

chapter 4



ENVIRONMENTAL CONSEQUENCES

Chapter 4. Environmental Consequences

4.1. INTRODUCTION

This chapter provides an analysis of the potential effects on environmental resources associated with the implementation of each of the four management alternatives for the Refuge. Potential impacts were identified for each alternative based on a review of relevant scientific literature, previously prepared environmental documents for Rocky Flats, and the best professional judgment of Service staff and other resource specialists.

This chapter is organized by resource, and provides an analytical comparison of the alternatives. Many of the potential management actions and resource impacts are similar between the alternatives, but the discussion differentiates impacts where applicable. Resource impacts are discussed according to the management goals and the appropriate types of actions or activities associated with those goals. For example, the discussion of impacts to vegetation associated with Goal 1 – Wildlife and Habitat Management includes the potential effects associated with Preble’s Habitat Management, Xeric Tallgrass Management, Mixed Grassland Prairie Management, and other management actions. Not all goals, objectives, and accompanying management actions are applicable to each resource; therefore, only those that are relevant for a particular resource are described.

Discussions are organized consistent with the goals, objectives, and strategies described in Chapter 2. General topic areas include:

- Wildlife and Habitat Management (Goal 1)
- Public Use, Education, and Interpretation (Goal 2)
- Refuge Operations, Safety, and Partnerships (Goals 3 to 6)

A summary of the impacts discussed is provided at the end of Chapter 4 in *Table 20 - Summary of Environmental Consequences*.

The Refuge Act (Appendix A) directs the Service to consider “the characteristics and configuration of any perimeter fencing that may be appropriate or compatible for cleanup and closure purposes, refuge purposes, or other purposes.” Fencing options and their impacts are discussed in Section 4.15 - *Fencing Considerations*. An



The potential effects of management activities on wildlife and habitat are analyzed for each alternative.

assessment of how the proposed alternatives conform with the Refuge goals is included in Section 4.16 - *Adherence to Planning Goals*.

METHODS

The determination of effects is evaluated at several levels, including whether the effects are adverse or beneficial, and whether the effects are direct, indirect, or cumulative with other independent actions. The duration of effects also is used in the evaluation of environmental consequences.

Direct effects are those where the impact on the resource is immediate and is a direct result of a specific action or activity. Examples of a direct effect include the effect of trail construction on vegetation along the trail or the effect of hunting on wildlife.

Indirect, or secondary, effects are those that are induced by implementation actions, but occur later in time or farther removed from the place of action through a series of interconnected effects. Examples of indirect effects include the downstream water quality effects from an upstream surface disturbance, or the impact that recreational use along a trail may have on nearby plant communities (through the periodic introduction of noxious weeds).

A cumulative effect is defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and

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Biological controls would be used as a weed management tool in all alternatives.

reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7). Reasonably foreseeable future actions independent of the CCP for the Refuge are described in Section 2.9.

Impacts are often described in terms of their context, intensity, and duration. *Table 10 - Impact Threshold Definition*, at the end of the chapter, defines the intensity levels (negligible, minor, moderate, and major) for each resource. The duration of effects are described as either short term or long term. Short-term effects would persist for a period of 3 to 5 years, and would consist primarily of temporary disturbance due to habitat restoration or facility construction and subsequent revegetation efforts. Long-term effects would last more than 5 years after project initiation, and may outlast the 15-year life of the CCP. Many long-term effects consist of long-term benefits to wildlife habitat resulting from habitat management actions.

4.2. GEOLOGY AND SOILS

Previous studies and available information on geologic and soil resources at Rocky Flats were used to identify potential effects from alternative actions. Potential effects were qualitatively and quantitatively evaluated based on the types and amount of land-disturbing activities for each alternative. Impacts to geologic resources are not discussed because none of the alternatives would affect geologic features or resources. Actions of concern for soils include those likely to generate erosion and reduce soil productivity or actions that promote soil stability and reduce soil loss.

WILDLIFE AND HABITAT MANAGEMENT ACTIONS

Xeric Tallgrass Management

Alternatives A, B, and C include prescribed fire as a management tool for maintaining xeric tallgrass habitat and controlling weeds. In addition, Alternatives B and C would allow livestock grazing. When used as habitat restoration tools, both prescribed fire and grazing would temporarily reduce vegetation cover. The use of these restoration tools has the potential to result in localized, minor, erosion and soil loss over the short term; however, these restoration

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Grazing and prescribed fire would be used in Alternatives A, B, and C to restore and maintain xeric tallgrass grasslands.

tools usually stimulate new plant growth and increase the vigor of existing plant communities, reducing long-term soil loss. Alternative D does not include prescribed fire or grazing and would not have the potential impact on soil resources associated with the use of these restoration tools. A potential minor effect on soil erosion from prescribed fire in Alternative A would be limited to the Rock Creek Reserve.

Mixed Prairie Grasslands Management

Restoration of 300 acres of non-native grassland in Alternatives B and C may result in a short-term minor disturbance of soil resources during site preparation and planting. Following establishment of native grasses, soil protection and productivity would be maintained long term. There would be no effect to soil resources if non-native vegetation is not restored under Alternatives A and D.

Road Restoration and Revegetation

Excluding the area retained by DOE, the Refuge currently has 56.5 miles of paved, graded, or two-track roads and numerous road stream crossings. The length of roads and number of stream crossings that would be removed and revegetated in each alternative are:

- Alternative A – 11.9 miles; 7 stream crossings
- Alternative B – 24.7 miles; 13 stream crossings
- Alternative C – 28.9 miles; 13 stream crossings
- Alternative D – 25.3 miles; 6 stream crossings

Road restoration efforts would include ripping, grading, or other methods to remove the existing roadbed and prepare the area for planting. Although restoration would be confined primarily to the existing disturbed road prism, soils adjacent to the road may be disturbed resulting in minor, short-term soil disturbance and erosion. However, successful revegetation and planned use of erosion control measures, such as mulching and water bars to control water flows, would minimize impacts. The greatest potential for soil erosion from roads would occur in Alternative A, which limits road restoration to the Rock Creek portion of the Refuge. Thus, a number of the existing roads would remain in place but would not be maintained, resulting in moderate long-term soil erosion. A long-term moderate benefit to soil resources would occur for Alternative A in the Rock Creek Reserve and Alternatives B, C and D Refuge-wide by stabilizing and revegetating roads that would no longer be needed.

Prairie Dog Management

Prairie dog communities are dynamic and vegetation and surface conditions often vary from year to year. Additionally, the enhanced nutrient cycling from prairie dog activities can stimulate plant growth and can contribute to soil stability. However, limited soil surface erosion may occur in each of the alternatives from the potential expansion of prairie dog populations. Through grazing, prairie dogs often denude vegetation to allow better visibility of surrounding burrows; therefore, the amount of bare soil is typically greater than surrounding lands. Exposed soils are more prone to wind and water erosion.

Alternative A would have the greatest potential for direct soil impacts with unlimited expansion of prairie dog populations, followed by Alternative D with 1,000 acres, Alternative B with 750 acres, and Alternative C with 500 acres. The loss of soil resources for Alternatives B, C, and D would be minor and would not adversely affect soil productivity. Soil loss from unlimited expansion of prairie dog populations in Alternative A would range from minor to moderate, depending on the size and distribution of the colonies.



Wildflowers such as blue flax are found in Refuge grasslands.

