teton National Park and the NER have implemented mandatory CWD sampling requirements for hunter-harvested elk. This mandatory sample submission in the Jackson elk herd unit provides sufficient samples to detect CWD occurring at 1% prevalence with 95% confidence.

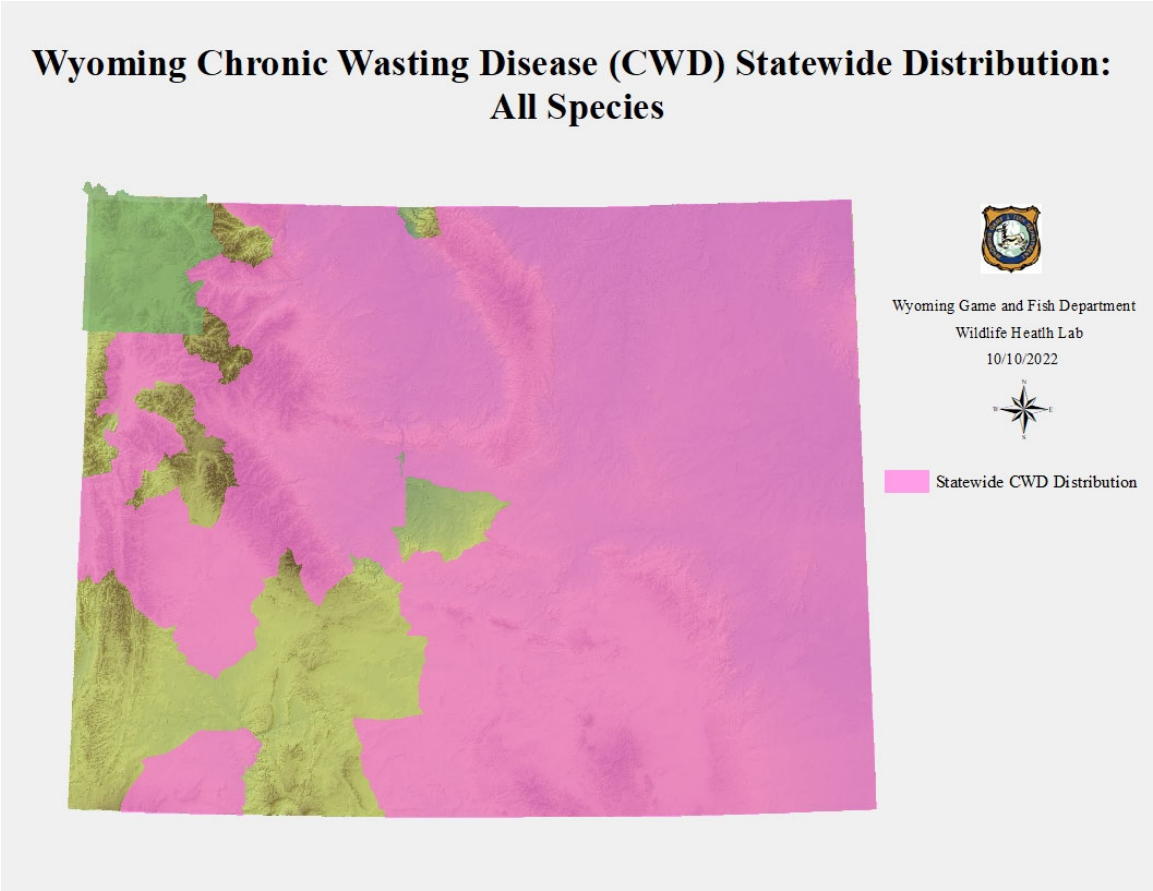

Figure 3. Distribution of CWD in all cervids in Wyoming, October 10, 2022

Feedgrounds and CWD

While the specific impacts of CWD on feedground elk populations are unknown, based on our understanding of CWD epidemiology, it is likely that CWD prevalence among feedground elk will likely exceed that of unfed elk. The prevalence of CWD in captive elk and deer has been found to be much higher (59-100%) than for free-ranging animals. This is thought to be due to an increased opportunity for animal-to-animal transmission and/or exposure to an increasingly contaminated environment.

There is a concern that CWD in elk on feedgrounds may mimic CWD in captive elk, resulting in an elevated CWD prevalence that leads to population declines. Although possible, the understanding of CWD in elk is less developed than that of the disease in mule and white-tailed deer, and predictions come with uncertainty. In general, disease transmission can be correlated to the density of animals in a given area, as well as the frequency of contact between animals. It can be safely assumed that when the disease becomes established, artificially concentrating elk on feedgrounds may result in more rapid spread of CWD and contribute to increased prevalence of prions in the soil and possibly uptake by vegetation (Pritzkow et al. 2015).

Modeling, Feedgrounds, and CWD

Models can be useful in predicting how CWD may affect elk populations once the disease becomes established. Several elk feedground specific models have been developed to date that incorporate

demographic data from feedground elk herds and integrate those data with the current knowledge of disease ecology of elk and CWD. Modeling studies, and the models themselves, will always have limitations due to the inability to predict all factors and influences, especially over a long timeframe.

There are three published models that forecast how CWD may affect feedground populations. Although there are many differences among the models, they all predict that hunting and mortality from CWD will act additively, resulting in higher mortality than would be present in the absence of one or the other.

Supporting adaptive management with ecological forecasting: chronic wasting disease in the Jackson Elk Herd (Galloway et al. 2021):

- This model incorporates an earlier unpublished model (Galloway et al. 2017) developed using disease ecology data from elk in Rocky Mountain National Park; a population that has been exposed to CWD for 30 to 50 years. These data were then combined with the demographic data from the Jackson elk herd to construct the model that could be used as a tool to inform managers how differing levels of CWD will interact with the population performance.
- This model forecasts that CWD prevalence would reach a mean prevalence of 12% in the population in six years, but there is a large amount of uncertainty in this prediction, and the authors could not rule out a prevalence as high as 20%. Using recruitment rates observed during the last two decades in the Jackson herd, the model predicted that a CWD prevalence of 7% in females would cause a decline in the population, even without female harvest. The authors could not rule out prevalence as high as 23% before population decline.

CWD model of genetic selection favoring prolonged survival in elk (Williams et al. 2014):

- The researchers based this model on elk genotypes and the knowledge that CWD-infected elk with the ML or LL genotype at codon 132 tend to have prolonged incubation periods (O'Rourke et al. 1999, O'Rourke et al. 2007) and, therefore, would have an extended reproductive life in a herd where CWD is endemic.
- The model uses "life table" data from 39 elk brought into a research facility heavily contaminated with CWD, where their survival time was tracked until nearly all elk had died from CWD. Using the survival time for elk with the MM genotype (1,568 days) and the ML genotype (2,882 days), along with the demographic data from the Pinedale elk herd, the model predicted that populations would decrease by ~62% but stabilize in approximately 90 years, assuming antlered harvest only. The model predicted the frequency of the MM genotype to decrease by 91%, and the LL genotypes would increase 20 times by year 100. However, genetic sampling of elk captured on feedgrounds indicates the LL genotype currently comprises only about 2-3% of feedground elk (Monello et al. 2017); potential fitness tradeoffs associated with this genotype are unknown.

CWD undermines efforts to control the spread of brucellosis in the Greater Yellowstone Ecosystem (Maloney et al. 2020):

- This bio-economic model considers both brucellosis and CWD with a cost/benefit analysis of closing feedgrounds or continuing to feed. The authors used GPS data from collared elk to predict migratory behavior and population densities with and without feeding using the demographic data from the Pinedale elk herd. Incorporated into the model are hunting benefits, brucellosis, damage, elk depredation costs, brucellosis prevention costs to livestock producers, and supplemental feeding costs.

- While this model considers many different scenarios and outcomes, the most economical and effective disease management strategy (for brucellosis and CWD) was to reduce the Pinedale herd to 950 animals (from 2,904) if feedgrounds remain or a reduction to 2,150 animals if feedgrounds are discontinued.
- In these populations, CWD prevalence was expected to reach 4.1% and 2.7%, respectively. The model predicted that continuation of feeding, with the current elk population management, could see prevalence exceed 75% and would cost the Pinedale area $19 million over 20 years once CWD is detected in the study area.

