



City of Boulder

Draft Plague Management Plan 12.8.21





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Executive Summary

Plague management in prairie dog colonies is complex and has been controversial in the Boulder community. Prairie dog colonies have been subject to periodic, unpredictable, substantial decline in numbers of prairie dogs due to plague. When these declines have occurred, some community members have expressed concerns about the city's ability to meet its prairie dog conservation goals. In contrast, prior city efforts to mitigate plague have been perceived by other community members as exacerbating current prairie dog conflicts or compromising environmental health through use of insecticides. Having more plague-resistant colonies in areas where prairie dogs and their associated species are desirable conservation targets is beneficial to the city's goal of managing grassland ecosystems. Being clear about where and how plague mitigation takes place so as not to exacerbate current land use conflicts and to undermine ecosystem health is also beneficial. This plan represents the city's current approach of how to best navigate this range of community concerns and overlapping resource management goals.

Plague interventions such as sylvatic plague vaccine (SPV) are risk management tools that help maintain a viable, secure prairie dog population by decreasing the likelihood and severity of large-scale prairie dog population die-offs (epizootics) caused by plague. Plague interventions are being used to help support population goals established in the Open Space and Mountain Parks (OSMP) Grassland Ecosystem Management Plan (GMAP) and are consistent with Boulder plans and policies that guide land management in areas where prairie dogs predominate.

The **purpose** of this plan is to clarify why plague management occurs on City of Boulder (COB) property and where, when, and how plague management will be implemented to support the city's multiple goals for grassland ecosystems. **Plan objectives** include:

- Establish plague management objectives, goals and strategies.
- Identify what conditions, locations or management designations are appropriate targets for plague management and under what circumstances.
- Review techniques and strategies for plague management.
- Identify appropriate plague management techniques, tools and applications to be used to help meet city goals for prairie dog occupancy levels and protection of high-integrity grassland habitat on city-owned properties designated for prairie dog conservation.
- Incorporate ecological resilience principles to monitor and adapt to the impacts of changing climate and other anthropogenic stressors on prairie dog populations and associated ecosystems.
- Identify a process for evaluating new tools for plague mitigation as they emerge.
- Identify costs for plan implementation.
- Describe the monitoring and adaptive management process.

The primary proactive or prophylactic **plague management objective** for city property is to reduce the risk of catastrophic prairie dog population decline where prairie dogs are conservation targets. The number of prairie dog acres the city is managing for is based on the OSMP Grassland Ecosystem Management Plan conservation goals (see Appendix B). These goals include a minimum number of 800 acres of prairie dogs across the OSMP system, including at least 10% occupancy in each of the three Grassland Preserves (North, South and East). If OSMP is successful in meeting these goals, the conservation of prairie dogs across Boulder's landscape will meet the criteria of being secure.

The COB is employing plague mitigation for the conservation of prairie dogs in the Boulder Valley. Hence, the overall **plague management strategy** is to reduce the risk of catastrophic population decline or epizootics by treating a recovery reservoir of prairie dog colonies. This recovery reservoir of active colonies would have some protection if an epizootic moved through the system. Those individuals that have some protection against plague will remain on the landscape and serve as an anchor to help repopulate the area. The spatial distribution of the prairie dog colonies to serve as a recovery reservoir will be a consideration on an annual basis. The number of acres of prairie dog colony to receive plague intervention is based on historic data and experience with past population recoveries.

In 2020 OSMP properties held approximately 4,800 acres of prairie dogs. These numbers can vary greatly year to year. In 1996, OSMP properties had 182 acres of prairie dogs following a substantial plague epizootic in 1994-1995. Following this low-level occupation, occupation recovered to 885 acres within two years (by 1998), thus meeting OSMP goals for “good” viability of system-wide prairie dog occupancy in a very short amount of time. As a result, staff identified this 182-acre level as an appropriate minimum threshold from which it believes that prairie dogs can recover. However, below this level, recovery may not be certain and thus prairie dogs might need to be brought in from other areas to repopulate. Since OSMP has acquired substantial lands since 1996, this threshold of 182 acres has been modified to represent an analogous number of acres based on the larger land system in 2021. As a result, the staff determined threshold for number of acres that that will receive annual plague intervention is 250 acres.

The two primary plague intervention tools to reduce risk of plague are the vaccine (SPV), to be distributed in colonies in the form of a bait, and the insecticide powder Delta Dust that is applied to prairie dog burrows to kills fleas that may carry plague. Though the use of Delta Dust and SPV would offer more protection from plague than SPV alone, insecticides are rarely used on city land and only under very limited circumstances. Due to the ecotoxicity and human health issues associated with broad-spectrum insecticides, widespread use on city natural lands is inconsistent with the city’s IPM policy, and inconsistent with the goals of the GMAP which focuses conservation attention not only on 400 species of vertebrates, but the many species of invertebrates that populate the grasslands and are critical to the ecological functioning of these protected areas. Therefore, the 250 acres of city property that will receive plague intervention will receive only SPV. The use of Delta Dust would be used on a limited basis as required by the State of Colorado to support prairie dog relocation efforts.

It is possible that city-wide prairie dog populations could again fall below 250 acres even with SPV treatments. If this should occur, additional plague mitigation thresholds and associated actions have been identified:

- If populations fall below 250 acres and statewide populations are secure (according to Colorado Parks and Wildlife definition) efforts will be made to restore populations with relocation.
- If populations fall below 250 acre and statewide populations are not secure, efforts to maintain and build populations on city lands will be pursued including evaluating use of insecticidal plague treatments and securing exemptions through the IPM process.

The current (2021) annual **cost** for treating 250 acres to serve as a recovery reservoir of prairie dogs with SPV, two rounds per year, is approximately \$8,000. This cost estimate is for the vaccine and does not include staff time for distribution.

Conditions of prairie dog occupancy are dynamic, and occupancy will be mapped and evaluated annually to inform plans for plague management each year. Similarly, plague intervention research is ongoing, and tools are evolving. City staff will continue to work with state and federal agencies to evaluate new plague management tools and their costs and benefits.

I. Introduction

The topic of plague management in prairie dog colonies is complex and has been controversial in the Boulder community. Prairie dog colonies have been subject to periodic, unpredictable, substantial decline in numbers of prairie dogs due to plague. When these declines have occurred, some community members have expressed concerns about the city's ability to meet its prairie dog conservation goals. In contrast, prior city efforts to mitigate plague have been perceived by other community members as exacerbating current prairie dog conflicts or compromising environmental health through use of insecticides. Having more plague-resistant colonies in areas where prairie dogs and their associated species are desirable conservation targets is beneficial to the city's goal of managing grassland ecosystems. Being clear about where and how plague mitigation takes place so as not to exacerbate current land use conflicts and to undermine ecosystem health is also beneficial. This plan represents the city's current approach of how to best navigate this range of community concerns and overlapping resource management goals.

In 2017, the city manager convened a Prairie Dog Working Group made up of interested community members and city staff to provide recommendations on the management and conservation of prairie dogs on city lands. During this effort, the need for starting plague management on city lands was discussed and included in the group's final set of recommendations that was accepted by the city manager in 2018, followed by a staff implementation recommendation accepted by city council in 2019 ([Appendix D](#)). Among these recommendations was that city staff develop a plague management plan to direct plague management on city-owned or managed prairie dog colonies. Reasons for pursuing plague management centered around concerns for the city's ability to conserve prairie dog populations with the challenge of periodic epizootic plague and resulting unpredictable large-scale declines in populations.

The **purpose** of this plan is to clarify why plague management occurs on City of Boulder (COB) property and where, when and how plague management will be implemented to support the city's multiple goals for grassland ecosystems. This plan will serve as a guiding document on this topic. City budgets are developed annually, and resources, costs and priorities can change annually and can affect plan implementation.

The **goal** of this plan is to provide the framework to manage plague as needed to support grassland ecosystems and meet citywide prairie dog conservation and management goals.

Plan **objectives** include:

- Establish plague management objectives, goals and strategies.
- Identify what conditions, locations or OSMP management designations are appropriate targets for plague management and under what circumstances.

- Review techniques and strategies for plague management.
- Identify appropriate plague management techniques, tools and applications to be used to help meet city goals for prairie dog occupancy levels and protection of high-integrity grassland habitat on city-owned properties designated for prairie dog conservation.
- Reduce the risk of catastrophic prairie dog population decline where prairie dogs are conservation targets.
- Incorporate ecological resilience principles to monitor and adapt to the impacts of changing climate and other anthropogenic stressors on prairie dog populations and associated ecosystems.
- Identify a process for evaluating new tools for plague mitigation as they emerge.
- Identify costs for plan implementation.
- Describe the monitoring and adaptive management process.