PUBLIC USE, EDUCATION, AND INTERPRETATION ACTIONS

Public Use Facilities

New Trails. For Alternatives B and D, the construction of new trails would result in localized soil disturbance, including erosion and reduced soil productivity. Alternative B has 1.7 miles of new trail, while Alternative D has 3.3 miles of new trail. Reduced soil productivity would be a long-term minor effect, but erosion would be minimized by revegetation efforts and the use of appropriate erosion and drainage control measures. Alternatives A and C do not include new trails and would have no effect on soil resources.

Trails Converted from Existing Roads. In Alternatives B, C, and D, the conversion of existing roads to trails (14.5 miles in B, 0.6 mile in C, and 15.2 miles in D) would result in minor localized soil disturbance and erosion during construction. However, these trails would be constructed within the existing disturbed roadway and the total amount of exposed soil would be less than current conditions following conversion from a roadway to a trail and revegetation bordering the trail. The short-term construction-related impacts to soils would be reduced by implementing trail design features such as water bars and tread resurfacing, resulting in negligible long-term effects.

The multi-use switchback trail proposed for the upper Woman Creek drainage in Alternatives B and D would replace the existing steep road grade. Construction of this trail and planned restoration of the existing road would have a long-term beneficial effect to soil resources by reducing erosion.

Trail Use. Alternatives B and D would allow hiking, as well as bicycle and limited equestrian use along multi-use trails. Trail use by hikers, bikers and equestrians typically results in soil compaction and erosion (Seney 1991; Dehring 1998). Several studies indicate that while all trail users cause soil impacts, they can be more pronounced by equestrian use (Dehring 1998; DeLuca et al. 1998; Cole and Spildie 1998). Some studies indicate that the erosional impacts of bicycles can be less than either equestrians or hikers (Weir 2000; Seney 1991).

A majority of the multi-use trails in Alternatives B and D would be located on flat, dry areas that are less susceptible to the erosional impacts of public use. In addition, the trails would be located along existing stabilized roadways. Regardless of user type, impacts to soil resources are expected to be negligible to minor over the long term with planned trail design, erosion control measures and revegetation of areas adjacent to trails. Off-trail pedestrian use would be limited to select locations; the development of social trails would be managed through signage, fencing, seasonal restrictions, and other visitor management techniques.

No formal trails would be developed in Alternative A and the impacts to soils from occasional guided tours would be negligible. Alternative C would likewise have negligible impacts to soils from a single short trail along an existing road.

Visitor Use Facilities. In Alternatives B and D, the construction of a visitor contact station, parking facilities, and overlooks would require soil excavation, grading, and other surface disturbances. Temporary

increases in soil erosion would occur in these areas, resulting in direct, short-term impacts to soils. The anticipated extent of soil disturbance due to facility development in Alternatives B and D is:

- Alternative B – 1.0 acre
- Alternative D – 1.4 acres

A long-term loss in soil productivity may occur from construction of visitor-related structures. The impacts of these activities on soils for all action alternatives would be negligible considering the small area of the Refuge that would be affected. Soil disturbance in Alternatives A and C would be minimal because the only facility would be a portable restroom.

REFUGE OPERATIONS

Each alternative would include the construction of maintenance facilities to support Refuge operations. There would be a long-term negligible loss in soil productivity for construction of these facilities and possible short-term erosion during construction. New surface disturbances would be minimized by locating these facilities in areas of existing disturbance. Estimated areas potentially affected by facility construction for each alternative are:

- Alternative A – 0.13 acre
- Alternative B – 0.24 acre
- Alternative C – 0.17 acre
- Alternative D – 0.25 acre

CUMULATIVE IMPACTS

Mining

Potential future gravel mining along the western edge of the Refuge may lead to erosion and windblown soil deposition from the construction and operation of surface mines and access roads. Impacts to soils resulting from any of the Refuge management alternatives would not contribute substantially to the cumulative impacts from mining.

Transportation Right of Way

Development of a transportation corridor on the eastern edge of the Refuge would potentially result in the loss of soil productivity within the 50- to 300-foot wide right of way for the 3 miles that the corridor borders the Refuge. Loss of soil productivity from transportation development would be substantially greater than the minor surface disturbance on the Refuge. Refuge contributions to the cumulative impact on soil resources would be minor.

4.3. WATER RESOURCES

Potential effects to water resources were evaluated based on existing information on the distribution and quality of water at the Refuge and the potential for Refuge activities to affect water resources. Water resource impacts from Refuge activities are primarily related to potential impacts to water quality rather than changes in surface or ground water hydrology, which are expected to be minor. As described in the *Future Hydrological Conditions* section of Chapter 3, the cleanup of Rocky Flats by DOE will result in several changes to existing water resources including the removal of discharge ponds, subsurface drains, and eliminating the import of water. Because these changes would occur prior to Refuge establishment, the analysis of impact to water resources for each of the alternatives is based on post-cleanup hydrologic conditions.

WILDLIFE AND HABITAT MANAGEMENT ACTIONS

Preble's Habitat Management

Planned protection and maintenance of riparian habitat along Rock Creek, Walnut Creek, Woman Creek, and the Smart Ditch in all alternatives would provide a long-term benefit to water resources by keeping intact the vegetation buffer surrounding principal drainages on the Refuge.

Road Restoration and Revegetation

Road Removal. In all alternatives, the Service would remove and revegetate many of the existing roads and road crossings of streams. The extent and location of this restoration is greatest for Alternatives B, C, and D and is least for Alternative A, which limits restoration to the Rock Creek Reserve. Alternative A would restore seven stream crossings, Alternative D would restore six stream crossings, and Alternatives B and C would restore 13 stream crossings.

Most of the streams at the Refuge are ephemeral or intermittent and restoration activities would be conducted when the streams are dry to minimize the direct introduction of sediment. Planned revegetation and stabilization of the stream channels would reduce the potential for stream sedimentation during precipitation events. Removal of road stream crossings would have a long-term beneficial impact on water quality by removing a source of erosion and sediment delivery. Benefits would include improved natural stream flows, restored channel morphology, and improved continuity of streamside wetland and riparian habitats that benefit riparian and Preble's habitat management goals. Additional benefits from improved streamside habitat



Before and after photos of road restoration initiated by DOE in 1999.

conditions would include bank stabilization and the retention and removal of sediments and pollutants from the water. Alternatives B and C would provide the most benefit because a greater number of stream crossings would be restored than in Alternatives A and D.

Road removal and revegetation at locations outside of the stream corridor may result in minor, short-term impacts to water resources due to erosion and sedimentation during and immediately following restoration. However, these restoration activities would result in long-term benefits to water resources. Indirect benefits from road restoration include an overall improvement in downstream water quality.

In Alternative A, many of the existing roads outside of the Rock Creek Reserve would not be revegetated or

maintained. Erosion of these roads over time may contribute sediment to streams at Rocky Flats, resulting in minor to moderate adverse effects to water quality.

Lindsay Ponds. In Alternative C, the Lindsay Ponds would be removed and the stream channel restored to pre-settlement conditions. Removal of the Lindsay Ponds would result in the long-term loss of aquatic habitat, water storage, and sediment removal functions currently provided by the ponds. However, restoration of the native stream conditions would return the site back to its original condition. The Lindsay Ponds would continue to function as they currently do under Alternatives A, B, and D with no effect on water resources.

PUBLIC USE, EDUCATION AND INTERPRETATION ACTIONS

Public Use Facilities

Trail Use. The majority of trails in all alternatives would be located away from drainages and water features and only negligible effects to water quality are likely. Alternative D would include an east-west multi-use trail along Walnut Creek. The close proximity of this trail to the creek may lead to social trails and localized erosion. Impacts to water quality from trail use in Walnut Creek is expected to be negligible.