Necrobacillosis

Background and Transmission

The anaerobic bacterium *Fusobacterium necrophorum* typically infects animals through the feet or mouth. After initial infection, the bacterium can then infect the rest of the body, particularly targeting the liver, and as the species name suggests, endo- and exotoxins produced by the bacteria cause tissue necrosis that can lead to death. This disease typically occurs sporadically in individual animals and is known to cause major outbreaks in large groups of congregated animals (Allred et al. 1944, Rosen et al. 1951, Wobeser et al. 1975, Leader-Williams 1982). The stress of crowding, inadequate nutrition, heavy contamination of local environments with feces, presence of domestic ruminants, and highly abrasive food material that traumatizes the oral mucosa increase the risk of disease for individual animals and populations.

Ungulates with infected feet can show signs of lameness (one or more than one limb affected) or spend a large amount of time in sternal recumbency. Additionally, animals will show hesitancy or difficulty in rising. If the infection is in the mouth, the animal will have a large amount of drool, drop food, or have difficulty manipulating/swallowing feed. Overall, animals spend less time eating, resulting in poor body condition. If the bacteria spread to the rest of the body, the animal will deteriorate rapidly. In some cases, the only sign of disease is sudden death.

Fusobacterium necrophorum is a normal inhabitant of the intestinal flora and is excreted in feces. Environments heavily contaminated with feces will also be heavily contaminated with *F. necrophorum*. This bacterium then takes advantage of compromised individuals invading compromised skin or mucosa.

Outbreaks in wild ruminants have been associated with the concentration of animals around water holes under drought conditions or around food sources at times of food shortage. Outbreaks often end when the cause of abnormal concentrations of animals is relieved. The risk of disease occurrence increases in situations where animals occur in high density (typically due to artificial congregation of animals), muddy soil, extensive manure accumulation, and standing water (Nagaraja et al. 2005), and while the bacterium is often found in feces, their presence alone does not cause disease.

Distribution and Prevalence

Found worldwide and is presently found in Wyoming, specifically on feedgrounds in western Wyoming.

Psoroptic mange

Background and Transmission

Different species of *Psoroptes* mites are a common parasite of the skin and are highly transmissible. In elk, evidence of disease typically includes itchiness or biting at lesions and various sizes of patchy areas of alopecia and skin crusting. These lesions are typically found on the neck, trunk, and upper legs. Males tend to become infected in the middle or late winter (associated with poor nutritional condition, other factors associated with the post-rut period). If infected animals survive until the spring, the disease can become self-limiting and clinical signs can resolve by early summer. This parasite is directly transmitted (animal to animal) and from contaminated environments (environment to animal). Mites can survive as long as two weeks in the environment outside of the host. There is no suitable treatment for large populations of animals dispersed over the landscape. However, management should revolve around prevention, limiting transmission, and minimizing stress.

Distribution and Prevalence

Worldwide distribution and is presently found in Wyoming.

Tuberculosis

Background and Transmission

Bovine tuberculosis (bTB) is caused by the bacterium *Mycobacterium bovis*, and while primarily a disease of domestic cattle, it does spillover and infect wildlife (primarily white-tailed deer, bison, and elk), but there have been cases in other free-ranging mammals. bTB is spread through inhalation; high-density or artificial concentrations of animals is thought to exacerbate the spread. This bacterium tends to cause pulmonary lesions but can spread to other organs, resulting in emaciation and, eventually, death. Similar to CWD, bTB can be difficult to spot, especially early in the disease process. There is no proven vaccine for wildlife, and treatment would be almost impossible in a wildlife setting due to the requirement of long-term antibiotic administration. Testing is also difficult in a living free-ranging animal setting since it requires holding animals for at least three days. This pathogen is zoonotic, and individuals should be cautious when handling infected tissues.

Surveillance

In response to an outbreak of bTB in Montana cattle from 1996-2002, field personnel collected over 1,100 samples from hunter-harvested elk on the NER and GTNP. The disease was not detected. Passive surveillance was utilized from 2003 to 2021, where tissues were submitted for diagnostic evaluation from any animal demonstrating bTB-specific lesions, including hunter-harvested and feedground mortalities. Active surveillance was initiated in 2021 by utilizing lymph nodes collected for CWD surveillance, where any identified abscesses within lymph nodes are further evaluated using established NVSL protocols. Unfortunately, surveillance is limited to only those animals sampled for CWD and demonstrating abscesses, which is unlikely to detect the disease at low prevalence. Early detection of bTB can be accomplished by increasing surveillance/monitoring programs from hunter-harvested elk from the GYE and surrounding hunt areas and increasing the Wildlife Health Laboratory's abilities to process the increased diagnostic load. Additionally, continuing to support the livestock industry in their surveillance/monitoring and eradication programs will decrease the risk of spill-over into a free-ranging wildlife population. It should be noted that while reducing and/or eliminating feedgrounds would not reduce the risk of introduction of bTB into western Wyoming, the

presence of feedgrounds could result in increased transmission (on and off the feedgrounds) and result in the establishment and maintenance of bTB in Wyoming.

Distribution
As of the date of this publication, bTB has not been established in Wyoming or the GYE. However, domestic cattle cases have been identified in Montana (beef, 2021) and Colorado (dairy, 2010). Regarding free-ranging species, cases have been identified across Canada, and the United States, particularly in Michigan, where white-tailed deer continue to be identified with bTB, and in Canada bTB has been identified in national parks in bison (Alberta) and previously in elk (Manitoba) (Wobeser 2009, VerCauteren et al. 2018).

Wildlife disease research and coordination

There exists a great need for research into both the benefits and the consequences of maintaining feedgrounds in the presence of CWD. The implications of retaining or closing feedgrounds and the long-term impacts of those actions on elk populations could be explored. Research must also address how the existence of feedgrounds affects individual livelihoods and local economies and how those livelihoods and economies may be affected by reduced populations - either from feedground closure or disease.

Habitat Enhancement

A primary goal of habitat enhancement projects is to enhance the quantity and quality of transitional and winter elk habitats to minimize elk dependence on feedgrounds, reducing the transmission and prevalence of disease in elk. Modifying vegetation can increase the production and palatability of forage used by elk. If habitat improvements are completed near feedgrounds or between summer range and feedgrounds, the enhanced forage produced may decrease the dependence of elk on artificial feed, snow conditions permitting. Reduced feeding durations and lower elk concentrations on feedgrounds may decrease the probability of intraspecific disease transmission events. Habitat enhancement projects also create age class and species diversity and can improve forest and range conditions for myriad species.

Elk are primarily herbaceous grazers and can consume an average of 20 pounds of forage per day during summer. During winter, elk on native range shift their diets to include a greater percentage of woody browse such as willows or aspen (Kauffman et al. 2018). Areas directly adjacent to feedgrounds can be impacted by intense browsing pressure throughout the winter, noticeably lack woody vegetation, and have a highlined appearance to trees with branches removed within the browse zone. Elk that utilize native winter range typically prefer to use south-facing windswept slopes with relatively easier foraging opportunities, lower elevation rangelands with less snow accumulation, or agricultural pastures.

Habitat enhancement projects can be employed to mimic natural disturbances and restore habitat to a properly functioning condition. The Department works with other agencies and private landowners

to implement habitat enhancement projects that improve elk transitional and winter ranges and habitat for many other wildlife species. These projects include several consistent steps, including identifying potential treatment locations based on wildlife use, inventory of existing habitat conditions, determining the habitat objective for the project area, developing a prescription or a management action to modify existing conditions, completing NEPA if occurring on federal land, securing funding, implementing the management action and post-treatment monitoring. In all cases, planning habitat enhancements requires time and resources to implement successfully.

Elk and Feedground Management Direction

Elk feedgrounds have been utilized in the management of elk populations in western Wyoming for over a century. Feedgrounds have proven instrumental for wildlife managers in maintaining elk populations to provide hunting opportunities that meet public expectations, minimizing damage to private property, reducing disease transmission to livestock, and limiting interspecies competition. However, elk feedgrounds present significant challenges when considering disease and localized habitat management issues. This Plan and subsequent management direction are necessary to provide a long-term path forward for Department employees.