A. Relationship to other Boulder plans and policies

The Plague Management Plan nests within the context and guidance of existing COB plans and policy documents. The broadest, overarching document of relevance is the COB Sustainability and Resilience Framework. Developed by the community, the [Sustainability and Resilience Framework](#) provides a vision for an inspired future and aligns efforts across the city by establishing a common language for goals and priorities (**Figure 1**).

The Sustainability and Resilience objective most relevant to Plague Management Plan is: *Build an environmentally sustainable community that protects and enhances the biodiversity and productivity of ecological systems.*

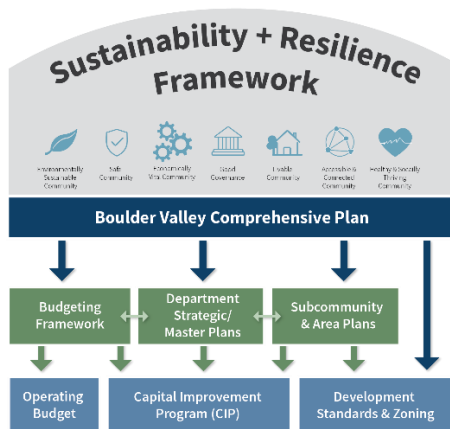


Figure 1. Relationship of COB Guiding Documents

The [Boulder Valley Comprehensive Plan](#) (BVCP) provides the overarching context and broad city policies for more detailed planning which occurs through all other city planning efforts. The BVCP is a joint plan between the City of Boulder and Boulder County, providing shared land use decision-making in the Boulder Valley. The BVCP sets a course for the future growth and development in the city and the lands just outside the city's boundaries. The plan is developed and adopted by four governing bodies: the City of Boulder Planning Board, Boulder City Council, the Boulder County Planning Commission, and the Board of County Commissioners.

BVCP Policies Relevant to the Plague Management Plan:

- *3.02 Adaptive Management Approach*

The city and county will employ an adaptive management approach to resource protection and enhancement. An adaptive management approach involves establishing objectives, conducting ongoing monitoring of resource conditions, assessing the effectiveness of management actions, revising management actions based on new information from research, and learning from experience what works and what does not.

- *3.03 Native Ecosystems*

The city and county will protect and restore significant native ecosystems on public and private lands through land use planning, development review, conservation easements, acquisitions and public land management practices. The protection and enhancement of biological diversity and habitat for state and federal endangered and threatened species, as well as critical wildlife habitats, migration corridors, environmental conservation areas, high biodiversity areas, rare plant areas, significant natural communities and county and local species of concern (i.e., resources identified in the Boulder County Comprehensive Plan) will be emphasized. Degraded habitat may be restored and selected extirpated species may be reintroduced as a means of enhancing native flora and fauna in the Boulder Valley.

- *3.09 Integrated Pest Management*

The approaches by the city and county to this policy differ in their management strategies. The city aims to reduce and eliminate, where possible, the use of pesticides and synthetic fertilizers on public properties and provide outreach and education to encourage the public to use a similar approach on private property. The city's practices carefully consider when pest management actions are necessary and focus on creating healthy and thriving ecosystems to lower pest pressure by natural processes. When pest management is necessary, the city commits to the use of ecologically based integrated pest management principles, which emphasize the selection of the most environmentally sound approach to pest management and the overall goal of using nonchemical pest-control strategies. The county's approach stresses control of invasive species and pests using the full suite of tools available in integrated pest management, including chemical methods when necessary. When public or environmental health risks are identified, the city and county will balance the impacts and risks to the residents and the environment when choosing management measures. The county will strive to reduce the use of pesticides and synthetic, inorganic fertilizers where use does occur.

Citywide plans, policy, and departmental master plans and resource management plans relevant to the Plague Management Plan include:

- *Preferred Alternative Regarding the Management of Open Space and Mountain Parks irrigated agricultural lands occupied by prairie dogs (2020)*

This city council memo dated August 20, describes a set of actions and policy modifications for the management of prairie dogs on irrigated agricultural lands in the area of city Open Space and Mountain Parks properties where irrigated agricultural lands are most affected by prairie dogs.

- *City of Boulder Integrated Pest Management Policy (2019)*

The city's Integrated Pest Management (IPM) Policy requires a whole-systems approach, viewing the pest or target organism within the context of the entire ecosystem. Ecosystem management

is the foundation of the policy, using knowledge about each site to promote stability of desirable species and sustain natural balances. The policy assumes that pesticides are potentially hazardous and directs that pesticide use is reduced and eliminated wherever possible. Chemical control is a last resort, and any pesticide use must be approved before it can be considered.

- *Open Space and Mountain Parks Master Plan (2019)*
The Open Space and Mountain Parks Master Plan describes five focus areas that reflect community priorities for open space and will guide management of the open space land system over the next 10 years. Among these focus areas is Ecosystem Health and Resilience which includes desired outcomes of diverse native plant and animal species on OSMP land. This outcome includes protection of all native plant and animal species and natural communities, including black-tailed prairie dogs and their associated species. To meet this outcome, the plan directs OSMP to accomplish this outcome by “using the best available science, we protect healthy ecosystems and mend those we have impaired”.
- *Prairie Dog Working Group Management Recommendations, and Implementation (2019)*
This city council memo dated May 7, lists the suite of Prairie Dog Working Group management recommendations, as well as the implementation prioritization proposed by staff.
- *Open Space and Mountain Parks Agricultural Resources Management Plan (2017)*
The Agricultural Resources Management Plan (Plan) identifies strategies to maintain and enhance the resources and facilities needed to support local agricultural operations. The Plan recognizes irrigated land and the water rights that allow for irrigation as critical to the continued support of working agricultural lands. It is difficult for prairie dogs and economically viable agricultural production to coexist on irrigated agricultural land. The Plan includes a management strategy to evaluate management options to better manage prairie dogs and agricultural conflicts.
- *Parks and Recreation Master Plan (2014)*
Currently being updated (final anticipated in 2022), the Parks and Recreation Master Plan provides strategic guidance on how the department should maintain and care for the department’s assets, including natural resources. The updated Master Plan will have an increased focus on resilience and the department’s role in maintaining and caring for the natural environment.
- *Parks and Recreation Boulder Reservoir Master Plan (2012)*
The Boulder Reservoir Master Plan identifies the west shore of the Boulder Reservoir as high-quality habitat for numerous wildlife species. The management area is managed as both short grass prairie and high functioning wetlands habitat. Prairie dogs are identified as an important species to maintain in these areas as a prey species and habitat for several species of special concern also identified at the Boulder Reservoir.
- *Open Space and Mountain Parks Grassland Ecosystem Management Plan (2010)*
The OSMP Grassland Ecosystem Management Plan identifies conservation targets and strategies to protect or enhance those targets. One target is the black-tailed prairie dog and associated species. The plan sets out goals for occupancy of prairie dogs on OSMP lands to best protect the species and associates, the habitats that support them, and reduce conflict between prairie dogs and other human land uses.

- *City of Boulder Urban Wildlife Management Plan (UWMP) Black-tailed Prairie Dog Component (2006)*

The UWMP identifies prairie dog conservation opportunities and removal areas in the urban service area of the City of Boulder. The colonies identified in the UWMP are not anticipated to receive sylvatic plague mitigation due to existing conflict with adjacent land uses in the city.

II. Sylvatic Plague Management in Prairie Dog Colonies

Sylvatic plague is a disease caused by a bacteria called *Yersinia pestis*. It is the same bacteria that causes bubonic plague in humans. When it occurs in wildlife populations, the disease is referred to as “sylvatic plague”. This bacterium is not native to North America but is thought to have been brought here by rats aboard ships about 120 years ago. It is transmitted from mammal to mammal by fleas, and by contact with infected tissues of sick or dead animals, inhalation of droplets or through environmental exposures, such as contaminated soil.