Off-trail Use. Off-trail use would be permitted in the southern portion of the Refuge in Alternatives B and D. While concentrated off-trail use is not expected, the potential for sedimentation of water bodies from off-trail use is negligible over the long term.

Visitor Use Facilities. Construction activities involved in developing parking areas, overlooks, viewing blinds, and other facilities may result in indirect, short-term impacts to water resources due to erosion and sedimentation. The extent of facility development and corresponding impacts would vary among the alternatives, with Alternative C having the least potential for impact and Alternative D having the greatest potential for impact. Considering the relatively small amount of facility development and distance from water features, the resulting impacts to water resources at Refuge would be negligible.

CUMULATIVE IMPACTS

Mining

Future mining along the western edge of the Refuge has the potential to alter surface and ground water flows in the upper Rock Creek drainage. These changes may adversely affect surface runoff in Rock Creek and ground water discharge along the pediment slopes. This

may affect riparian and Preble's habitat, establishment of a native fishery, and the type and quality of vegetation communities. Proposed management actions associated with implementation of the CCP at the Refuge would not contribute measurably to the cumulative effects on water resources from mining.

Transportation Right of Way

The transfer of Rocky Flats land to other entities for the purposes of transportation improvements may include a 50-, 125- or 300-foot right of way along the eastern edge of the Refuge. Water resources within the various right of way widths would include the following lengths of intermittent streams and ditches:

- 50-foot right of way: 705 feet
- 125-foot right of way: 2,218 feet
- 300-foot right of way: 5,133 feet

Some loss or disturbance to these drainages is likely with development of a transportation corridor. Water resources effects from Refuge activities are primarily beneficial and would not add to the cumulative adverse effects from the transfer of a right of way for transportation purposes.

4.4. VEGETATION COMMUNITIES

Vegetation management would be a key component to managing wildlife at the Refuge. Wildlife and vegetation communities are interrelated; the quality of wildlife habitat is affected by vegetation management, and the quality of vegetation is affected by wildlife management. Potential impacts to vegetation were evaluated based on the management goals for each alternative and the potential to disturb vegetation, change species composition, or change the quality of the vegetation community. For some actions, such as road restoration, effects to vegetation are quantified based on the number of acres restored. For other actions, a qualitative assessment of effects to vegetation was made.

WILDLIFE AND HABITAT MANAGEMENT ACTIONS

Preble's Habitat Management

Habitat Protection. Alternative A would protect and maintain Preble's habitat throughout the Refuge, while Alternatives B, C, and D would also seek to improve Preble's habitat, focusing on the preservation of woody riparian vegetation. These actions would result in long-term benefits to the composition and integrity of riparian and wetland habitats on the Refuge and continued protection of suitable Preble's habitat.

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Overbrowsing by deer or elk could impact riparian and shrubland vegetation on Alternative A.

For all alternatives, the maintenance and protection of Preble's mouse habitat would have a beneficial effect on riparian, wetland, and shrubland vegetation communities.

Ungulate Exclusion. Riparian and wetland habitat management in Alternatives B, C, and D would include the option for selective exclusion of grazing/browsing animals from sensitive riparian areas using fences. This would contribute to long-term benefits to the structure and integrity of the riparian communities at the Refuge, but would only be implemented if monitoring indicates resource damage. In Alternative A, the Service would not implement these measures, and use by ungulate and other grazing animals may result in moderate, long-term adverse impacts to riparian and shrubland vegetation in some locations.

Monitoring. Vegetation surveys conducted as a part of Preble's inventories for Alternative C would provide long-term benefits to riparian communities through periodic assessments of riparian habitat condition. Alternatives A, B, and D only include species

composition data with Preble's monitoring, which have negligible value in managing riparian habitat.

Xeric Tallgrass Management

In all alternatives, the Service would complete a vegetation management plan and participate in regional efforts to implement tallgrass prairie conservation measures. These actions would provide indirect, long-term benefits to the xeric tallgrass community by improving the Service's understanding of the community's species composition, allowing implementation of successful restoration techniques, and appropriate responses to management concerns.

Other components of xeric tallgrass management would focus on weed management and road revegetation (discussed below under *Road Restoration and Revegetation*). Managing weeds and revegetating abandoned roads also would result in long-term benefits to the xeric tallgrass community.

All alternatives would use mowing to help maintain xeric tallgrass habitat, but only Alternatives A, B, and C would use prescribed fire. The effects of grazing, prescribed fire, and other restoration tools are discussed in greater detail below under *Weed Management*. Alternatives A and D would exclude grazing as an ecological restoration tool. The absence of grazing for Alternatives A and D and the absence of prescribed fire for Alternative D would make it more difficult to maintain the species composition and health of tallgrass prairie and would have a minor to moderate adverse effect on the xeric tallgrass community, depending on the effectiveness of other management tools.

In Alternative A, the Service would focus grassland management efforts on about 1,000 acres of xeric tallgrass habitat in the Rock Creek Reserve. However, management of those portions of the xeric tallgrass outside of the Rock Creek Reserve (about 950 acres) would be limited to weed containment, which includes controlling the spread of existing weeds rather than reducing overall infestations. This reactive approach to grassland management may have long-term, moderately adverse effects on the xeric tallgrass communities outside of the Rock Creek Reserve.

Mixed Grassland Prairie Management

Management of shortgrass and mixed grasslands would include weed control efforts, restoration of non-native hay meadows (Alternatives B and C), prairie dog management, and species reintroductions. While other management measures that are specific to mixed grassland prairie communities are not anticipated, the application of these measures would provide for long-

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Goldfinch on a choke cherry branch.

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Blanket flower.

term beneficial protection and maintenance of these native grasslands.

Management actions for weed control and habitat restoration outside of the Rock Creek Reserve would be limited in Alternative A, which may result in minor

to moderate adverse impacts to mixed grassland prairie. This approach may result in long-term habitat degradation to the mixed grassland prairie communities outside of the Rock Creek Reserve because of a reduced capacity to manage these areas and respond to management issues.

All alternatives would use mowing to help maintain mixed grassland prairie habitat, but only Alternatives A, B, and C would use prescribed fire. Alternatives A and D would exclude grazing as an ecological restoration tool. The absence of grazing for Alternatives A and D and the absence of prescribed fire for Alternative D would make it more difficult to maintain the species composition and health of mixed grassland communities and would have a minor to moderate adverse effect, depending on the effectiveness of other management tools.

In Alternatives B and C, the Service would restore the 300-acre hay meadow and other non-native grasslands to native mixed grass prairie. This would have a long-term, beneficial effect to the environmental integrity of the Refuge by restoring a native grass ecosystem. A short-term increase in erosion and weed infestation is possible, but appropriate management actions would be used to reduce these impacts. The hay meadow would remain in Alternative A and D and non-native grasses may expand their distribution and degrade adjacent native grasslands.

Road Restoration and Revegetation

In all alternatives, road and stream crossing removal and revegetation would result in long-term benefits to vegetation communities on the Refuge by restoring native plant communities, reducing erosion, and reducing habitat fragmentation (Table 11). The removal and revegetation of roads and stream crossings would include diligent weed control and erosion control measures to restore large, contiguous patches of grassland habitat and uninterrupted corridors of riparian and wetland habitat. Large patch sizes of undisturbed vegetation reduce the potential for weed introduction and the spread and propagation of non-native plant communities in addition to the benefits of wildlife movement and distribution as described in Section 4.5. Alternative C provides the greatest benefit because of the amount of road restoration, followed by Alternatives B and C. Alternative A provides the least benefit.