The overall goal of this plan is to encourage managers to continue to explore opportunities for elk to winter away from feedgrounds by increasing tolerance for elk on private, state, and federal lands while reducing reliance on supplemental feeding. These actions will, in turn, decrease disease transmission on feedgrounds. Under this Plan, the Department will also publicly review herd unit objectives every five years and provide the public with updated herd demographic data and disease prevalence. During the review, if public support for a population objective change for a given herd unit exists, managers will present an objective change proposal at a subsequent Commission meeting. The Department must strive to achieve this goal while staying within clearly established sideboards. The Department shall:

- Maintain publicly supported elk population objectives
- Maintain hunting opportunity
- Limit any increase in damage to private property
- Limit any increase in disease transmission to livestock
- Limit any increase in interspecies competition with other wildlife species

This Plan is designed to provide overarching direction to Department employees to ensure a unified goal with regard to long-term feedground and disease management. The management direction in this Plan will drive the creation of localized individual FMAPs in Phase III of the *"Elk Feedgrounds: A Challenge We Can Take On*" public process and planning effort. It shall be the responsibility of all Department employees to adhere to this Plan and the management direction it provides.

Feedground Management Action Plans (Phase III)

Upon adoption of this Plan by the Commission, each elk herd and associated feedground(s) will be evaluated using set criteria. This work will be overseen by the regional wildlife supervisor for the region responsible for each elk herd. Each FMAP will:

- Be adaptive and experimental in nature based on outcomes achieved
- Provide specific direction for future feedground/herd unit management
- Utilize local stakeholder working groups consisting of "potentially-impacted" stakeholders
- Have a long-term focus on reducing or eliminating the need for supplemental elk feeding
- Stay within the clearly established sideboards determined by the Department
- Maintain and encourage seasonal movements of migratory elk

There are six elk herd units that are supported by supplemental feeding in Wyoming. Each herd unit will have individualized FMAPs, with an overall three-year completion objective for all six elk herds upon adoption of this Plan by the Commission. The Pinedale and Jackson regions will each complete one target herd unit FMAP each year. The creation of these FMAPs will be a Department priority and completed using a localized public collaborative stakeholder group process.

Elk harvest strategies

Goal: Maintain elk numbers in herd units with feedgrounds at publicly-supported, Commission-approved population objectives using hunting as a primary tool.

Strategies:

- Wildlife managers will continue to explore incentives for hunter access to and/or across private lands to achieve harvest goals, especially for antlerless elk in areas above population objectives.
- Flexibility in setting seasons and adapting to changing conditions is critical. The Department will work to reduce constraints to be able to adapt to challenges and implement management actions efficiently.
- The Department adopted changes to Commission Regulation Chapter 34, which will allow rapid responses to damage situations and may provide opportunities for non-traditional hunting seasons in areas where populations are over-objective and normal hunting season strategies have been ineffective.

Public Education/Outreach

Goal: Public outreach will be critical to managing elk feedgrounds into the future.

Strategies:

- Every five years, the Department provides the public with an update on population dynamics, disease prevalence, and an overview of the herd unit objectives and feedground quotas.
- The Department will provide information to the public related to the latest science-related to disease management and herd health.
- The Department will provide the Commission with a recommendation on herd management for the six elk feedground herds.

CWD and feedground management

Goal: Prevention/early detection of CWD from entering the feedgrounds should be the Department's primary strategy. If detected, the Department's strategy would change to attempting to manage the disease on the feedground to limit incidence and spread of CWD off of the feedgrounds.

Preventative measures:

- The Department will continue to survey for CWD on feedgrounds.
    - In an attempt to manage disease risk effectively and quickly, the Department will require mandatory post-mortem CWD sampling and testing of any elk (or other cervids) found dead or sick on feedgrounds.
    - Funding will be provided for increasing CWD diagnostic capabilities within the Department.
- The Department will establish individual localized collaborative stakeholder groups to work toward the development of FMAPs.
- The Department will investigate methods to reduce the risk of environmental CWD transmission through soil alterations, fencing, and hay acquisition.
    - Prions are known to bind to many soil types (Smith et al. 2011), and when bound to bentonite clay, infectivity is dramatically increased (Johnson et al. 2007). To limit the bioavailability of prions in the environment to cervids, substrate conversions of feeding areas should be considered. Suitable substrates may include gravel or other aggregates (without sharp edges) that would limit the availability of fecal material on the surface when snow cover is absent. While an aggregate substrate would not prevent prion transmission, if designed correctly, it may reduce indirect prion transmission. Maintenance of the substrate would be required once the aggregate substrate is no longer porous (filled with sediment or manure).
    - In consideration of prions, soil types, and the ability of plants to uptake, bind, and transport prions from the soil (Pritzkow et al. 2015), feedgrounds may serve as an indirect source of CWD transmission to cervids during the spring, summer, and fall months (Zabel and Ortega 2017). Fencing feedground areas should be considered an option to restrict cervid access, thereby limiting CWD transmission from these areas until prions can no longer detected in the soil via RT-QuIC or PMCA. Where fencing is considered a viable option, special consideration must be given to how wildlife migration may be hampered, the initial cost of construction, and long-term maintenance costs.
    - The knowledge of a plant's ability to uptake, bind, and transport prions from the soil (Pritzow et al. 2015), coupled with the potential for fecal/urine/saliva contamination of hay/alfalfa in agricultural fields by CWD-positive cervids, warrants considering sourcing hay/alfalfa utilized on the feedground only from CWD-free areas, if possible.
    - An additional option for limiting prion contamination of the environment includes removal of manure from feeding areas at the end of the feeding season. Where possible, manure may be removed mechanically and properly disposed of through alkaline hydrolysis (Murphy et al. 2009), incineration, or in an approved landfill.

- The Department will develop an emergency carcass disposal/removal plan.
    - This will be dependent on the feedground and will be developed in conjunction with the FMAP.

If CWD is detected on a feedground:

Given the seriousness of this disease and the difficulty of eradication once established in wildlife populations, swift and deliberate actions are required to limit CWD to the full extent possible.

- The Department will increase CWD sampling and testing on the feedground and around the feedground (within a 10-mile radius or a radius determined by the Department) through hunter harvest.
    - Each herd unit will become an annual focus for CWD surveillance, whereas the Department will strive for 100 samples by increasing hunter opportunities from adult elk to accurately monitor the disease.
- The Department will target and remove elk (and other cervids) that appear to be infected with CWD on the feedgrounds.
    - These animals, or appropriate tissue samples, will be sent for testing to the Wildlife Health Laboratory as a priority.
- The Department will reduce elk density while decreasing risk of CWD transmission.
    - Employ low-density feeding at the lowest densities possible given the usable feedground area.
    - Research has predicted that elk populations will begin declining due to CWD somewhere between 7% (Galloway et al. 2021) and 13% (Monello et al. 2014). If CWD prevalence in the respective herd unit reaches 7%, the Department shall evaluate options and strive to reduce feedground densities by 10% through population reductions, feeding modifications, or winter distributional shifts within one year. If the CWD prevalence in the respective herd unit reaches or exceeds 10% for three consecutive years, the Department shall consider and evaluate the need to begin the process of closing the feedground as soon as possible. Prevalence thresholds shall remain adaptive as scientific research findings better define the influence of CWD on elk populations.
- Public outreach.
    - Public meetings will occur to inform interested parties of what has been found and what the Department is proposing to mitigate the situation.

Necrobacillosis and feedground management

Goal: Prevent necrobacillosis from occurring on feedgrounds. If an outbreak occurs or is detected, the Department's strategy would change to attempting to control the disease.

Preventative measures:

- The Department will continue necrobacillosis surveillance on feedgrounds.
    - In an attempt to manage disease risk effectively and quickly, the Department will require sampling/testing from elk on feedgrounds when history/clinical signs dictate.
- The Department will reduce risk of environmental necrobacillosis transmission through alternative management practices.
    - Adequate drainage of feeding and loafing areas to prevent water/mud accumulation and the formation of ice. Broken ice can damage the interdigital area of the hoof, allowing infection.
    - Feed on clean, dry ground/snow.

- Prevent injury to the oral mucosa by not feeding coarse forage (large or tough stems-alfalfa).
- Remove any sharp objects that could cause hoof injuries (e.g., wire, scrap metal).
- Moving feeding locations to prevent excessive manure accumulation. In some cases, manure may need to be manually removed (e.g., tractor with blade or bucket).