Sylvatic plague occurs on city of Boulder properties and has reached levels of infection and impact to prairie dogs that are widespread and have a large impact on prairie dog populations (epizootic). These epizootics occur periodically with the last two occurring on the system between 1994-1995 and 2005-2008. During these epizootics, plague impacts a large percentage of prairie dog colonies including mortality of most, if not all prairie dogs within a colony. In the last two epizootics, plague has impacted prairie dogs across multiple years, with localized die offs largely occurring within a short timeframe of only a few days to weeks. Following the 1994/94 epizootic, OSMP mapping indicated that with the exception of a few isolated colonies, all colonies experienced some level of population reduction. Overall, prairie dog occupancy was reduced to 182 acres by 1996. In 2005-2008, the epizootic first impacted colonies in the northern portion of city lands, leading to widespread population reduction to low levels. However, pockets of prairie dogs survived and quickly recolonized, repopulating the northern area to a large degree at the same time that the epizootic impacted populations in the southern portion of the city’s land system. As a result, overall occupancy never dropped to levels consistent with 1996, although spatial distribution of populations shifted with first low occupancy in the northern area and high occupancy in the south followed by recovery in the north and low occupancy in the south following the die-off. In the 2005-2008 epizootic, several of the colonies that had not been impacted in the 1990s experienced die-offs. Overall, it appears that the return interval of plague epizootics is unpredictable and the dynamics of each epizootic cannot be anticipated based on patterns previously seen. As a result, plague management cannot be planned based on any predicted epizootic, rather in a way that anticipates that plague may occur at anytime, anywhere on the city land system.

A. Why mitigate sylvatic plague in prairie dog colonies on City of Boulder lands?

The COB manages prairie dog colonies across a spectrum of land uses and not all are appropriate candidates for proactive plague intervention. Areas where occupation of prairie dogs and the species that exist with them are part of the land management objective is where plague intervention is being proposed. The City’s Open Space and Mountain Parks (OSMP) land system contains the most acreage of high integrity grassland habitat, and most of the city’s prairie dog colonies (4,798 acres in 2020).

Prairie dogs are highly susceptible to plague. When outbreaks, called epizootics, occur they can drastically reduce prairie dog populations or even wipe out entire colonies in a short time. The factors

involved in creation of a plague epizootic are not well-understood, and epizootics cannot be predicted with any accuracy. This uncertainty makes management for conservation of prairie dogs and associated species challenging.

Substantial prairie dog habitat loss over the last 200 years in their historic range in the United States and continued control of prairie dogs have reduced populations to a small fraction of historical numbers. This has led to concerns that plague is a substantial threat to the conservation of prairie dogs across their range. For land managers in parts of the country where the endangered black-footed ferret has been reintroduced, plague poses a critical threat to successful recovery of the species since ferrets are dependent upon extensive prairie dog complexes and populations for prey and shelter, and ferrets can also contract sylvatic plague. On city lands, where black-footed ferret reintroduction is not currently an objective, the potential loss of prairie dog colonies threatens the prairie dogs themselves, and reduces availability of prey for raptors, coyotes, bobcats, and badgers, and affects available habitat for species that use prairie dog burrows such as burrowing owls, as well as a variety of insects, small mammals, reptiles, and amphibians.

On the OSMP land system, the Grassland Ecosystem Management Plan (GMAP) guides prairie dog management most directly, as do the Prairie Dog Working Group recommendations, and the Preferred Alternative for Irrigated Agricultural Lands. These documents are further supported by the Agricultural Resources Management Plan and the OSMP Master Plan. The GMAP defines goals for occupied acres of prairie dogs in areas of the OSMP system referred to as 'grassland preserves' and on OSMP lands overall. The goals for conservation of prairie dogs include at least 10% prairie dog occupancy in each of 3 grassland preserves (north, east and south) and a minimum of 800 acres of prairie dogs across the whole OSMP system. A viable prairie dog population is needed to meet these prairie dog conservation goals as well as other management objectives for conservation of sensitive species such as raptors, burrowing owls and badgers. However, there are also other sensitive species and plant communities that are not compatible with environmental conditions created by prairie dog colonies, so conservation objectives are framed to create a balance between conservation of thriving prairie dog and associated species communities along with other important (non-prairie dog) habitat types.

Although current prairie dog populations are very high in portions of the city land system (northern area), they remain low in other areas. As demonstrated by previous plague epizootics, the occurrence of a plague epizootic is unpredictable and has rapid impacts that reduce prairie dog populations substantially over a broad spatial area. As a result, plague management is an important consideration for helping to meet management goals for conservation of prairie dogs and associated species long-term. Because the city wants to support a diverse and heterogeneous prairie habitat (not to have as many prairie dogs as possible) and there are other land management objectives where prairie dogs exist (e.g., irrigated agriculture, tallgrass prairie, parks and urban infrastructure areas), the OSMP GMAP, Agricultural Plan and Master Plan conservation objectives, as well as other guiding documents such as the Preferred Alternative for Irrigated Agricultural Lands, will inform plague management goals and strategies while ensuring conflicts that exists between land uses and the presence of prairie dogs are not exacerbated.

1. Plague management goal and objective

Plague represents a threat to ongoing conservation of black-tailed prairie dogs on city land. As a result, the city's objective was developed to support management of this threat at a level that can support long-term conservation on city lands. The **plague management objective** for city property is to reduce

the risk of catastrophic prairie dog population decline where prairie dogs are conservation targets. This objective reflects the city's commitment to ongoing prairie dog conservation. To meet this objective, plague management must support long-term conservation goals as well as city priorities for conservation of other resources. As a result, the **plague management goal** of the city is to maintain sufficient acres of prairie dog occupancy following a plague epizootic to allow repopulation to levels within this "good" range as defined in the GMAP, within a short period of time- approximately two to five years while minimizing the use of chemical pesticides.

B. Plague suppression tools

Plague management tools include an oral vaccine for prairie dogs (sylvatic plague vaccine) and insecticides that focus on controlling the fleas that transmit the bacteria to prairie dogs. Plague suppression tools described are the Sylvatic Plague Vaccine (SPV) and chemical insecticides that kill the fleas that potentially carry plague. This section describes the tools available for use, but not necessarily used or recommended for use on city lands.

1. Sylvatic Plague Vaccine

The sylvatic plague vaccine (SPV) is a relatively new tool for prairie dogs and was developed as a management tool for conservation of endangered black-footed ferrets (Rocke et al. 2010ⁱ). Prairie dogs receive the vaccine by eating bait pellets where SPV is incorporated into a highly palatable matrix. Consumption of baits by prairie dogs can be confirmed since the bait pellets also contain a dye that is evident in scat around burrows within a day or so of distributing SPV baits. Because the bait is attractive to other animals such as mice, rabbits, and coyotes, it is distributed early in the morning, so they are available to prairie dogs for as many daylight hours as possible and less available to more nocturnal species. However, no harmful effects have been reported for prairie dogs or other wildlife species that have consumed SPV baits (USGS 2012ⁱⁱ, Rocke et al. 2017^{iv}, Bron et al. 2018ⁱⁱⁱ).

Field studies demonstrated that prairie dogs do consume SPV baits, SPV is safe for prairie dogs, and SPV provides some protection against sylvatic plague (iv et al. 2017)^(OBJ). However, SPV did not provide total protection to prairie dogs from plague. Factors thought to affect efficacy of SPV include uptake rates and concentration of the SPV serum in the baits. Uptake rates can be improved by distributing baits later in the season when vegetation has dried out and prairie dogs have fewer food choices (Abbott et al. 2019)^(OBJ). Serum concentration in baits can be increased by adding more serum, but initial estimates are that serum concentrations may need to be eight times the concentrations used in baits during 2019-2020, potentially leading to large increases over the current cost of approximately \$15 per acre for a single dose (not including staff time). Another way to increase efficacy is to distribute two doses of the SPV per year, effectively providing a booster to the first dose, and also providing more opportunities for prairie dogs to access SPV baits (D. Tripp, CPW, pers. comm). There is ongoing development and fine-tuning of the technology as it has proven to protect prairie dogs at a level that is not sufficient to support populations of ferrets when epizootic plague is present. Efficacy of SPV, as evidenced by seroconversion in the blood (development of detectible antibodies), is roughly 30-40% with one dose of SPV, and can be increased to roughly 60% by a second dose (D. Tripp, CPW, pers. comm). A meta-analysis of seven SPV studies indicated that SPV increased the survival of prairie dogs by 4% (Roth 2019^{vi}). The current (2021) assessment of SPV as a management tool for sylvatic plague in prairie dogs is

that SPV can prevent colony collapse but may not be effective enough to maintain sufficient prairie dog populations to support black-footed ferrets through an epizootic.