The removal of roads and stream crossings for all alternatives would result in a minor, short-term impacts to vegetation during excavation, grading, construction, and revegetation activities. In addition, road restoration may result in minor impacts to wetlands

where road crossings are removed and the stream channel restored. The result of these actions are expected to have a net long-term beneficial effect on wetlands by restoring the natural stream channel and establishing wetlands where hydrologic conditions are suitable.

The Service will comply with Section 404 of the Clean Water Act should impacts to wetlands require permitting. Wetland impacts would be mitigated as required by the U.S. Army Corps of Engineers. In Alternative A, seven road and stream crossings would be removed in the Rock Creek Reserve. Alternative D would have the least beneficial effect to riparian and wetland vegetation by removal of six road stream crossings.

Weed Management

The Service would prepare an Integrated Pest Management (IPM) plan in Alternatives B, C, and D. IPM planning would enable the Service to develop a targeted weed management strategy that would result in long-term benefits to vegetation communities by controlling or reducing weed infestations on the Refuge. While the Service would implement IPM techniques in Alternative A, an IPM plan would not be completed and a moderate long-term adverse effect to vegetation communities outside of the Rock Creek Reserve may occur in the absence of a detailed plan.

The intensity of weed management efforts and the different tools including chemical control, prescribed fire, biological control, and mechanical control would vary between the alternatives. In general, successful weed management efforts would benefit vegetation and wildlife habitat at Rocky Flats by increasing the diversity and vigor of native plant species. The magnitude of the impacts and benefits of the following weed management tools would correspond with the intensity of the efforts. In Alternative A, weed reduction targets would apply only to the Rock Creek Reserve, although weed containment outside of the Rock Creek Reserve would occur. The use of weed containment only outside of the Rock Creek Reserve for Alternative A is likely to allow increased weed density in currently affected areas and may make it difficult to implement weed containment actions.

Chemical Control. Using herbicides to control weeds would provide a long-term benefit to native vegetation communities by reducing weed competition, maintaining desired species composition, and improving production of grasses and sedges for all alternatives. Herbicide application may result in short-term, minor impacts on native grasses and sedges from physiological damage and reduced growth for the first growing season after application. However, native vegetation in application areas would be expected to recover from the effects of herbicides and increase production of grasses and sedges in subsequent growing seasons (DOE 1999).

Table 11. Road Restoration and Average Vegetation Patch Size Following Revegetation

Vegetation Type/Action	Alternative			
	A	B	C	D
<i>Xeric Tallgrass Grassland</i>				
Roads Removed (miles)	2.5	7.3	8.3	7.2
Average Patch Size (acres)	74	123	134	105
<i>Riparian and Wetland Areas</i>				
Roads Removed (miles)	0.7	1.4	1.5	1.2
Stream Crossings Removed	7	13	13	6
Average Patch Size (acres)	53	87	96	87
<i>Other Grasslands</i>				
Roads Removed (miles)	4.3	10.9	11.3	11.8
Average Patch Size (acres)	73	169	169	134.2
<i>TOTAL</i>				
Roads Removed (miles)	7.5	19.6	21.1	20.2
Area of road restored (acres)	21.6	44.9	52.5	45.9
Average Vegetation Patch Size Refuge-wide (acres)	58	98	121	97

Prescribed Fire. The grassland communities at Rocky Flats have evolved with fire over millennia. Natural grassland fires rejuvenate grassland by controlling exotic weed species, removing plant litter, and stimulating new plant growth. While fire has generally been limited from the site over the last 50 to 75 years, periodic wildfires due to lightning strikes or human-caused ignition have occurred at Rocky Flats. These periodic wildfires would continue to occur at Rocky Flats over the long term. In the event of unplanned ignitions, the Service will work with local agencies (by way of mutual aid agreements) to aggressively suppress the fire.

Prescribed fire is a restoration tool that would simulate the ecological benefits of natural fires and reduce the magnitude and severity of periodic wildfires. In Alternatives A, B, and C, the use of prescribed fire would have a short-term, beneficial effect on vegetation communities by improving plant vigor, controlling weeds, and maintaining desired species composition. The ecological timing of prescribed fire is a critical component of its successful use as a restoration tool that would maximize benefits to desirable species and effectiveness in controlling weed species.

The indirect, long-term benefits of prescribed fire would include the reduction of hazardous fuel loads that can contribute to uncontrolled wildfires. Prescribed fire would not be used as a restoration tool in Alternative D

or in Alternative A outside of the Rock Creek Reserve. The lack of fire as a restoration tool would have a moderate adverse effect on the ability to maintain native plant communities, control weeds, and reduce the potential for wildfires.

Prescribed fires would be conducted in accordance with approved vegetation management and fire management plans, Service policy, and state air quality regulations.

Biological Control. The introduction of a non-native insect predator to control non-native weeds would beneficially affect native plant communities by controlling weed distribution for all alternatives. For example, in all alternatives the Service would distribute the field bindweed mite, a biological control agent, across the Refuge. However, biological control methods have the potential to adversely affect native, non-target plant species. The remote potential for these adverse impacts is offset by the benefits of using a weed management tool that is self-sustaining and reduces the need for herbicide application.

Mechanical Control. The use of mowing and other methods to control weeds as part of an overall IPM strategy would provide an additional weed management tool for all alternatives that would not introduce chemicals into the environment. These methods may result in adverse impacts to vegetation



Prescribed fire is a restoration tool that would be used in Alternatives A, B, and C to improve plant vigor, control weeds, and maintain species composition.

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The Service and CDOW would work together to manage deer and elk populations.

communities, such as the dispersal of weed seeds, soil disturbance, and direct impacts to native plants within treatment areas. However, the potential adverse effects of mowing are generally offset by their benefits.

Grazing. Alternatives B and C include the option for selective grazing by cattle, goats or other livestock as an ecological restoration tool. Managed grazing would have a beneficial effect on vegetation communities by reducing the number and density of weed species and stimulating native plant growth. A secondary benefit of selective grazing can be weed control. Grazing could also result in short-term impacts to wildlife, particularly elk, due to competition for limited forage. However, the benefits of managed grazing, such as grassland enhancement and weed control are expected to have long-term beneficial effects on grasslands. Alternatives A and D do not include a grazing option and would not realize the potential benefits of weed control.

Weed Mapping. All alternatives include annual mapping of weed patches and treatment sites. This management

tool would provide long-term benefits to a variety of vegetation communities on the Refuge by allowing Refuge staff to respond to new infestations and adapt weed control strategies based on past experience.

Interior Fencing. In Alternatives B and C, the Service would construct interior fencing to control and collect wind-dispersed tumbleweeds. While this may increase weed establishment near the fence, it would result in long-term overall benefits to a variety of vegetation communities at Rocky Flats. No interior fencing would be used for Alternatives A or D, and weed dispersal for species such as diffuse knapweed may be greater.

Deer and Elk Management

In all alternatives, the Service and/or CDOW would maintain deer and elk populations to meet target population estimates for the Refuge. This is expected to reduce the potential for overgrazing or overbrowsing of vegetation, resulting in long-term benefits to grassland and shrubland communities on the Refuge. Alternative A does not specify a timeframe for meeting target population goals. The potential for minor adverse effects to vegetation from overgrazing would be greatest for Alternative A followed by Alternative B and then Alternatives C and D.