- The Department will reduce elk congregation.
  - Reduce elk densities where possible and acceptable.

- The Department will develop an emergency carcass disposal/removal plan.
  - This will be dependent upon the feedground and will be developed in conjunction with the FMAP.

If necrobacillosis is detected on a feedground:

- The Department will reduce elk density while decreasing risk of necrobacillosis transmission.
  - Reduce elk densities where possible and acceptable, reducing congregation.
  - Moving feeding locations to prevent excessive manure accumulation. In some cases, manure may need to be manually removed.
  - Increasing drainage
  - Due to welfare concerns, the Department will target and remove elk that are unable to rise or appear unable to eat on feedgrounds

Psoroptic mange and feedground management

Goal: Prevent psoroptic mange from occurring on feedgrounds. If an outbreak occurs or is detected, the Department's strategy would change to attempting to control the disease.

Preventative measures:

- The Department will continue psoroptic mange surveillance on feedgrounds.
  - In an attempt to manage disease risk effectively and quickly, the Department will require sampling/testing from elk on feedgrounds when history/clinical signs dictate.

If psoroptic mange is detected on a feedground:

- The Department will reduce elk density while decreasing risk of psoroptic mange transmission.
  - Reduce elk densities where possible and acceptable, reducing congregation.

Tuberculosis and feedground management

Goal: Prevention of bTB from entering the feedgrounds should be the Department's primary strategy. If detected, the Department's strategy would change to attempting to eradicate the disease on the feedground and preventing the spread of bTB off of the feedgrounds.

Preventative measures:

- The Department will institute bTB surveillance on feedgrounds.

- In an attempt to manage disease risk effectively and quickly, the Department will require sampling/testing from elk on feedgrounds when history/clinical signs dictate.
- Funding will be provided to increase bTB diagnostic (i.e., Wildlife Health Laboratory molecular testing) capabilities within the Department.
- Review the "Guidelines for surveillance of Bovine Tuberculosis in Wildlife" developed and provided by the USDA (https://www.aphis.usda.gov/animal_health/animal_diseases/tuberculosis/downloads/wildlife_tb_surv_manual.pdf).

- The Department will develop an emergency carcass disposal/removal plan.

If bovine TB is detected on a feedground:

Given the seriousness of this disease and the difficulty of eradication once established in wildlife populations, swift and deliberate actions are required to limit this disease to the full extent possible.

- The Department will increase bTB sampling and testing on the feedground and around the feedground (within a 10-mile radius or a radius determined by the Department).
  - Remove and test all elk and other cervids in the determined radius; the required sample size will be determined by the Department personnel.
  - The Department's Wildlife Health Laboratory will provide increased diagnostic and mapping support to track the extent of the outbreak.
  - Sample and test all hunter-harvested samples from the determined radius during hunting seasons.
  - If an appropriate number of cervids cannot be sampled, the Department will look to sample coyotes that are found around the feedground (at least a radius of 10 miles away); this is to assist in delineating the extent of bTB on the landscape.
- Reduce transmission and elk density.
  - Cease feeding if possible; this disease has been shown to spread quickly in populations at high densities, especially those that are supplementary fed (Schmitt et al. 2002). If feeding is stopped, animals must be monitored to ensure no contact with domestic livestock. If supplemental feeding must continue or if contact with domestic livestock is a concern, low-density feeding shall be employed at the lowest densities possible given the usable feedground area.
  - Reduce animal density on the feedground by population reduction with a target elk density of 1-2 animals per km2 (Shury 2015). Alternatively, a 50% reduction in white-tailed deer has been shown to reduce transmission (Schmitt et al. 2002, Ramsey et al. 2014, VerCauteren et al. 2018). This could potentially occur through increased hunter opportunity.
  - If the feedground cannot be closed the first year bovine tuberculosis is detected, the Department shall work to close the feedground as soon as possible.
- Public outreach and stakeholder meetings.
  - Stakeholder groups will be developed, and meetings will occur to focus on current findings, plans, and potential management solutions on eradication bTB on feedground(s).
  - These groups should include (but should not be limited to) individuals from the livestock board, public health agency, and sportspeople.

Disease research and coordination

Goal: To better understand the complex nature of feedgrounds, disease, and their economic value, the Department will promote and actively engage in research opportunities and partner with appropriate entities to pursue research funding.

The Department will collaborate with external entities (e.g., state, federal, tribal) and academic institutions on research priorities, projects, and funding to facilitate the continued expansion of knowledge. The Department is committed to a long-term investment in research on adaptive feedground and disease management. The Department will continue to monitor published research and contribute to the body of knowledge through relevant conferences, symposiums, written documents, and other collaborative forums to ensure it remains current on the newest scientific information that applies to feedground and disease management.

The Department has identified the following potential research priorities:

- Role of environmental transmission in disease maintenance and expansion.
- Reduction of disease transmission on feedgrounds.
- Predator effects on disease and elk distribution.
- Feedground soil/substrate and prion binding.
- Improved disease detection methods in elk (e.g., chute side diagnostics for CWD, brucellosis, bTB, etc.).
- Early/rapid CWD detection in elk.
- Environmentally friendly methods of prion deactivation.
- Effective brucellosis vaccine/research for elk, cattle, and bison.
- Necrobacillosis research on the effects of feed type, animal density, and influence of climate on incidence.
- How feeding influences CWD prevalence over time.
- Mule deer to elk, elk to mule deer CWD transmission dynamics and juxtaposition of migratory habitat and feedgrounds.
- Economic analysis of carcass disposal/prion deactivating methods (e.g., thermochemical conversion gasification, alkaline digestion, incineration, biochar).
- How feedground closure may influence competition between elk and other big game species.
- Evaluate the influence of habitat treatments (including variables such as veg type, slope, proximity to feedgrounds, seasonal range, etc.) on reducing the duration of feeding or dependency on feed.
- Pilot project for feedground phase-out.
- Economic analysis of how feedgrounds contribute to local economies.

Elk habitat acquisition, access, and land use

Goal: Cooperatively pursue access to habitat currently unavailable for elk use in order to increase opportunities for elk to winter away from elk feedgrounds while considering inter-species competition and conflicts with agricultural producers.

Adapting elk management strategies in western Wyoming to reduce reliance on supplemental feeding is a long-term vision for the Department to combat CWD and other wildlife diseases associated with

dense aggregations of animals on feedgrounds. Long-term alternatives for how elk are allowed to winter in western Wyoming will require changes in law, funding, and public attitude regarding disease, damage, and elk occupancy. As an arbiter of change in the future of elk management, the Department's long-term perspective is essential in guiding short-term goals and actions. Increasing native winter range availability and use will take considerable time and funding, and major shifts in current land use. To manage for disease issues in western Wyoming elk, new and innovative paths need to be explored to allow elk to winter away from feedgrounds where opportunities allow, while ensuring minimal conflict with livestock and limiting competition with other wintering wildlife.

The Department has identified the following actions to pursue native elk winter range:

- Seek opportunities to acquire, through purchase, lease, or other elk occupancy agreements, lands that could be used as winter range for elk as an alternative to feedgrounds.
- Identify properties that could serve as elk winter range, or serve to connect migrations to native winter ranges and develop a long-term plan to pursue elk occupancy agreements.
- Cooperatively seek opportunities to utilize conservation easements and special elk occupancy agreements with private landowners that will allow increased elk occupancy on private lands. In the case of Teton and northern Lincoln counties, this will require looking outside of traditional agricultural use properties. Land ownership in western Wyoming has changed in recent decades, and there are now far fewer traditional agricultural operations. The long-term focus of this Plan must consider non-traditional land ownership as an avenue that must be explored as part of the future of elk winter habitat. The Department must seek out ways to cooperatively increase elk wintering opportunities on these lands.