2. Chemical Insecticides

There are two chemical insecticides that suppress plague by killing fleas on prairie dogs, and in and around the burrow where prairie dogs live. DeltaDust® 0.05% deltamethrin, is a powder that is applied inside and around the entrance to prairie dog burrows and reduces the presence of fleas for about 10 months (Eads et al. 2019)^{vii} and is the only product currently approved by the EPA for use in prairie dog burrows. Deltamethrin decreased flea abundance by 85% in a meta-analysis (Roth 2019)^{vi} Fipronil, which is distributed as laced grain at burrows, also suppresses plague transmission by acting as a systemic insecticide, thus reducing the presence of fleas on prairie dogs for 9-14 months. In available studies, fipronil reduced flea abundance by 94.8%. (Roth 2019).^{vi} Because it is still being evaluated and tested, Fipronil currently requires federal approval for operational use^{viii}. Decreased flea abundance is not always correlated with increased prairie dog survival. However, some studies show increased survival associated with flea suppression. (Roth 2019)^{vi}.

C. Assessment process for sylvatic plague insecticide tools

The city's IPM (Integrated Pest Management) policy provides requirements and guidelines for pesticide use on city-owned properties. Non-chemical methods are the foundation of the city's IPM program and pesticides are not allowed without justification and approval following an assessment process. In the case of plague management, the decision to consider the use of any insecticide for plague management beyond the limited use of Delta Dust that is currently required to obtain a state permit for prairie dog relocations, would require that the thresholds described in the *plague management thresholds* and *plague management approach* sections this plan were exceeded and an environmental risk assessment determined that insecticide use were appropriate.

Boulder's IPM Policy was first enacted in 1992. Periodic updates require review by city staff across departments, outside experts, advisory boards and city council before final approval by the city manager. The IPM Policy requires environmentally sound land management with a "whole systems" approach, viewing the target species as it relates to the entire ecosystem. This approach assesses impacts to human health, water quality, non-target organisms and the preservation and enhancement of biodiversity to promote balance within ecosystems. As climate change, habitat fragmentation, pollution, invasive species, biodiversity loss and other anthropogenic and climatic stressors increase the vulnerability of the world's ecosystems, maintaining balance becomes more challenging. The increasing instability of ecosystems underscores the necessity to manage them in a way that best maintains ecosystem function, stability, and resilience under current and future conditions.

When a pest issue needs to be addressed, the city's ecological [IPM process](#) evaluates management practices from the least impactful/most ecologically compatible to the most impactful that carries the most potential risk of harm or can interfere with other management options or ecosystem balance. The overall priority is placed on using practices with the least impact and highest ecological compatibility. This evaluation can be quite complex and requires continuous gathering of information, review, and developing new approaches.

The IPM policy assumes that all pesticides are potentially hazardous to human health and the environment with the goal to reduce and eliminate pesticides whenever possible. Pesticide application is restricted on city-owned land and only pesticides that have been assessed and included on the

[Approved Pesticide List](#) are allowed – and only then for specific targets and site types with additional restrictions in many cases. Pesticides are categorized by [hazard criteria](#). The process is described in the city's [IPM operations manual](#) beginning on page 15.

1. Allowed Uses of Insecticides

Insecticides are rarely used on city land and only under very limited circumstances. Due to the ecotoxicity and human health issues associated with broad-spectrum insecticides, widespread use on city natural lands is inconsistent with the city's IPM policy. In the event of exceptional circumstances, a formal approval process would be required for any proposed use. There are only three cases where insecticides are currently approved for use. Only two cases allow broad use. In each case, data analysis, pesticide ecological risk assessment and extensive literature reviews, monitoring, and the development of a management plan were necessary before these insecticides were approved. The three current approved uses of insecticide are:

- *Urban Forestry* - Only one synthetic insecticide is approved for city trees and its use is restricted to Emerald Ash Borer treatment. A detailed and well-researched comprehensive plan compared the benefits from protecting trees for their environmental and ecosystem services to the ecological impacts from the insecticide. This plan was approved by advisory boards and city council. Only a small portion of the city's ash trees are treated once every three years.
- *Mosquito Program* - The city's mosquito program uses one product, a natural bacterial larvicide *Bacillus thuringiensis israelensis (Bti)*. Its use is restricted due to ecosystem impacts. The mosquito plan focuses on enhancing biodiversity to keep mosquito populations low and collects biodiversity survey data at hundreds of sites to track the impact of *Bti* on wetland ecosystems and the correlation of biodiversity to mosquito populations. This approach was also approved by advisory boards and city council.
- *Prairie Dog Relocation* – Delta Dust (deltamethrin) and Pyranha (pyrethrins) are allowed *only* for treatment at sending sites prior to prairie dog relocation due to CPW requirements included in the state permit because there would be no other option for the city to continue to relocate prairie dogs without it. Delta Dust does not pass the city's assessment process due to high acute toxicity to mammals, amphibians, fish, bees and other terrestrial insects, aquatic invertebrates^{ix} and multiple ecosystem-level impacts. It also has concerning health effects due to neurotoxicity, endocrine disruption, reproductive toxicity, organ damage, and suppression of the immune system of rodents. The city's [hazard criteria](#) allows a product that has failed to be considered for use in some circumstances and treated as a Special Use pesticide.

2. Consideration of insecticides for sylvatic plague management

Before any new use of an insecticide product would be considered, the decision would first have to be made that insecticide application is appropriate for plague management; the city's threshold would have to be met and the proposed benefit for prairie dog conservation would have to clearly outweigh the risk to grassland ecosystems and vulnerable organisms including solitary ground nesting bees and other insects, amphibians, other nontarget organisms and the potential harm and disruption to ecosystem function. Insecticides do reduce flea populations, which is associated with lower incidence of plague, but it does not eliminate the risk of an epizootic and the long-term risks to prairie dogsⁱⁱⁱ and overall disease ecology and dynamics are not well understood.

The city's pesticide approval process includes an ecological assessment, and in cases of vector-borne diseases, disease ecology principles are also included in the assessment (See [pages 19-20 IPM Operations Manual](#)). When evaluating management options for sylvatic plague, like all other pest or land management practices, the city's IPM policy requires an ecosystems approach, which includes

gathering as much knowledge as possible about the ecology and interactions of the vector, hosts, pathogen and other components of the ecosystem.

The perspective that plague and other zoonotic diseases should be viewed within an ecological context is not new. Zeppelini et al. (2016)^x suggest exploring the relationships between the vectors, hosts, and pathogen transmission cycle at the landscape level and the interactions within ecological communities. Different plague reservoir models should be considered to better understand disease dynamics and estimate the risk of epizootics. In addition to the complexity of the ecological interactions of plague, climate change impacts^{xi} and other external disruptors can affect the disease cycle. The potential impact of insecticides in this system must be carefully assessed and considered before being used for routine plague management on city property.

If the city decided at some point in the future to use an insecticide for plague management, beyond the limited use of Delta Dust that is currently required to obtain a state permit for prairie dog relocations (see above), insecticides that were approved by the EPA for use in prairie dog burrows at that time would be individually reviewed before a specific product were chosen. City staff follow the availability of tools for plague management and will continue to do so.

D. COB current plague mitigation activities

Plague management currently occurs on a subset of prairie dog colonies within the OSMP land system- focused on areas of low populations or those that are part of relocations. This includes twice yearly distribution of sylvatic plague vaccine (SPV) on all active colonies in the OSMP southern grasslands, and where relocations are planned for the year. The second distribution improves protection by providing a booster dose. Sylvatic plague vaccine has been used since 2018. During this time, epizootic plague has not occurred on the city land system, so efficacy cannot be evaluated. As a result, staff use efficacy measurements derived from study areas on other land systems.

City staff continue to work with State researchers to evaluate the ongoing effectiveness of SPV to help meet conservation goals. Staff consider SPV to be a useful tool on city lands to reduce the risk of catastrophic population loss in the face of plague epizootics by preventing complete colony collapse if plague moves through. Based on the data on effectiveness, SPV is an appropriate tool for plague management, given the current management goals for prairie dogs, and current lack of black-footed ferrets on the OSMP system. The city works with Colorado Parks and Wildlife (CPW) and federal agencies such as U.S. Fish and Wildlife Service and U.S. Department of Agriculture to keep abreast of new developments and best use of the current plague mitigation tools.

Deltamethrin dust, commercially known as Delta Dust, is a plague management tool the city currently only uses in limited circumstances and is applied to burrows from which prairie dogs will be trapped and relocated, regardless of land ownership or management. This is required by the CPW (State) permit for wild-to-wild relocations. Delta Dust is not otherwise used on City-owned or managed lands due to citywide priorities to reduce pesticide use and concerns about impacts to non-target organisms. As required in relocation permits, relocated prairie dogs are also sprayed with the insecticide Pyranha (pyrethrins) before release to their new homes to further reduce the chance of transporting plague carrying fleas with relocated prairie dogs.