All alternatives call for monitoring of ungulate-induced degradation of vegetation, although the frequency, methods, and detail of monitoring would vary among the alternatives. Monitoring would provide an indirect benefit to grassland and shrubland communities by enabling the Service to more readily respond to deer and/or elk overgrazing or overbrowsing.

Prairie Dog Management

Management of prairie dog populations for Alternatives B, C, and D would include confining their range to short and mixed grasslands and non-native grasslands. In Alternative A, prairie dog populations would be allowed to expand subject to natural habitat and predator controls. Under natural conditions, xeric tallgrass habitat does not provide suitable prairie dog habitat because of the tall height of the grass and the stony soils. Riparian communities are too moist and/or vegetation is too tall to favor prairie dog establishment. However, prairie dogs have been known to colonize these areas when they have been degraded by drought, weeds, or accumulated thatch, which can lead to additional habitat degradation and further colonization (Hygnstrom et al. 2002).

If necessary, to protect important vegetation communities from the potential impacts of prairie dog

colonization, all alternatives would trap and relocate prairie dogs from riparian areas. Prairie dog exclusion from these habitats would benefit the long-term viability of riparian communities and still allow development of sustainable prairie dog colonies. In Alternative A, the capture and relocation of prairie dogs from riparian areas would occur only in the Rock Creek Reserve. Alternatives B, C, and D would also relocate prairie dogs to protect xeric tallgrass habitat.

The expansion of prairie dog populations in Alternative A may have minor to moderate adverse effects on native plant communities, depending on the extent of prairie dog dispersal. A shift in vegetation composition for portions of the Refuge is possible. In Alternatives B, C, and D, limits on prairie dog expansion is expected to have a minor adverse effect on species composition and distribution.

Species Reintroductions

The planned removal of the Lindsay Ponds in Alternative C would affect about 1 acre of open water and adjacent wetland habitat. Restoration of the native stream channel is expected to replace some of the affected wetlands, but no open water habitat would be created. Should a net loss in wetlands occur from removal of the Lindsay Ponds, the Service would create replacement wetlands in accordance with Section 404 permitting requirements. None of the other alternatives would affect wetlands or open water at the Lindsay Ponds.

PUBLIC USE, EDUCATION AND INTERPRETATION ACTIONS

Public Use Facilities

New Trails. Implementation of Alternatives B and D would result in the direct long-term loss of vegetation from the construction of new trail segments within the xeric tallgrass and mixed grassland prairie communities (Figures 23 and 25). The area of disturbance from constructing these trails is 2.4 acres for Alternative B and 4.7 acres for Alternative D (Table 12). The loss of vegetation for both of these alternatives would be minor and would not adversely affect the overall quality and characteristics of vegetation communities. No new trails are planned for Alternatives A and C and hence there would be no disturbance to vegetation communities (Figures 22 and 24).

In Alternatives B and D, several trails cross through riparian and wetland habitat areas sensitive to disturbance. Alternative B would have 11 such crossings, while Alternative D would have 18. All trail crossings would use existing culverts, bridges, or low-flow crossings to minimize effects to vegetation.

Alternative D includes a new, 0.2-mile hiking trail connecting the Lindsay Ranch area and the Plum Branch within the Rock Creek drainage. This short trail would descend through mixed grassland prairie along the pediment slopes adjacent to an area dominated by shrublands including the rare tall upland shrubland community. Only minor adverse effects to these shrubland communities are expected with careful trail design and placement.

Trail Use. Public trail use on the Refuge in Alternatives B and D would have the potential to adversely impact surrounding vegetation communities by:

- Development of social trails
- Localized trampling and erosion
- Soil compaction
- Introduction and dispersal of noxious weeds and other introduced species
- Fragmentation of habitat

Social trails and trampling are more common effects of hiking and equestrian use, while weed dispersal can be exacerbated along multi-use trails where bicycling and equestrian use is permitted (Weir 2000). Bicycles have the potential to carry and disperse weed seeds on the bike itself, while horses may introduce noxious weed seeds from off-site in their manure, hooves, and coat (Weir 2000; Benniger-Traux et al. 1992). Soil compaction associated with public use of social trails, especially in the case of equestrian use (Swinker et al. 2000), can hinder the re-establishment of native vegetation (Dehring 1997).

Public use of Refuge trails in Alternatives B and D may result in localized, long-term effects to vegetation communities near trails. However, with appropriate trail maintenance and visitor use management, the overall effect of public trail use on vegetation communities would be minor. The limited trail use in Alternatives A and C would have negligible effect on vegetation.

In Alternatives B and D, the Service would monitor the impacts of public use on riparian communities. Monitoring would provide a long-term benefit to riparian habitat by allowing the Service to effectively respond to impacts and implement appropriate management measures.

Off-trail Use. Seasonal off-trail use in Alternatives B and D may result in localized vegetation trampling, the development of social trails, and increased weed dispersal in the southern portion of the Refuge (Figures 23 and 25). The extent and severity of these impacts

Table 12. Vegetation Disturbance Associated With New Trail Construction

New Trail Segment	Map ID†	Segment Length (ft.)	Xeric Tallgrass Impact (acres)‡				Mixed Grassland Impact (acres)‡			
			A	B	C	D	A	B	C	D
Rock Creek Loop	1	4,180	-	0.9	-	0.9	-	0.6	-	0.6
Upper Woman Creek switchbacks	2	1,487	-	0.1	-	0.1	-	0.4	-	0.4
Southeast loop connection	3	2,803	-	-	-	-	-	1.0	-	-
South ridge loop	4	4,909	-	-	-	1.6	-	-	-	0.1
Lindsay Ranch-Plum Branch connection	5	1,012	-	-	-	-	-	-	-	0.4
North boundary connection	6	2,166	-	-	-	0.2	-	-	-	0.5
TOTAL			-	0.9	-	2.8	-	2.0	-	1.9

† Shown in Figure 23 and Figure 25.

‡ Area calculated assuming a 15-foot impact width during construction (does not include trails converted from existing roads).

- = No impact.

may be increased by consistent off-trail use of specific areas, or by large groups of visitors. Impacts would be minimized by restricting off-trail access to the non-growing season. As a result, only minor, long-term effects to vegetation are anticipated for off-trail use in Alternatives B and D.

No off-trail public use would be allowed under Alternatives A and C, and there would be no effect to vegetation.

Visitor Use Facilities. Construction of public use and Refuge management facilities in Alternatives B, C, and D would result in minor impacts to the vegetation communities at Rocky Flats. New facilities would include parking areas, trailheads, restrooms, overlooks, viewing blinds, visitor contact facilities, and interpretive facilities. Disturbance to vegetation communities from specific facilities in Alternatives B, C, and D are small (Table 13). The central parking and trailhead area in Alternatives B, C, and D would be primarily in a previously disturbed area of xeric tallgrass grassland north of

the Upper Church Ditch. Additional indirect impacts may result from social trails, trampling, and weed infestations associated with public use of these facilities. Construction of most of these facilities would result in a minor, long-term loss of vegetation but effects would be minimized by placing facilities in previously disturbed areas and directing visitors to developed facilities.

REFUGE OPERATIONS, SAFETY AND PARTNERSHIPS

Refuge Operations

Maintenance Facilities. In all alternatives, the Service would construct a maintenance facility within degraded portions of the xeric tallgrass community to minimize effects. This would be a stand-alone facility in Alternative A; in Alternatives B, C, and D, the maintenance facility would be co-located with visitor use facilities (described above). The area of permanent impact for a maintenance facility would be less than one acre for all alternatives.