The Department recognizes the following concerns associated with securing additional elk winter range:

- Funding
    - The effort to secure access for elk to additional state, federal, and private lands while focusing on reducing reliance on supplemental feeding of elk will require significant funding. Land purchases, leases, and easements will require substantial investment by the Commission and other entities. It is the Department's responsibility to promote best management practices for the long-term management of elk in a way that includes the agricultural community, accounts for inter-species competition, and emphasizes the reciprocal benefits to elk and the public.
- Public support
    - The Department must consistently promote cooperative winter elk use away from feedgrounds and encourage the positive prospects of doing this with the broader public. Considerable public support will be required to increase elk occupancy on lands currently not utilized by elk. Funding for winter habitat acquisition will not become available to the Department without this broad public support, including the support of the agricultural community and lawmakers.
- Balance with agricultural interests
    - The Department will need to reassess its approach to addressing damage to agriculture, commenting on county land development regulations, and influencing city ordinances. The Department will continuously seek to promote and encourage changes in elk management that garner public support for funding, both governmental and private.
- Changes to law, land development regulations, and city ordinances
    - To garner the support needed to begin implementing necessary changes in our long-term vision for elk wintering in western Wyoming, the Department will look for

cooperative opportunities to influence positive changes to statutes, regulations, county land development regulations, and city ordinances in order to encourage and promote cooperative elk use on private lands.

- Lawmaker/Legislature support
    - It is the Department's responsibility to ensure the education of Wyoming lawmakers about the positive benefits to the future of elk management with regard to reducing reliance on supplemental feeding. Without broad support in lawmaking bodies, funding will likely not meet the needs required for making positive advancements for elk winter occupancy away from feedgrounds. Gaining the support of the Wyoming legislative body and local county and city governments will be critical to the mission of this Plan.

Livestock producer coordination and cooperation

Goal: Work cooperatively with agricultural producers on voluntary livestock management strategies designed to reduce conflict and disease transmission.

All strategies outlined in this section will require substantial coordination between all affected parties and considerable funding to be successful. Evaluation and implementation of the livestock management alternatives in this section are under the jurisdiction of individual livestock operators, the Wyoming Livestock Board, the Wyoming State Veterinarian, and the U.S. Department of Agriculture Animal Plant Health Inspection Service Veterinary Services. Land use decisions and livestock grazing management options are under the jurisdiction of the respective land management agency (BLM, USFS, Office of State Lands and Investments) or individual private landowners. Discussion and recommendations pertaining to these options should be contained in individual herd plans for each affected livestock operation and further investigated in FMAPs.

The Department has identified the following actions for voluntary livestock management strategies to reduce elk-livestock conflicts:

- Shipping livestock to areas of low risk for conflict and damage.
    - Shipping livestock to areas of low risk for conflict and damage could reduce the risk of disease transmission, co-mingling of elk and livestock, and conflict and private land damage, reducing reliance on elk feedgrounds and increasing tolerance for elk wintering on private lands.
- Exclusionary fencing to maintain separation of elk and livestock.
    - Elk-proof fencing of stored crops and winter livestock feeding pastures reduces the risk of co-mingling of elk and livestock and damage by preventing a food reward to elk. Reducing the risk of disease transmission and private property damage may result in greater tolerance of elk on currently unavailable native winter ranges and private lands.
- Conversion from cow-calf operations.
    - Changing cattle operation type from cow-calf to yearling, spayed heifer, or steer would eliminate brucellosis transmission potential within cattle and the testing requirements associated with cow/calf operations. Conversion to yearlings would also eliminate the need to store most hay crops and winter feeding, reducing winter elk conflicts.
    -

- Incentivizing conflict-reduction management actions.
    - Smaller changes in operations, such as developing a water source enabling the producer to calve in a lower brucellosis transmission risk area, could be more appealing if incentives were provided.
- Utilizing high-risk grazing areas after the peak brucellosis transmission period.
    - Utilization of elk movement data to develop maps depicting areas of high risk of brucellosis transmission on both private and public land grazing allotments allows the Department and affected producers to strategically plan grazing rotations that reduce risk of brucellosis transmission, especially during the latter portion of the transmission period (May 1 – June 15).
- Pursuing voluntary allocation or conversion of AUMs (Animal Use Month) for wintering wildlife on federal lands.
    - Currently, most public land allotments on BLM and USFS lands are stocked with livestock. Shifting elk winter use from feedgrounds to native winter ranges will only be successful if sufficient forage is available. The Department will work with federal land management agencies, local producers, the Wyoming State Livestock Board, and the Governor's Office to determine areas where livestock AUMs can be adjudicated from livestock to wildlife use. This would allow additional residual forage to be left available, increasing the amount of time that wildlife can subsist on native winter range and reducing the reliance on supplemental feed in the winter. Leaving additional forage on transition and winter ranges will also help in reducing inter-species competition in these seasonal ranges and allow for increased productivity of wildlife species utilizing these areas year-round.
- Elk occupancy agreements on private lands
    - Compensating private landowners for allowing elk to utilize private lands during winter could reduce the reliance of elk on supplemental feed by providing an alternative winter range while supporting the agricultural community by providing alternative income.

Federal, state, and private land management coordination

Goal: Work cooperatively with the USFS, BLM, Office of State Land and Investments, and private landowners to increase elk occupancy off elk feedgrounds onto native winter ranges.

The Department has the opportunity to provide habitat management recommendations to federal partners through public land management planning processes such as USFS Forest Plans and BLM Range Management Plans. Coordination with the USFS, BLM, Office of State Land and Investments, and private landowners is critical in increasing elk occupancy off of elk feedgrounds onto native winter ranges.

The Department has identified the following actions to facilitate elk occupancy off elk feedgrounds:

- Actively participate in public land management planning processes by identifying and advocating for crucial native elk winter ranges through comment during USFS Forest Plans and BLM Range Management Plans.
- Maximize opportunities with willing lessees to rest or retire public land grazing allotments in key locations on native elk winter ranges.
- Identify key elk native winter ranges and coordinate with land managers to determine if

closures to human recreation (winter range closures) will increase elk occupancy off feedgrounds.

Non-governmental organization (NGO) coordination

Goal: Work cooperatively with various NGOs to raise funding and support for increasing elk occupancy off elk feedgrounds onto native winter ranges.

NGOs are active partners in accomplishing wildlife and habitat management objectives in order to benefit elk and other wildlife and can bring considerable funding and support to individual projects. As such, it will be important for the Department to continue to build relationships and grow partnerships with NGOs with an emphasis on increasing elk occupancy on native winter ranges. The Department will build working relationships with NGOs and coordinate with them to maximize opportunities to increase elk occupancy on native winter ranges.

The Department has identified the following actions related to NGO coordination:

- The Regional Wildlife Supervisor will identify themselves or a dedicated contact person within the Game and Fish regions for each NGO active in that region.
- The Supervisor or their designee will meet with each NGO at least annually, or as frequently as needed, to pursue funding and support to assist with alternatives to winter elk feedgrounds (e.g., elk occupancy agreements on private lands, willing seller purchase of fee-title lands with native elk winter ranges).
- Encourage active, mutual participation in wildlife conservation activities between the Department and NGOs, and discourage litigation as the only recourse for NGOs.

Wildlife crossings and wildlife-vehicle collision reductions

Goal: Work cooperatively with NGOs and the Wyoming Department of Transportation to limit elk-vehicle collisions while providing native elk winter range opportunities.

The risk of wildlife-vehicle collisions (WVC) with elk present on roadways is a major factor in the decision-making of the initiation and duration of supplemental feeding of elk at some feedgrounds in western Wyoming. Elk distribution to lower-elevation native winter ranges can result in increased WVC, wildlife mortality, and human safety concerns. Allowing elk to safely cross roadways and utilize native winter ranges adjacent to roadways would increase winter foraging opportunities alternative to feedgrounds and potentially reduce the duration of supplemental feeding in areas where livestock and private land conflicts have been addressed. The construction of wildlife crossing structures has demonstrated they are an effective measure to reduce WVC, allow for permeability of roadways, and improve motorist safety in areas that have high densities of wildlife seasonally (Huijser et al. 2017). Wildlife crossings is a broad term that includes actual wildlife crossing structures (overpasses and underpasses), associated fencing to direct wildlife to crossing locations, and other infrastructure required to facilitate the safe passage of wildlife through roadways. Variable Message Signs and permanent wildlife crossing signs are currently in use seasonally in an effort to alert motorists of increased wildlife movements in relation to roadways. This technique works well in certain situations but, over time, loses effectiveness unless signs are moved or changed frequently

(Huijser et al. 2015). Public education is also an important factor in reducing WVC and ensuring the success of wildlife crossing projects.