1. Monitoring of city prairie dog populations

City staff complete annual monitoring of all prairie dog colonies on OSMP and Boulder Parks and Recreation (BPR). Mapping is field based, and each colony is mapped to capture the periphery of occupied area, thus giving a highly accurate measurement of occupied area. Mapping is completed in the fall of each year to capture the most stable/representative time in annual prairie dog population cycles. Mapping completed during other times of the year is often highly variable due to migration of individuals and large population variations during the breeding season. Annual mapping provides information that can inform conservation planning and evaluation as well as tracking die-offs due to plague or other factors.

In addition to die-offs detected through annual mapping, city staff follow up on all reports (from staff or the community) of sick or dead prairie dogs or sudden population declines to look for evidence of plague. City staff members work with other biologists and health departments at the County and State levels to stay up to date on reporting, outbreaks, and new developments in plague management. All issues related to plague and human health are coordinated with the Boulder County Public Health Department.

E. What are other local land management agencies doing?

During the development of this Plague Management Plan, city staff developed a questionnaire to better understand how our land management neighbors, and other land management agencies manage for plague in prairie dog colonies. The questionnaire was completed by staff of six agencies including Boulder County Parks and Open Space, Jefferson County Open Space, City & County of Broomfield, Colorado Parks and Wildlife (CPW), U.S. Fish & Wildlife Service (USFWS) and Colorado Front Range National Wildlife Refuge Complex. The questions focused on prairie dog colony management objectives, plans, plague management tools used, and experiences with plague on their property. In summary, the State and Federal land management agencies that manage the most prairie dog occupied land, use a chemical tool in the form of Delta Dust, and SPV in the context of Black-footed ferret reintroduction and conservation. USFWS also uses Fipronil-coated grain. These agencies have plague management plans in the context of their black-footed ferret reintroduction programs, but do not use proactive or reactive plague mitigation inputs for the sole purpose of conservation of black-tailed prairie dogs. In other words, these agencies do not use proactive plague mitigation inputs on prairie dog colonies unless the area land management objective includes reintroduction of black-footed ferrets.

Some of our local neighboring land management agencies (Broomfield and Boulder County) are also treating some prairie dog colonies with Delta Dust and/or SPV. Boulder County uses proactive plague mitigation for prairie dog conservation, and/or the maintenance of habitat associated with the presence of prairie dogs. The County has committed to work toward black-footed ferret reintroduction and uses SPV on certain properties, sometimes in conjunction with Delta Dust, and sometimes not. Broomfield is the only other land management agency that completed the survey and uses proactive plague mitigation for prairie dog and associated species conservation with no intent of building populations for black-footed ferret re-introduction. Broomfield use Delta Dust annually on a single site.

F. Coordination of public health related response to plague

Boulder County Public Health (BCPH) provides guidance and services for assessing and mitigating human health risks associated with plague. When prairie dog colony die-off is observed and plague is suspected, it is reported to BCPH for an evaluation and assessment. The city cooperates with BCPH in obtaining samples for epidemiological evaluation. If plague is confirmed, BCPH Division of Environmental Health

determines the appropriate actions to provide for human safety and provides guidance on how to best mitigate human health risks. In most cases, public notices will be posted according to the Colorado Department of Public Health and Environment's guidelines. In some cases, the area will be dusted with insecticide to kill fleas in prairie dog burrows (e.g. heavily used area directly adjacent to neighborhood or office building).

III. Description of Plague Intervention Areas and Approach

The City of Boulder seeks conservation opportunities for prairie dogs on a spectrum of environments from urban to natural areas and high-quality mixed grass prairie. In some areas where the land has been identified for development, prairie dogs are protected until development commences. In other areas, prairie dogs are part of the fundamental vision of the property in establishing and maintaining ecosystem function. This distinction is being used to identify areas where plague interventions are being considered.

A. Identification of colonies appropriate for plague mitigation

Although an important species in native short and mixed grass prairies, prairie dogs are often considered a nuisance in the built/urban and agricultural environments. Due to the landscape alteration and dispersal activities of prairie dogs and a reduced number of predators, prairie dogs are often in conflict with urban, agricultural, and recreational land uses. Prairie dogs can cause costly damage to agricultural crops, landscaping, and recreational infrastructure.

Prairie dog colonies are not static. As colonies grow, individual animals disperse to other sites and establish new colonies. Prairie dogs will readily move from one site to adjacent properties and forage on lawns, established landscaping or irrigated or dryland agricultural or grazing areas. Sites within Boulder that are currently unoccupied by prairie dogs may be occupied in the future.

Outside of OSMP colonies, prairie dogs occur within the city primarily in a few natural areas or on small, urban, fragmented parcels. Vegetation on urban sites is generally non-native and plant diversity is low. Furthermore, because the colonies are bounded by either unsuitable habitat or no habitat at all (roads), coterries (family groups) are restricted to their current locations for extended periods of time. In these more urban areas their ecosystem is extremely modified and simplified. In addition to causing damage, prairie dogs can be a safety hazard. Many of the prairie dog colonies within Boulder city limits are in transportation rights-of-way. As the colonies expand, they sometimes disperse across roads causing potential hazards to themselves and motorists.

The non-OSMP natural area colonies are primarily on land that is pending near or future development or is land between OSMP and existing parks and active recreation amenities. The size of these non-OSMP natural areas varies as does the mix of native and non-native vegetation and the management designations. Depending upon the size of and the existing and future objectives for the site, they may be minimally managed or actively managed for ecological function. Some sites are managed as native habitats where prairie dogs are part of the conservation target. Others are managed with the intention of coexistence; essentially having prairie dog colonies while attempting to mitigate conflict with contiguous uses. Continual monitoring, barrier installation and maintenance, and passive relocation are often utilized to minimize dispersal into incompatible areas such as ball fields.

Across all city land types, proactive plague mitigation is only being considered in areas where prairie dogs are part of the conservation target for the property and there are no conflicts with current or planned land uses. Colonies in more developed (urban) areas, in conflict with other land uses, or in areas identified for future development will not receive proactive plague interventions unless regional or local population plummets are identified.

Guidelines for plague mitigation on City of Boulder managed properties has been divided into three categories: Open Space and Mountain Parks (OSMP) sites; Boulder Parks and Recreation (BPR) Conservation Sites; and Urban and Other Conflict Sites.

B. Description of plague mitigation area categories

Plague intervention is being considered in the categories of Open Space and Mountain Parks (OSMP) sites, and Boulder Parks and Recreation (BPR) Conservation Sites. Proactive plague interventions will not be considered in colonies in the category of Urban Sites & Other Conflict Sites unless prairie dog populations on city land have dropped below 250 acres, and statewide populations are no longer in a secure state (as defined by CPW). A further description of population thresholds can be found in the *Plague Management Framework* section of this plan. Plague intervention category descriptions are as follows:

- *OSMP sites*
The OSMP department has established goals and conservation targets for prairie dog colonies through the development of the city's Grassland Ecosystem Management Plan. Proactive plague intervention was evaluated accordingly (see below). Proactive plague intervention would be considered on some but not all sites.
- *BPR Conservation Sites*
This category includes BPR natural areas where prairie dogs and their associated species have been identified as a part of a conservation target in an existing plan, policy or management designation. BPR natural areas have conflicts or potential conflicts of varying degrees with neighboring parcels or other land use designations. Plague intervention at these sites will require additional evaluation.
- *Urban Sites, and Other Conflict Sites (no anticipated proactive intervention)*
This category includes all colonies not listed in the previous two categories, and includes all colonies described in the Urban Wildlife Management Plan and other colonies that are small, and/or adjacent to land uses or infrastructure that is not compatible with the presence of prairie dogs.

C. Approach for mitigating plague

A management approach that is focused on preventing catastrophic decline in prairie dog populations allows for a higher risk threshold than managing land to sustain black-footed ferrets. In attempting to prevent catastrophic population collapse, land managers are willing to accept mortality rates that may be substantial, but do not reach levels that jeopardize long-term presence on the landscape. In fact, during time periods of lower population levels, vegetation communities and soils have an opportunity to recover from long-term grazing pressure by prairie dogs to ensure resilient habitats that can support prairie dogs and other species reliant on more robust vegetation in the future. For this approach, having some areas protected with vaccine could help maintain a level of occupancy which supports repopulation of areas that experienced high rates of mortality while also allowing population cycles and

periods of rest for portions of the grasslands to occur. This could provide for population recovery in a shorter timeframe than would have occurred without some level of plague mitigation.