The construction of maintenance facilities would result in a minor, long-term loss of vegetation in the xeric

Table 13. Vegetation Impacts from Public Use Facilities

Vegetation Type	Area of Impact (acres)†			
	Alt. A	Alt. B	Alt. C	Alt. D
Xeric Tallgrass Grassland	-	0.5	0.01	0.08
Other Grassland	-	0.6	-	1.3
Riparian and Wetland	-	-	-	-
TOTAL	-	1.1	0.01	1.4

† This does not include impacts from new trail construction shown in Table 11.

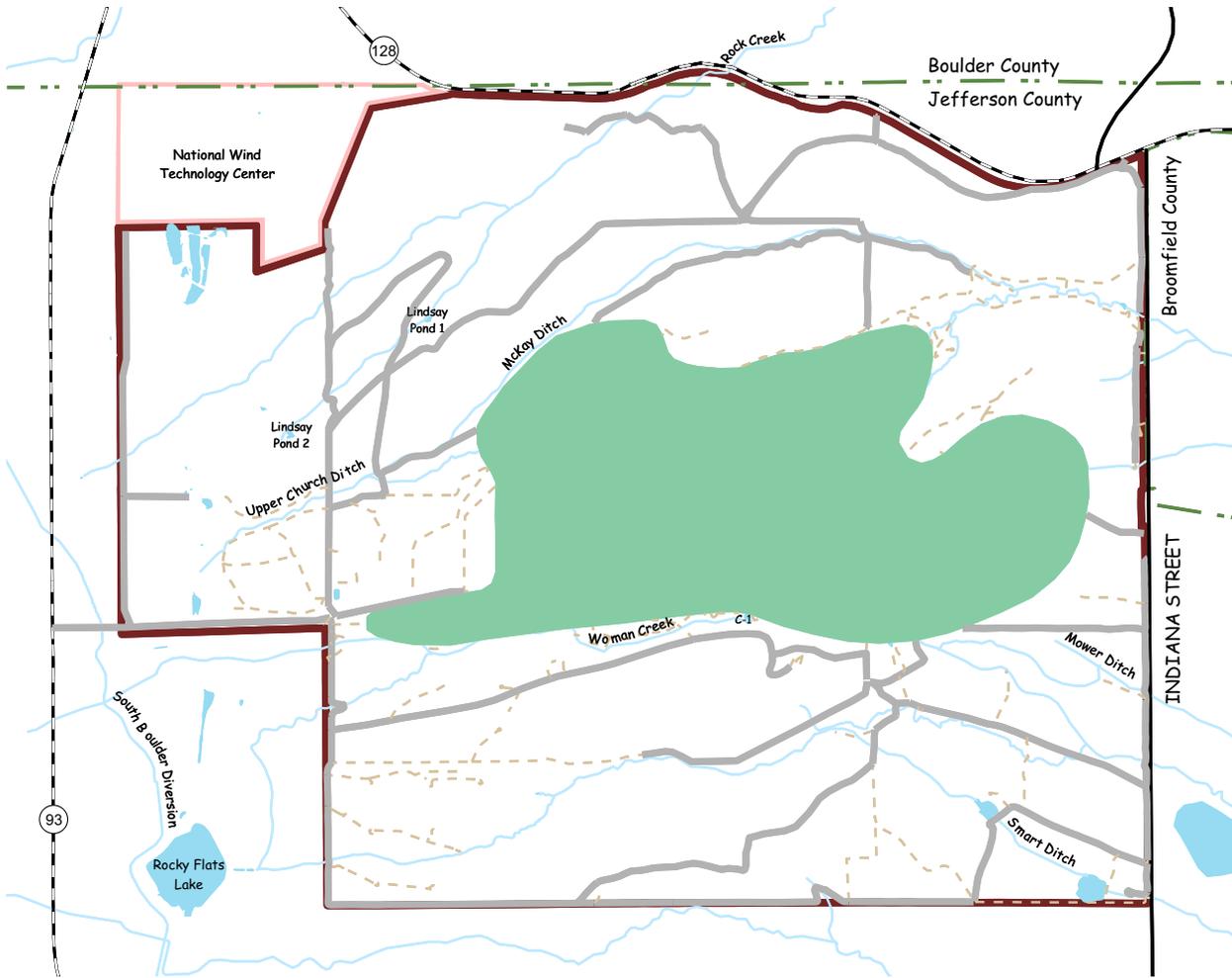
- = No impact.



US Fish & Wildlife Service

Rocky Flats National Wildlife Refuge

Jefferson County, CO



Alternative A

Roads and Trails

- ▬▬▬▬ Trails Converted From Existing Roads
- ▬▬▬▬ Newly Constructed Trails
- - - - - Unpaved Roads
- ▬▬▬▬ Access Road
- █ DOE Retained Area (Subject to Change)