The Department has identified the following actions related to reducing WVC while seeking native winter range opportunities for elk:

- Continue to work with the Wyoming Department of Transportation in highway development planning, design, and implementation to ensure that wildlife crossings and reductions in WVC continue to be investigated and incorporated into new highway development and replacement with an emphasis adjacent to native elk winter range and migration corridors.

Feedground management alterations

Goal: The Department will actively implement the latest science and technology to improve management of feedgrounds, decrease disease transmission, and improve animal welfare and health.

There are several options to improve management of feedgrounds to decrease disease transmission (some disease more than others) and generally improve animal welfare. The Department will continually evaluate available options to improve feedground management and implement feasible options whenever possible. Below is a list of options that could be considered to improve feedground management; not every option is suitable for every feedground.

The Department has identified the following actions to improve management of elk feedgrounds:

- Diverging from static to moving feedgrounds to simulate natural elk movements
    - A moving or migrating feedground scenario could be accomplished with access to large, continuous tracts of land. Heavy equipment would be required for feeding operations, and feeding in remote locations would require strategically placed hay supplies along the route. Feeding operations in less remote areas could have the hay supply move with the operation but would require routes along year-round access roads. This option would allow for feeding on clean snow daily, decrease elk concentration while on feed, and potentially decrease intraspecific disease transmission. There would be potential for increased interspecific disease transmission in some areas and a larger area of prion deposition on the landscape. In most situations, this scenario would involve feeding on federal land, which would require an extensive permit process.
- *Delaying start/stop feeding dates:*
    - Delaying the initiation of feeding would likely reduce indirect and direct CWD transmission, thereby slowing the spread of the disease. Additionally, truncation of both the beginning and end of the feeding season to ensure that the feedground is completely covered in snow when elk are present may also reduce environmental transmission in those areas where feeding has occurred over multiple years, allowing for a cumulative accumulation of prions in the soil. Reducing feeding season length requires increased monitoring of elk distribution (e.g., via satellite-linked GPS collars) to minimize damage and prevent elk-cattle co-mingling. The use of aerial drones can be utilized as a tool to haze elk away from potential conflict situations.
- *Feeding area expansion:*
    - Expanding feeding areas is possible in some current feedground locations. The limiting factors are terrain, obstacles, special use permit restrictions, land status, equipment, and hay storage. Equipment, such as horses and sleighs, are practical for a

limited distance from the hay supply, but their practicality is limited by snow depths. Heavy equipment (i.e., snowcat, tracked tractors) can access deeper snow and reach further distances from the hay supply. Depending upon the distance to each hay supply and the overall area available to feed, one large elk herd could be fed a full daily ration divided equally in several locations. This may allow the elk to distribute themselves at lower densities. However, moving heavy equipment from one feeding site to another may be limited due to terrain, and additional equipment may be required at each feed source. A horse and sleigh operation would require additional horse teams, sleighs, and personnel. Feedgrounds with only one location for the hay supply could employ a combination of heavy equipment and horse teams, but additional personnel would be required to complete the daily feeding routine. Prion contamination would also occur in a broader area by expanding the feeding area.

- *Heavy equipment acquisition:*
    - Small square hay bales fed from a sleigh pulled with horse teams are the preferred and traditional method for feeding elk, allowing for feeding to occur in the coldest winter conditions. Horses and a sleigh are more economical than heavy equipment. Unfortunately, small square bales are difficult to acquire due to decreased supply and increases in cost. Large square bales have become readily available and less expensive than small square bales but require heavy equipment to load (generally, large square bales cost $50-$100/ton less than small square bales).
    - Currently, large bales are fed on many feedgrounds, where the bales are loaded onto the sleigh with a tractor but fed by hand as the sleigh is pulled with a team of horses. A tracked tractor with a mechanical bale processor is able to access more area in deep snow than a horse team and, in most circumstances, is the best combination to remove hay bales from the stack and feed them. Snowcats are another option that would access steeper terrain and deeper snow conditions better than the tracked tractor option. However, snowcats do not have a loader option to move large square bales, so a tractor with a loader would also be required. The use of snow groomers is another option that could be utilized to allow feeding over larger areas. Groomers are pulled with a snowcat or tracked tractor, and pack feed areas flat and smooth, so elk are not confined to feedlines and movement trails. In addition, if the feeding area is distant from the feed source, the use of a groomer would allow the area to be kept open and accessible to elk.
    - Although heavy equipment may expand feeding areas in deep snow and steep terrain, it also brings its own set of challenges and requirements, including heated buildings and year-round access roads to accommodate maintenance problems as they arise. Expense is also a consideration, where a tractor with tracks and a loader, bale spear, and a bale processor can easily cost $250,000.00. Spare heavy equipment would need to be made available when feeding in remote locations, and a full-time mechanic for equipment maintenance/repair should also be considered if heavy equipment is utilized on a significant number of feedgrounds. Using additional heavy equipment for operating feedgrounds would not appreciably reduce CWD transmission.
- *Additional feedgrounds:*
    - Anecdotal evidence suggests that 400 elk fed for 100 days or less is a best-case scenario. While additional feedgrounds would likely not reduce the transmission/occurrence of CWD, the transmission of some diseases may be reduced by allowing for smaller elk concentrations across the landscape while being more manageable for feeding personnel. Current elk numbers would require 43 feedgrounds,

which would require land acquisitions, additional federal land permits and/or private land leases/easements, additional facilities, feeding personnel, and feeding equipment. This would be a challenging option given the difficulty in obtaining additional USFS leases for feedground areas.

- *Hay acquisition:*
    - Unfortunately, some local hay production lands have been developed into subdivisions, decreasing available hay acreage, and finding hay to purchase in close proximity to feedground operations has become more difficult. Given these circumstances, land acquisition that includes hay production properties (such as those found in Farson and Star Valley) may be an important consideration to provide hay to the feedgrounds over the long term.
    - The Department will pursue a revised hay purchasing process to increase efficiency and purchase directly from the producer as needed, with fewer constraints of state contracts and purchasing requirements.
- *Carcass removal and disease monitoring on feedgrounds:*
    - Removal of symptomatic elk and carcasses is essential to reducing the spread of disease on feedgrounds. It is important to document morbidity and mortality of elk on feedgrounds to ensure that disease outbreaks can be addressed and management actions can be taken. Removal of sick or dead elk from feedgrounds, especially in the actual feeding areas, reduces disease transmission risk (Miller et al. 2004), reduces risk of injury/damage to the feeding equipment/horses, and is essential for maximizing the area in which elk can be fed. Elk that are exhibiting signs of serious illness or neurologic disease are to be euthanized immediately by Department personnel, sampled, removed from the feedground, and transported to an approved disposal location.
    - An additional employee in each region is required to monitor and remove sick or dead animals from the feedground area. These additional positions would be of particular importance on remote feedgrounds without road access, where transporting just a few carcasses could require several hours.
    - Consider additional compensation for elk feeders to remove carcasses from feedgrounds.
    - Currently, all carcasses suspected of CWD are taken to an approved landfill, but with changing municipal waste disposal regulations and increasing volume and cost, other disposal options may become less cost-prohibitive. These options include (but are not limited to) incineration, composting, alkaline hydrolysis (Murphy et al. 2009), and biochar (Wang and Wang 2019), all of which are not feasible at this time but may become more economical in the future.
    - The Department will consider an alternative disposal option that denatures the CWD prion (pilot biochar facility).
    - An additional laboratory scientist may also be required in the Wildlife Health Laboratory to help cover the increased workload over the elk feeding season.

Habitat enhancements

Goal: Implement treatments that increase forage production in native elk winter ranges.

Habitat projects have been utilized historically in areas adjacent to feedgrounds with some success in reducing feeding duration, but rarely have habitat enhancement projects been focused on native elk winter ranges distant from feedgrounds if elk are the only species of concern. Many aspen and other habitat enhancements have been completed across mid and high-elevation areas with objectives focused on mule deer or other ecological health goals. Projects should be designed in areas that provide the opportunity for elk to free range during the brucellosis transmission period in areas away from cattle. The decision authority to implement enhancement projects is typically with the appropriate federal land management agency or private landowner. In some instances where the Commission owns the land, that decision will be handled per Commission Policy and developed by Department biologists. Although not a planned action, wildfires also have opportunity to significantly improve foraging opportunities for elk if the post-fire land management decisions prioritize wildlife habitat. All habitat enhancement strategies need to include vegetation monitoring to ensure objectives are being met, typically including livestock rest or deferment, and any potential weeds must be managed if they increase after a management action.