The city land system has been divided into geographical groups of north and south and proactive plague mitigation may occur across those two areas. Whenever possible, planning where plague management will occur will consider spatial distribution of treatment to ensure that following plague, source populations would be located across the landscape.

OSMP is the primary department within the city managing for prairie dogs in non-urban/conflict sites. Therefore, OSMP data and decision-making is used as the foundation for a city-wide approach to mitigating plague. The thresholds described below were developed in the OSMP departmental Grassland Ecosystem Management Plan and are being used to define the population thresholds on all city lands.

1. Plague management thresholds

Based on OSMP Grassland Ecosystem Management Plan (GMAP) conservation goals (see Appendix B), plague management should be focused on meeting the targeted conservation goals of a minimum of 800 acres of prairie dogs across the OSMP system, and at least 10% occupancy in each of the three Grassland Preserves. If OSMP is successful in meeting these goals, then it will be within the “good” range for conservation of prairie dogs on OSMP. Spatial arrangement and location of prairie dogs is important, and OSMP would strive to have the 800 acres of prairie dogs protected within land management designations that are conducive to prairie dog conservation (Grassland Preserves, Multiple Objective Areas and Prairie Dog Conservation Areas). Because relocation provides a valuable tool that allows the city to move prairie dogs around the landscape, the location of the 800 acres is not specifically addressed in the plague management framework as it can be modified if needed through relocation of prairie dogs. Because OSMP manages most prairie dogs on city lands, these conservation goals are seen as appropriate for the broader city land system as well, including Parks and Recreation and other lands.

Although 800 acres and 10% of Grassland Preserves defines the goal for a condition as defined in the Grassland Plan as “good” in terms of prairie dog conservation, it is necessary to further define what conditions might warrant additional measures be implemented to meet the more basic goal of continued presence of prairie dogs on city lands, and conditions that can lead to meeting conservation goals long-term. Two factors can influence the definition of this threshold: the status of prairie dog occupancy on city lands, and the status of prairie dog occupancy in the broader landscape- statewide. If city-wide prairie dog populations are very low, but broader landscape occupancy on non-city lands is high, then prairie dogs can be moved onto the city land system from conflict areas elsewhere to repopulate following a plague die-off. However, if landscape level prairie dog occupancy is low, and city prairie dog occupancy is low, then recovery of populations within a reasonable timeframe is not certain and additional efforts may be warranted to preserve the prairie dogs that are still present on city lands. Because the Grassland Plan does not define what “fair” or “poor” viability for prairie dog occupancy is for OSMP, staff defined these thresholds here for the purposes of plague management.

Staff evaluated the conditions present in past plague epizootics to determine what level of occupancy resulted in sustained growth of populations, repopulations of vacant colonies, and a return to sufficient prairie dog occupancy to meet OSMP goals as defined in the GMAP. This was used to determine the lower end of “fair” and upper end of “poor”. In 1996, OSMP properties contained 182 acres of prairie

dogs following a substantial plague epizootic in 1994-1995. Following this low-level occupation, occupation recovered to 885 acres within 2 years (by 1998), thus meeting OSMP goals for “good” viability of system-wide prairie dog occupancy in a very short amount of time (even though the department owned less land in 1998 than in 2010 when the 800 acre goal was set). As a result, staff defined this level as an appropriate threshold from which we believe that prairie dogs could recover without efforts to bring prairie dogs from elsewhere. However, below this level, staff is unsure that recovery would be certain and thus prairie dogs would need to be brought in from non-OSMP lands to repopulate areas. Since OSMP has acquired substantial lands since 1996, this threshold of 182 acres was scaled based on acquisitions since 1996 to represent an analogous number of acres based on our larger land system in 2021. As a result, the staff determined threshold between “fair” and “poor” is 250 acres. As a result, “fair” for prairie dog conservation is 250-800 acres and “poor” is less than 250 acres of prairie dog occupancy. Poor is the threshold at which staff believe additional action may be needed to prevent a situation where we cannot meet our conservation goals for prairie dogs long term. Based on the very quick recovery in 1996 from this level of occupation and the addition of acres to account for additional prairie dog occupied lands acquired since 1996, staff believes this is a conservative threshold with sufficient buffer to ensure recovery in a reasonable timeframe of prairie dogs following plague even with uncertainty of how quickly and where plague would cause declines in prairie dog populations on city lands.

Finally, thresholds for landscape level prairie dog occupancy were determined. Because prairie dog mapping is not commonly available beyond city and other public land management agencies, staff looked to statewide prairie dog goals and objectives for broader prairie dog occupancy. Plague die-offs during epizootics have tended to occur at more localized scales, not at the scale of entire states. As a result, statewide populations are not expected to follow the same patterns seen at the scale of city lands. Prairie dog populations are defined to be “secure” if mapping indicates more than 350,000 acres of black-tailed prairie dogs are present statewide. These thresholds were established as part of a multi-state prairie dog conservation planning effort and scaled down to the state level by looking at occupancy levels on historic and current suitable habitat across the state (Colorado Division of Wildlife 2003)^{xii}. This level of prairie dog occupation suggests that prairie dogs will exist in many areas of the state in conflict with local land use, and thus be available for relocation to available city receiving sites. In addition, at this level of occupation, the State’s plague management plans do not include use of plague management for the purposes of prairie dog conservation (since populations are “secure”), except in circumstances where prairie dog colonies support endangered black-footed ferrets. Below this threshold, statewide populations are not secure and the opportunity to receive prairie dogs through relocation from outside city lands is reduced. This situation would suggest that protection of the existing prairie dogs on city lands is of crucial importance to maintain populations capable of repopulating areas no longer active on city lands following a plague epizootic.

2. Plague management framework

Due to constantly changing conditions in prairie dog occupancy, appropriate proactive plague management will be determined each year based on up-to-date mapping and on-the ground conditions. Plague management plans for the following year will be communicated to the public each year at the annual prairie dog management update meeting (typically held in early Dec.). Determination of which tools and where in any given year will be made according to the attached flow chart, and as described below. Basic assumptions built into the decision-making framework include:

- The goal of plague management is to meet thresholds for “good” prairie dog occupancy as defined in the Grassland Plan (2010) which includes:
 - o A minimum of 800 acres occupation system-wide on OSMP properties; and
 - o At least 10% occupancy in each Grassland Preserve.
- Plague management should avoid increasing conflict between prairie dogs and other land uses on colonies not designated for prairie dog conservation (transition and removal areas, adjacent private properties, etc).
- Exceptions could occur if minimum thresholds are not met to ensure ongoing conservation of prairie dogs is possible.

3. Plague management strategy

To maintain populations on city properties during a plague epizootic, plague management needs to be completed annually in a prophylactic manner since detection and response to an epizootic is often not sufficiently quick to stop high levels of mortality.

Sylvatic Plague Vaccine (SPV) will be the primary management tool for prophylactic plague management (based on guidance from City of Boulder IPM management plans and policies to minimize use of pesticide on city properties, and a concern for non-target impacts of insecticides on other organisms within OSMP grasslands).

Populations below 250 acres represents a level where recovery or conservation of prairie dog populations on city lands without importing animals (through relocation) becomes uncertain. Across the state, many prairie dogs are in conflict with human land uses and could serve to repopulate areas on city lands. State goals for prairie dog conservation are sufficiently conservative that if populations are “secure” as defined by the State’s Grassland Species Conservation Plan, prairie dogs will be available for relocation to repopulate city lands. However, if populations drop below 250 acres and statewide populations are no longer in a secure state (as defined by CPW), ability to conserve any level of prairie dog occupancy on city lands becomes uncertain and all available tools should be considered for use in protecting remaining populations.

Plague management will be adapted each year due to high levels of change in key components of decision factors for the plague management framework. City staff will be implementing this strategy including evaluations, and decision making. These decision-making considerations include:

- Conditions of prairie dog occupancy are dynamic and occupancy will need to be evaluated annually to inform plans for plague management each year.
- Statewide conditions of prairie dog occupancy are evaluated on a ~10 year cycle, so data or anecdotal information from state wildlife managers will be used to evaluate if conditions have substantially changed on a statewide basis in years that new mapping data is not available.
- Plague management tools are evolving and new ones being investigated. As new technology becomes available or additional data on existing tools is collected, staff will incorporate this new information to plague management planning each year.

4. Summary of plague management strategy (based on decision tree below)

- Minimum acceptable population to support growth and recovery is 250 acres – therefore, proactive plague treatment (SPV) will be ongoing on 250 acres every year, regardless of system-

wide occupancy levels. This will reduce risk that occupancy doesn't drop below this threshold in the event of a system-wide plague event. These acres will typically occur in OSMP Grassland Preserves in areas of low conflict and high habitat suitability, or on colonies that are being prepared for relocation out of a conflict area. Sites may include Non-OSMP Conservation Sites.