0 1 2 Miles

December 2003

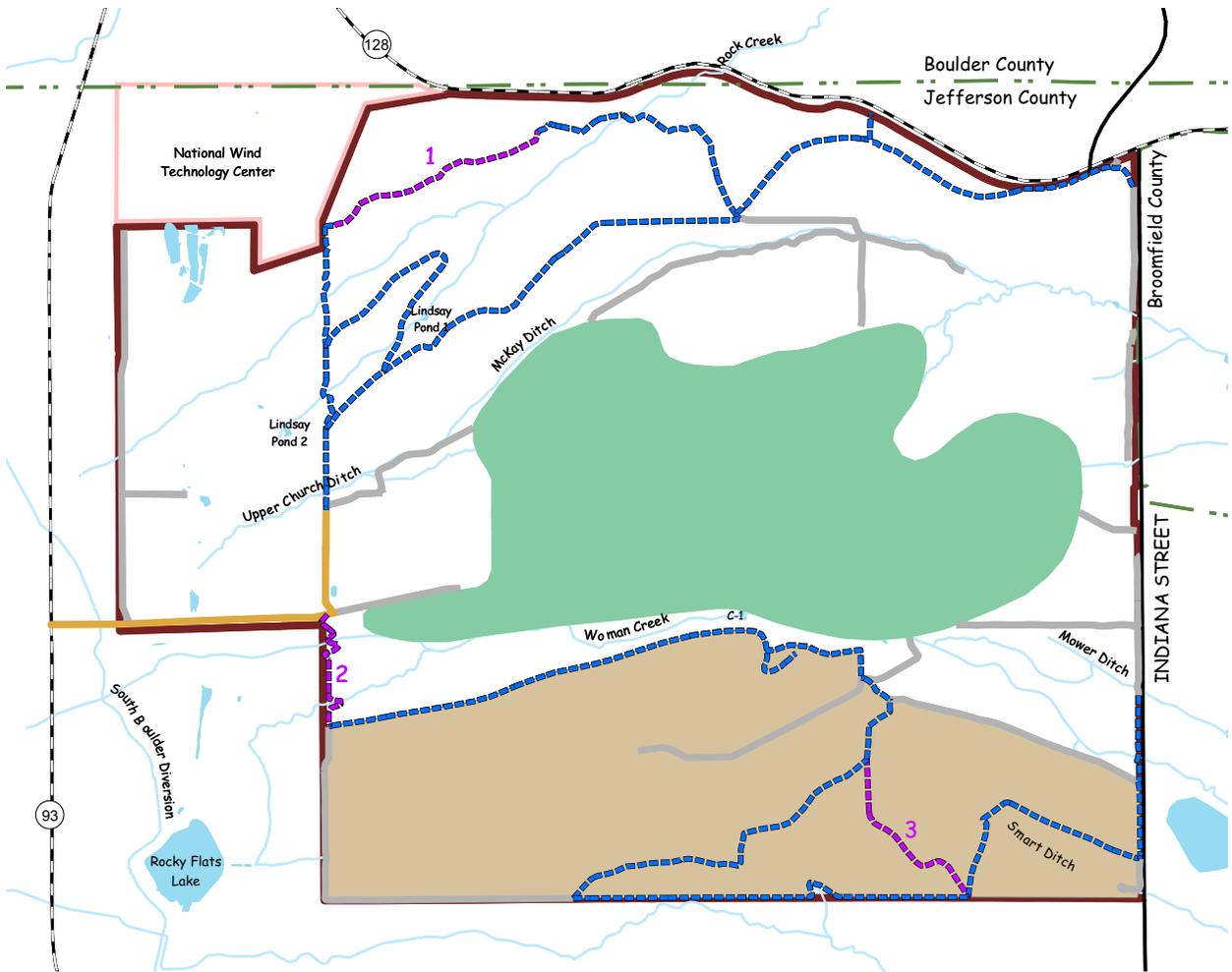


Figure no. 22



US Fish & Wildlife Service

Rocky Flats National Wildlife Refuge Jefferson County, CO



Alternative B

Roads and Trails

- Off-Trail Use Area
- Trails Converted From Existing Roads
- Newly Constructed Trails
- Unpaved Roads (Publicly Accessible)
- Access Road
- 1 New Trail ID (See Table 12)
- DOE Retained Area (Subject to Change)

0 1 2 Miles

December 2003



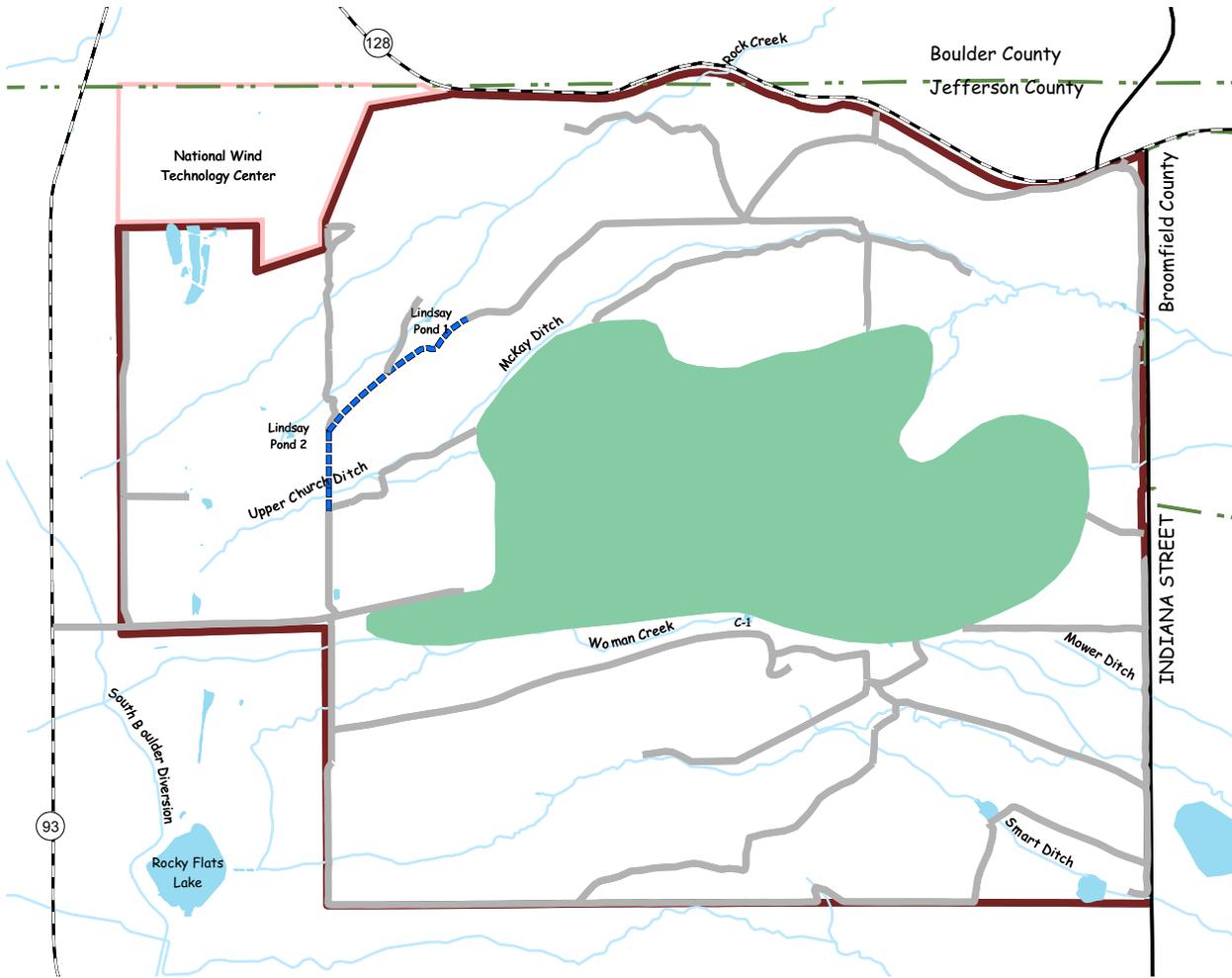
Figure no. 23



US Fish & Wildlife Service

Rocky Flats National Wildlife Refuge

Jefferson County, CO



Alternative C

Roads and Trails

- ▬▬▬ Trails Converted From Existing Roads
- ▬▬▬ Newly Constructed Trails
- ▬▬▬ Unpaved Roads (Publicly Accessible)
- ▬▬▬ Access Road
- █ DOE Retained Area (Subject to Change)