The Department has identified the following actions to improve elk forage production on native winter ranges:

- Prescribed Fire: Prescribed fire has been used as one of the more common habitat enhancement techniques, specifically with elk habitat in mind. Aspen habitat has been successfully improved through use of prescribed fire throughout western Wyoming and continues to be a common strategy to increase herbaceous forage. Other habitats are also suitable for prescribed fire, including mountain shrubs and mesic sagebrush communities.
- Mechanical Treatments: Many different implements have been used to reduce shrub or mat-forming forb cover, set back succession, and increase herbaceous forage. Tractor-pulled mower, Lawson aerator, pitter, and harrow implements have been successfully used throughout western Wyoming for over 30 years.
- Herbicide: Two separate types of herbicide applications have been used to improve elk habitat. The most widely used application is aerial application of herbicide for control of cheatgrass. By reducing invasive annual grasses, increases in native grass production can be achieved, which are preferred by elk for foraging over invasive species. Also, by managing cheatgrass, we are reducing the threat of unplanned wildfires, which can rapidly spread by wind in areas with a consistent understory of cheatgrass. The second type of herbicide application is a sagebrush thinning herbicide application of tebuthiron ('Spike').
- Rest/Deferment: A change in grazing management strategies can also be considered a habitat enhancement when additional standing forage is left for elk after the grazing season.
- Irrigation: Irrigating hay meadows with the intent of providing standing forage for elk can be a successful enhancement strategy when livestock management allows for residual forage for elk.
- Reseeding: In places where less desirable, non-native, or weedy vegetation has been allowed to dominate, reseeding or planting higher quality forage species can improve the quality and quantity of forage for elk. Previous disturbances or lands formerly used as pasture land can be prime candidates for these efforts.
- Wildfire: Post-wildfire habitat management has occurred throughout western Wyoming for over ten years. Through a collaborative approach with federal, state, and county agencies, private landowners, livestock permittees, county weed and pest districts, NGOs, and elected

officials, wildlife objectives can be achieved by developing solutions unique to each set of circumstances. These solutions typically include weed management, sediment and erosion control and livestock deferment, and other site-specific components. The Department follows the outline provided in the Department Wildfire Response Guide (https://wgfd.wyo.gov/WGFD/media/content/PDF/Habitat/WGFD_Wildfire-Response-Guide_2019.pdf).

Feedground phase-outs

The long-term implementation of the Plan may allow for feedground phase-outs in the future. A feedground phase-out would require significant planning, effort, and coordination, in addition to approval from the Governor. Depending on the particular feedground(s) to be phased out, successful implementation would require a combination of several management strategies, including; reduced feeding season length, reduced numbers of elk on feedgrounds, elk-proof fencing to prevent elk from moving onto private land, elimination of brucellosis seropositive elk on a feedground through test and slaughter immediately prior to feedground termination, conducting habitat enhancements in suitable winter ranges, and acquisition of native or potential winter ranges through fee-title purchase, conservation easements, or other methods. Considerable effort toward outreach and education would also be required.

During and after the completion of feedground phase-out, increased monitoring of the elk population would be required to minimize damage to private property and prevent elk-cattle co-mingling. Outfitting an adequate proportion of the elk population with satellite-linked GPS collars would provide an efficient way to monitor distribution in near real-time. Aerial drones and options for depredation or emergency hunting seasons would provide methodologies for restoring elk to desirable native ranges.

The advantage of implementing feedground phase-outs, in addition to obvious economic benefits, is that the dense aggregations of elk associated with feeding would cease, reducing incidence of brucellosis, CWD, necrobacillosis, and other diseases in elk and potential disease spill-over to other domestic or wildlife species. Disadvantages of feedground phase-out would include increased risk of elk damage and elk-cattle brucellosis transmission and associated damage control costs, increased elk winter mortality, reduced elk populations and associated hunter opportunity, increased potential for vehicle-elk collisions, and a potential increase in competition of native range with other wildlife species.

Elk Feedgrounds Communication and Outreach

Elk feedgrounds are of considerable interest to a wide variety of stakeholder groups at local, regional, and national levels. As the agency charged with managing Wyoming's wildlife populations, the Department has an obligation to provide timely, accurate, and unbiased information about elk feedgrounds to the public. To date, the Department has conducted substantial information and education efforts regarding elk feedgrounds, both within the agency and for the general public and stakeholder groups. However, continued outreach efforts, both internally and externally, will be required for the successful implementation of this Plan.

The Department recognizes that extensive communication and involvement is a critical step for garnering public support to implement meaningful strategies with regard to elk feedgrounds management and the goal of finding ways for elk to winter away from feedgrounds. Concerned constituents will be more likely to support long-term management actions if they have been thoroughly informed about and are involved with feedground-related issues, including the necessity for action and how those actions may affect them, their hunting and recreational opportunities, and wildlife populations.

The Department will coordinate internally with the Communications and Education Division to communicate the complexities and challenges surrounding elk feedgrounds and gain support for proposed management actions as described in the Wyoming Elk Feedgrounds Management Plan and the subsequent Phase III FMAPs. The Department will utilize all existing avenues of outreach to increase awareness of ongoing and emerging issues regarding elk feedgrounds management, including how those issues are being addressed and how the public and other stakeholders can further engage and participate.

- The Department will continue to actively engage and involve the public in the management of elk feedgrounds during annual season-setting public meetings in the Jackson and Pinedale regions.
- The communications team will provide current talking points internally within the Department.
- Communications regarding elk feedgrounds will consider public concern with potential elk management strategies as the need arises and will articulate the scope of proposed elk feedgrounds management strategies at a local and statewide level.
- Phase III - Upon adoption of this Plan, specific items will be added with regard to when/how/what to communicate to stakeholder groups regarding FMAPs.

Feedground Management Action Plans (Phase III)

In order to achieve the desired outcome of the creation of FMAPs, we must acknowledge constraints and work to garner additional funding, educate, and engage all stakeholder groups to achieve public support for management actions, and focus on Department personnel to help achieve milestones toward our overarching goal. Part of achieving these goals will include meeting and documenting the steps that are occurring. We have included an example of what this documentation could entail (Appendix 1. Feedground Stakeholder Working Group Template). These templates could be used in Phase III stakeholder group meetings to discuss the next steps and track the progress that has been made.

Funding: We must acknowledge the role of budgetary constraints. Current feedground management is driven by funding, and future monitoring and modifications proposed in FMAPs will require significant funding increases to incorporate some proposed recommendations. The Department should expect annual funding requests to support this effort and should explore non-traditional funding sources in order to support the future of elk management.

Public support: Public support is paramount to ALL decision-making with regard to wildlife management and the future of elk feedgrounds. The Department will need to achieve greater public awareness and understanding to increase support for future feedground management changes and actions.

Personnel: Department personnel are key to the creation and implementation of FMAPs. This may require changes to personnel duties or the creation of new positions to ensure the Plan is implemented and will require significant long-term coordination and monitoring to achieve intended outcomes. Personnel dedicated to this work will ensure internal accountability and coordination, focusing keenly on external partnerships, exploring non-traditional funding options, and targeting communication and educational priorities.

We expect that additional personnel and resource needs will be identified through the FMAP process. However, we have already identified that current personnel does not have the capacity to effectively initiate and implement the FMAP process. Examples of immediate needs that some iteration of a FMAP Implementation Biologist could address include: damage prevention (e.g., fencing); feedground data management, processing, and analysis; GIS data analysis and cartography; landowner outreach and relationship development; co-mingling prevention (e.g., hazing elk); identify, recommend and pursue real estate, conservation easements, and elk occupancy agreements, education and outreach for public engagement and support; pursue Access Yes opportunities; HMAP management and implementation; auxiliary hunt management; emergency feeding management; and general feedground management personnel.