- Within individual Grassland Preserves, the management goal is 10% occupancy, so all occupied acres (up to 250 acres) will be treated within an individual Grassland Preserve with SPV if occupancy is below 10%. If more than one Grassland Preserve is below 10% occupancy, then the 250-acre treatment area will be split among the Grassland Preserves that are below target.
- If annual treatment of 250 acres is focused in one area of the city land system (for example the southern grasslands) in a given year, additional OSMP or BPR Conservation Sites may be considered for treatment in the other portion of the city-wide system (for example the northern sites) to maintain spatial diversity of proactive plague management activities. Once 10% occupancy is reached, revert to system-wide application of 250 acres primarily in Grassland Preserves and relocation colonies, but may also include Non-OSMP Conservation Sites.
- If plague drops populations below 250 acres across city lands SPV will be considered on all active acres regardless of management designation.
 - o If populations statewide are secure (according to CPW definition), then animals will be available elsewhere for relocation- efforts will be made to restore populations with relocation.
 - o If populations statewide are not secure (according to CPW definition), then animals may not be available elsewhere for relocation and all efforts to maintain and build populations on city lands should be pursued including securing exemptions for use of insecticidal plague treatments.

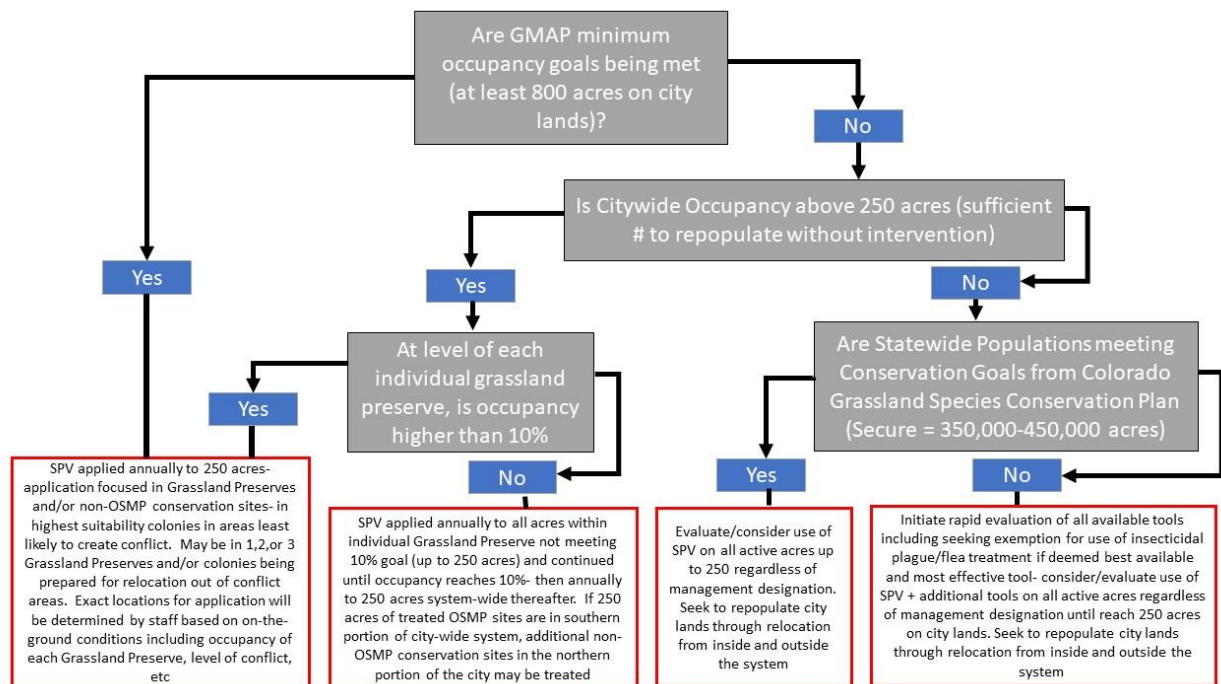


Figure 2. Plague Management strategy decision tree

Appendix A

2021 Costs Associated with Sylvatic Plague Vaccine (SPV)

SPV requires the purchase of a serum and a bait matrix to carry the serum. In 2021 the serum cost was \$880 per bottle, which treats 80 acres. The bait matrix was \$3.39 per acre.

The annual cost for treating 250 acres with SPV, two rounds per year, is \$7,905.

2021 costs were based on Colorado Parks and Wildlife producing the bait at no cost. If in the future there were manufacturing or production costs associated with obtaining the baits, costs could increase substantially.

Appendix B

Black-tailed prairie dog conservation goals on OSMP

Open Space and Mountain Parks (OSMP) manages up to 154 prairie dog colonies (depending on occupancy) across the Eastern half of the OSMP land system. The occupancy of these colonies changes through time, but in 2020, ~4,798 acres of prairie dogs inhabited 115 colonies. These colonies exist in a variety of landscape and habitat conditions including large, intact native grassland habitats, small fragmented parcels, and areas of irrigated agriculture. As a result, conservation goals for prairie dogs and associated species were created in the Grassland Ecosystem Management Plan (2010) (GMAP) in an attempt to encourage conservation of prairie dogs on OSMP while simultaneously reducing conflict in areas where prairie dogs and other land management objectives (especially irrigated agriculture) overlap.

In the context of plague management, these conservation goals as well as objectives intended to reduce conflict, inform the goals and objectives that a plague management plan should support and provide quantitative measures of how successful we are in preserving prairie dogs and their associated species on OSMP lands. The first of these objectives is to maintain between **800-3,137** acres of active prairie dog colonies on OSMP. This number is based on levels of occupancy defined as “good” in the GMAP in areas of prairie dog conservation (Grassland Preserves, Prairie Dog Conservation Areas and Multiple Objective Areas). The second objective that provides guidance is a goal to have all three Grassland Preserves occupied by prairie dogs at a level of **10%-26%**. Both of these goals were created in the context of ecosystem conservation- focusing prairie dog conservation in areas with the least conflict with agriculture or other competing land uses, and supporting conservation goals for communities and species that do not tolerate prairie dog occupancy (e.g. xeric tallgrass prairie). As a result, they provide a good foundation for plague management as a tool for maintaining healthy prairie ecosystems

Appendix C

Plague Management Plan Summary of Engagement Window Events May 2021 – Jan. 2022

The purpose of the Plague Management Plan engagement window is to connect with stakeholders about how the city manages for plague to support grassland ecosystems and meet citywide prairie dog conservation and management goals. The engagement window has two phases. Phase one, that occurred from May - Aug. 2021 focused on getting feedback on preliminary elements of the plan that would guide the draft: plan goals, objectives, criteria, and outline. Phase two, that is occurring from Dec. 2021- Jan. 2022, will focus on getting feedback on the draft plan.

The project's staff team targeted community members and organizations that expressed an interest in how the city manages prairie dogs, wildlife, ecological systems and natural areas, or pesticide use and provided email contact information. An email list was created that included the City of Boulder Wildlife list serve (263 community members and local organizations) and the Open Space and Mountain Parks stakeholder list which included community members that specifically identified prairie dog management as an interest (107 community members and local organizations).

Engagement objectives included:

- Provide information on how we manage for plague now, and the broad range of considerations and issues associated with plague management (limiting pesticide applications, multiple objectives of grassland management),
- Learn what is of most interest to stakeholders so we can include it in the plan, and
- Get stakeholder feedback on preliminary elements of the plan that will guide the draft: Plan Goals, Objectives, Criteria, Outline, and again when the plan is drafted.

Phase One of the project engagement window (May through mid-August 2021) included two major products:

- In May the Plague Management Plan [project page](#) was launched, and included an four minute [informational video](#) describing the purpose of the plan, and how community members could participate.
- On June 21, 2021 a virtual community meeting was held to kick-off the development of the first City of Boulder Plague Management Plan by getting feedback on the [framework of the plan](#). It was also an opportunity to provide information to interested community members on how the City manages for plague now, and the broad range of considerations and issues associated with plague management. There were nine attendees at the meeting. The [community meeting was recorded](#), and an email sent to stakeholders to watch if they were unable to attend. At the meeting, [15 comments and suggestions](#) were received, posted on the project page, and helped staff draft the plan.

Phase Two of the project engagement window (Dec. 2021 through Jan. 2022) included soliciting feedback on the draft plan:

- Stakeholder email list was notified the draft plan was available for review. The draft included information on how the comments provided in phase one were considered (**Attachment A**), and how to provide comments on the draft plan.

- Stakeholder email list will be notified when the final plan is available. Final plan release will include information on how the comments provided in phase two were considered.

Plague Management Plan Public Meeting Attendee Feedback and Responses

On June 21, 2021 the City of Boulder Planning & Development Services hosted a virtual public meeting to connect with stakeholders about how the city manages for plague to support grassland ecosystems and meet citywide prairie dog conservation and management goals.

The purpose of this meeting was to kick-off the development of the first City of Boulder Plague Management Plan by getting feedback on the framework of the plan. It was also an opportunity to provide information to interested community members on how the City manages for plague now, and the broad range of considerations and issues associated with plague management, and for city staff to learn what is of most interest to stakeholders.

Feedback on [preliminary elements of the plan](#) were discussed at the meeting and captured in this document. There were nine (non-city staff) attendees at the meeting. Attendees included four people affiliated with government agencies, and five community members. Feedback is organized in response to four questions that were provided during the meeting.

Four questions asked at the June 21 virtual meeting, feedback and comments received, and responses to how feedback was incorporated or considered

Questions #1. Do you have ideas about Plague Management Plan (PMP) goals or objectives that are not included, or do you feel that there is something that should be removed?

Comment/feedback and response

1. In the objectives of the plan, consider the future of reintroduction of black-footed ferrets on City lands at some level. Consider opening the objectives of the Plague Management Plan to include reintroduction of black-footed ferrets.

Response- The Plague Management Plan is being developed considering current city objectives and commitments. If the city commits to black-footed ferret reintroduction, plague management would be evaluated and adjusted if need be, to support that objective.

Question #2. Do you have suggested changes to the outline/overall framework of the plan?

Comment/feedback and response

1. Would like to see consideration for opening up plague management plan to update as needed so don't need to wait for needed updates.

Response- The plague management plan provides the framework for decision making around plague management. City staff are continually working with and meeting with state and federal agencies to evaluate plague management tools, and benefits. Change in the type of vaccine for example would not require a plan change. However, in section II.C.2., Consideration of insecticides for sylvatic plague management the plan describes the process for evaluating new chemical tools. It is important to note, before any new use of an insecticide product would be considered, the decision would first have to be made that insecticide application is appropriate

for plague management. The plan provides the decision framework for evaluating that based on conditions at that time.

2. Look at ferret management sooner than later- move forward.

Response- Black-footed ferret reintroduction is an important consideration in grassland system management. The timing and decision-making process has not been identified at this time. Current conditions would not support black-footed ferret reintroduction, so evaluation of the reintroduction would be done for an undetermined future date when conditions could allow a reintroduction.

3. Extend framework geographically so it is not limited to city lands- action/implementation would be on City, but should be done in conjunction with adjacent landowners.

Response- staff work with frequently with other land management agencies to share plans, and information related to prairie dog conservation and plague management. We have summarized some of the plague management work of those agencies that impact the larger landscape. Because neighboring land management agencies operate based on different sets of priorities, their decision-making around plague management often looks different than the City's. As a result, the scope of the plan is focused (as are most all plans of this type) on the lands for which the city can direct what action will or will not be taken based on the priorities of the Boulder community. Staff will continue to collaborate with neighboring land management agencies and coordinate management where our conservation and management goals align.

4. Include cost analysis of treatments (per acre).

Response- Costs per acre are \$11-12 for Sylvatic Plague Vaccine (SPV) serum (one bottle costs \$880 and treats 80 acres; can't get partial bottle) and \$3.39 for bait matrix. CPW manufactures baits and does not charge for labor. These costs don't reflect staff time for distribution.

5. Include cost benefit analysis of Deltamethrin from a biodiversity standpoint- what is on our systems?

Response- The city's process is outlined in the IPM policy and associated guidance documents that focus on ecosystem management and ecological risk assessment using a precautionary approach for pesticide use. A cost-benefit analysis is typically not used for environmental issues where the impacts from intervention/disturbance to individual species or interactions at an ecosystem level are not understood and there is incomplete data to establish the unknown costs to non-target species.

6. Need additional information on plague management for prairie dog conservation (not just keep some prairie dogs on the system)- look at level of protection for prairie dogs and evaluate if it is sufficient to keep associated species on landscape.

Response- On OSMP lands, conservation goals and targets were established in the Grassland Ecosystem Management Plan. The target that includes prairie dogs is the Black-tailed prairie dog and associated species. This conservation target includes species associated with prairie dogs. Conservation goals and thresholds were developed to ensure that prairie dogs and associated species could be conserved on city lands. Although the plague management plan focuses on

prairie dog specific goals and thresholds, the Grassland Plan includes similar goals and thresholds for associated species. The Grassland Plan is available here: <https://bouldercolorado.gov/media/2430/download?inline>

7. Look at providing cost share or other funding sources for private landowners to participate in plague mitigation.

Response- Currently, city staff does not have resources to explore funding sources for private landowners to participate in plague mitigation, however staff continues to be a source of information about plague and plague mitigation for community members.

8. Collaborate with adjacent/neighboring land management agencies. Identify key colonies that can be conserved together (with partners such as Jefferson County and Boulder County).
Response- Collaboration with our neighboring land management agency is an important aspect of conservation on City lands and ongoing collaboration is a priority. City staff have been collaborating with Boulder County, Jefferson County and US Fish and Wildlife Service regarding grassland habitats south of Boulder. Current efforts include applying for a collaborative grant with these agencies and the Humane Society of the United States to obtain funding for prairie dog conservation and grassland restoration activities in these areas. This group of land managers have collaborated around each agency's goals for prairie dog conservation on their properties and have an overall picture of prairie dog conservation over a complex of colonies that span a variety of land ownership.

Question #3. Do you have any specific concerns related to plague management that you want to be sure staff consider as they put together the draft plan?

Comment/feedback and response

1. Plague management is currently not adequate in Southern Grasslands, more is needed to establish viable, sustainable populations. Populations are not sufficient in S. Grasslands in to support ferrets- need to manage plague to support them.
Response- The plague management plan is focused on meeting current conservation goals as determined in the OSMP Grassland Ecosystem Management Plan. If the city determined in the future that black-footed ferret reintroduction is something we are committed to, then actions associated with supporting that goal would be determined. Plague management to be utilized is being evaluated in the plague management plan and strategies most likely to support conservation of black-tailed prairie dogs within the context of other city priorities and conservation goals will be included.
2. It takes a while to build-up adequate prairie dog populations for black footed ferrets, to support black-footed ferrets and the discussion of re-introduction.
Response- Agreed. Current relocations and plague management are intended to support population expansion at Southern Grasslands. If the city determined in the future that black-footed ferret reintroduction is something we are committed to, then actions necessary to support that goal would be determined.
3. We don't understand what is going on with plague in south- continuous cycles of plague even without full plague tool use- need to understand before we write a management plan.

Response- Plague dynamics on city properties and elsewhere are highly unpredictable. How to obtain the type of information and understanding you are suggesting is not known. Long-term, comprehensive studies of plague on City property by plague researchers have not provided information that has allowed us to understand plague dynamics as you suggest. As a result, waiting for a full understanding of plague to write the management plan is not an option. If understanding of plague progresses and indicates a need to change approaches, then adaptive management is built into the plan to allow us to evaluate and respond to new developments or information.

4. Be sure to include cost.

Response- Per acre costs will be included in the plan. Yearly community updates on plague management will include cost estimates for coming years, and actual costs for work completed.

Question #4. Are there experts in a relevant field or sources of information you want to be sure staff reaches out to or has access to as they put together the draft plan?

Comment/feedback and response

9. Dan Tripp recent research, and a good person to work with.

Response-Thank you! Dan Tripp has been incredibly helpful and an amazing resource for the development of this plan providing reports, publications, and phone conversations answering questions.

10. Talking with and working with adjacent land managers and partners is key. Include on a map, who the adjacent land managers are, and what they are doing for plague management so that we can be congruent with our neighbors. Include conflict areas so plague management can be viewed on a landscape level. Specifically, our neighbors in Southern Grasslands (Fish and Wildlife Service, Jefferson County, Boulder County, City of Boulder, and a private landowner). Having the designations on a map is the simplest way to do it.

Response- Our adjacent landowners were specifically reached out to and asked questions about their plague mitigation practices and experiences as part of this plan. A map would be a great visual tool, but time and resources allotted for this plan does not allow us to gather and provide.

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