FMAP Development

Goals: Develop individual Feedground Management Action Plans (FMAP) at the herd unit level that provide Department direction based on the best available science and expertise on how to 1) maintain cervid health by limiting disease transmission while providing supplemental feed and 2) reduce or eliminate reliance of elk on supplemental feed (in accordance with W.S. § 23-2-305) while maintaining both publicly-supported populations and acceptable levels of elk damage and elk-cattle co-mingling on private lands.

Process:

- Two regional internal feedground working groups will develop FMAP for the six elk herd units containing feedgrounds. Each working group will be composed of the following, at a minimum:
    - *Working Group Organizer*: Regional wildlife disease biologist (Jackson and Pinedale - three herds each).
    - *Core Members*: Feedground managers, regional wildlife biologists, game wardens, habitat biologists, and regional habitat and access representatives with feedgrounds within their district.
    - *Regional Wildlife Supervisor and/or Wildlife Management Coordinator*: Acts as project manager and ensures the process moves forward with active participation from all

members. Provides specific direction and intervention as needed to ensure the group is following the process to achieve the goals identified in this document.

- Each FMAP will identify herd unit obstacles and then solutions to those obstacles. Below are some principal guidelines to follow when developing the FMAP, how to reduce risk of disease transmission while feeding, and what obstacles exist if feeding were to no longer occur:
    - *Goal 1: maintain cervid health by limiting disease transmission while providing supplemental feed*. Management plans must outline disease management strategies to limit disease transmission, maintain cervid health, and continue/enhance disease surveillance/monitoring. Consider the status of the disease in question (preventative versus reacting to an established pathogen) when following disease management options during plan development and review.
        - Low-density feeding: Determine what is necessary for a feedground to maintain low-density feeding throughout the feeding season. Consider additional feeding equipment, additional land, feedground relocation for larger feeding area expansion, reduction in feedground quotas, etc.
        - Reducing disease transmission: Consideration should be given to both intraspecies and interspecies disease transmission, as well as the pathogen in question. While each feedground is different, the following should be evaluated in reducing transmission; feeding on clean snow, manure removal, carcass removal, providing adequate drainage, feedground substrate conversions, reducing animal densities thru population reduction and increased feeding area, delaying the start and earlier stop feeding dates, fencing to prevent contact with domestic livestock, hay type (i.e., grass, alfalfa, mix) and quality (course forage can promote necrobacillosis), etc.
        - Disease surveillance: Surveillance and long-term monitoring of CWD and other diseases is critical to determining appropriate and effective control measures. This includes disease-testing of all mortalities within and surrounding feedground areas. Sick animals should be humanely dispatched, necropsied, and appropriate tissues sampled. Disease prevalence should be monitored within the herd unit as well as in surrounding herd units. Surveillance and testing infrastructure (i.e., elk traps) should be located at all commission-operated feedgrounds and in good working order. Assess how the current prevalence of disease may influence the urgency to reduce reliance on feeding ("trigger points") as outlined in this plan.
        - Carcass Removal Plan: Pursuant to the Department CWD Management plan, this is a priority and must be developed within each FMAP.
    - *Goal 2: reduce or eliminate reliance of elk on supplemental feed (in accordance with W.S. § 23-2-305)*.
        - Identify obstacles and specific solutions to overcoming those obstacles.
            - Examples of specific obstacles: Lack of native winter range, public expectations, current elk population levels, increase in damage to private

property, increase in spillover over of *B. abortus* from elk to cattle, reduced sportsperson opportunity, increased interspecies competition, lack of public support, lack of funding, need for habitat enhancements/acquisition, etc.

- Examples of specific solutions: Use current and further develop, if needed, the methodology utilizing geographic information systems (GIS) and available wildlife data to rank and prioritize properties for an easement, elk occupancy agreement, lease, or acquisition.

- Address the outstanding management questions (e.g., where will elk go if not fed, what would be a realistic population objective based on available winter range). Consider if these management questions could be answered through collaborative research (see Potential Research Priorities) or managed with the Department. Assess if the current feedground quota is applicable for the feedground under review.
- Consider what additional personnel or resources will be required to implement each FMAP. Considerations should include temporary/permanent positions (e.g., biologists, information and education, GIS/data management, habitat and access biologists, feeding personnel, damage technicians, etc.), altering/changing existing positions (e.g., title, level, etc.), equipment, expertise/collaborators (e.g., research scientists, disease ecologists, agricultural habitat specialist, economist, etc.), and additional resources required to implement and maintain the objectives of the plan.
- Consider utilizing the "*Brucellosis Management Action Plans*," input from "Elk Feedgrounds: A Challenge We Can Take On" public collaborative process, and the "National Academy of Sciences report on Brucellosis in the GYA" for historical perspective and direction of the next steps.

- Public Involvement:
  - *Based on the obstacles identified by the Department FMAP working groups, stakeholders will be engaged to collaboratively help determine potential solutions.*
    - Once obstacles are identified for each FMAP, the Department will prioritize those plans for review by local stakeholders. The prioritization may be based on many factors, including the availability of native winter range, disease, or other management considerations.
    - Local affected stakeholder groups for each herd unit will be established. Membership and stakeholder representation will be approved by the Regional Supervisor.
- Product:
  - Written plans will be developed for each herd unit that outline the necessary actions to accomplish Goals 1 and 2.
  - A prioritized list of actions that can be pursued immediately so Department managers and partners can begin working on them without delay.

- Annual progress summary reports will be developed by the FMAP working groups to be incorporated into the Job Completion Report for each respective elk herd unit. This reporting will track progress (using the FMAP Working Group Template; Appendix 1) in achieving the actions outlined in each FMAP to ensure consistent monitoring and accountability.
- Once an FMAP is finalized, Department FMAP working groups will meet annually, at a minimum, to update progress on plan implementation.
- FMAPs are intended to be a concise, straightforward playbook that specifically identifies obstacles and solutions to accomplish Goals 1 and 2.
- Final FMAPs will be approved by Wildlife Division Chief for implementation.
- FMAPs will be updated as new science/data, obstacles, and solutions are identified.

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APPENDIX 1: FMAP Working Group Template

Feedground:	Meeting date[1]:
Member's present[2]:	

Elk Objective review:

Elk population size:
Has the FWG reviewed herd unit objectives and feedground quotas (yes/no; explain):

Elk harvest strategies:

Has the FWG reviewed Department harvest strategies in an effort to manage herds to approved objectives/feedground quotas (yes/no; explain):

Habitat ACCESS/acquisition:

Has the FWG made attempts to acquire/lease habitat (yes/no; explain):

Elk land use:

Has the FWG made attempts to pursue regulation/statute changes to encourage cooperative elk use on private lands (yes/no; explain):

Has the FWG made attempts to enhance the habitat to increase elks ability to winter away from feedgrounds (yes/no; explain):

Livestock/producer coordination and cooperation:

Has the FWG made attempts to work with producers on voluntary livestock management strategies designed to reduce conflict and disease transmission (yes/no; explain):

Federal/state land management and NGOs coordination:

Has the FWG made attempts to work with federal/state/NGOs on habitat access and acquisition (yes/no; explain):

Infectious disease status:

CWD detected (yes/no); if yes, provide prevalence estimate:
Necrobacillosis detected (yes/no); if yes, provide prevalence estimate:
Psoroptes mange detected (yes/no); if yes, provide prevalence estimate:
Tuberculosis detected (yes/no); if yes, provide prevalence estimate:
Other infectious disease occurrences:

Please describe the working groups disease management work conducted since last meeting[3]:
Has an emergency carcass disposal/removal plan been developed (yes/no; if no, explain):

Research opportunities:

Has the FWG made attempts to pursue funding, promote and engage in research opportunities where applicable (yes/no; explain):

Supplemental feeding policy:

Has the FWG updated the supplemental feeding policy for this feedground (yes/no; if no, explain):

Highway and public safety:

Has the FWG made attempts to pursue funding for wildlife crossings, additional signage, and educate the public (yes/no; explain):

Public outreach and communication:

Has the FWG informed the public/other stakeholders of this past year's progress:

[1]Working group members will meet at least once a calendar year

[2]Must include at least four FMAP working group members: one being a regional member of the Department, but should include an external stakeholder identified (per Public Involvement section under Development of Feedground Management Action Plans in the Feedground Management Plan)

[3]List preventative measures undertaken and/or trigger measures undertaken.