0 1 2 Miles
December 2003

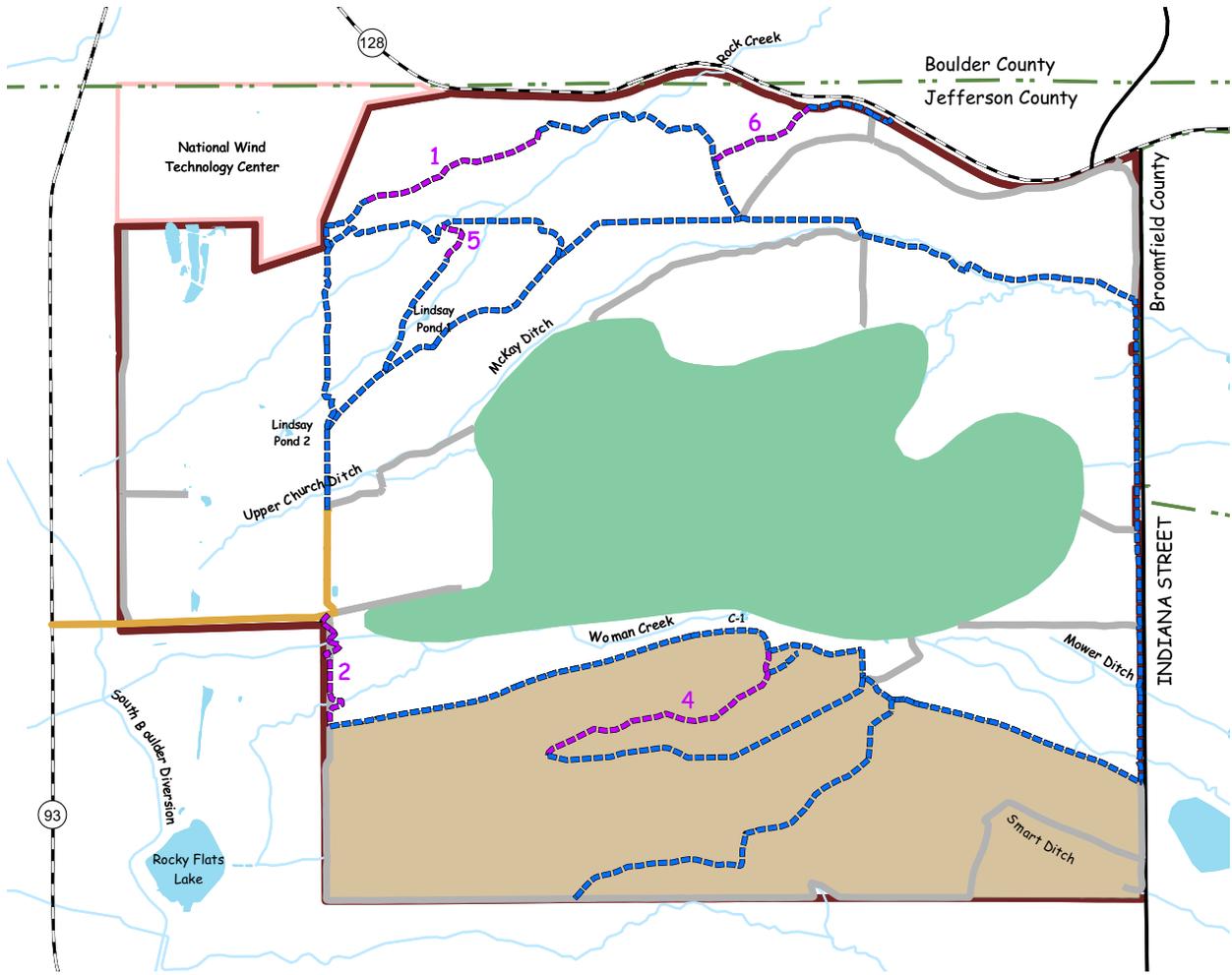


Figure no. 24



US Fish & Wildlife Service

Rocky Flats National Wildlife Refuge Jefferson County, CO



Alternative D

Roads and Trails

- Off-Trail Use Area
- Trails Converted From Existing Roads
- Newly Constructed Trails
- Unpaved Roads (Publicly Accessible)
- Access Road
- 1 New Trail ID (See Table 12)
- DOE Retained Area (Subject to Change)

0 1 2 Miles

December 2003



Figure no. 25

tallgrass community. Additional, indirect impacts may result from social trails, trampling, and weed infestations associated with the ongoing use of the facility.

Partnerships

Regional Coordination. In Alternatives B, C, and D, the Service would meet annually with nearby open space managers and landowners to coordinate resource management strategies. Coordination of Refuge resources and management issues with adjacent land managers would likely result in long-term benefits to vegetation communities. The sharing of knowledge between agencies and other landowners would result in more effective and efficient vegetation management, including weed control, habitat restoration, and fire management. The coordination of management strategies would help ensure that resource management strategies off of the Refuge do not conflict with or counteract management actions on the Refuge. Alternative A would not realize these benefits.

Research. Alternatives B, C, and D direct the Service to identify information needs and consider proposals for compatible scientific research on the Refuge by staff or external researchers. The Refuge presents many opportunities for targeted research on various resource management issues. This research would result in indirect benefits to wildlife and habitat on the Refuge by improving the Service’s base of knowledge for management and decision-making. Alternative A would not realize these benefits.

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Trails would be designed to minimize impacts to wildlife.

CUMULATIVE IMPACTS

Mining

Potential future mining along the western edge of the Refuge would result in major, long-term impacts to the vegetation communities in those areas, due to major habitat disturbance and the encroachment of weed species. About 264 acres of xeric tallgrass grassland and 16 acres of riparian habitat may be lost or disturbed within the permitted mining areas. These vegetation communities may eventually be re-established following mining, but reclamation would be a long-term effort.

The deposition of windblown soil from mining areas has the potential to adversely impact adjacent vegetation communities by burying native plants and by providing a foothold for noxious weed infestations. Management actions on the Refuge would not add to the adverse cumulative impacts from mining.

Table 14. Vegetation Communities within Various Right of Way Widths

Vegetation Community	Right of Way Width		
	50 ft.	125 ft.	300 ft.
Wetlands	0.6	1.5	3.5
Mesic mixed grassland	10.6	25.9	61.0
Reclaimed mixed grassland	2.7	7.0	17.5
Riparian shrubland/woodland	0.1	0.3	0.7
Xeric tallgrass grassland	0.6	1.9	4.0
Xeric needle and thread grassland	1.5	3.8	9.2
Other	0.3	0.6	2.8
Total Right of Way area	16.4	41.0	98.7

All areas in acres.

Transportation Right of Way

As discussed in the Reasonably Foreseeable Activities section of Chapter 2, the transfer of Rocky Flats land to other entities for the purposes of transportation improvements may comprise a 50-, 125- or 300-foot right of way along the eastern edge of the Refuge. Several vegetation communities are located within the various right of way widths. The mesic mixed grassland would be the community most affected (Table 14). Proposed management and conservation of these vegetation communities for all alternatives would be beneficial and would not contribute to the cumulative impact from loss of vegetation in the transportation right of way.

4.5. WILDLIFE RESOURCES

Potential effects to wildlife species were evaluated based on the anticipated types of actions and disturbances associated with each alternative. Quantifiable impacts to wildlife are not readily predicted, but inferences can be made based on the amount of habitat lost or gained, changes in the quality of the habitat, and known wildlife response to human activity and other disturbances. Potential effects to wildlife were refined further by input from regional wildlife specialists, the knowledge of Service and consulting biologists, previous studies at Rocky Flats, and published information.

WILDLIFE AND HABITAT MANAGEMENT ACTIONS

Preble's Habitat Management

All alternatives would protect and maintain Preble's habitat on Refuge drainageways, survey habitat to detect any degradation, and allow natural revegetation of native species on abandoned roads. Habitat protection for Preble's in all alternatives would provide secondary benefits to other riparian wildlife species, such as raptors, numerous songbirds, voles, and other riparian rodents. This section addresses environmental consequences of Preble's habitat management on general wildlife resources; direct impacts of Preble's habitat management on Preble's and other threatened and endangered species is discussed in the *Threatened, Endangered, and Candidate Species* section.

Alternative A would provide the least benefit for Preble's and other wildlife. This alternative would protect Preble's habitat, control weeds (with limited herbicide use), and monitor the presence/absence of Preble's, but provides few other benefits to wildlife in general. Alternatives B, C, and D provide additional moderate

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Monitoring Preble's meadow jumping mouse populations within the riparian habitat

benefits to all riparian wildlife species by protecting riparian vegetation with temporary fencing as needed and providing better control of ungulate populations. These three alternatives would protect, maintain, and improve about 1,000 acres of Preble's habitat, providing a moderate benefit to Preble's compared to the simple protection for habitat in Alternative A. Alternative D would also establish a plan to monitor trail use and recreation impacts on Preble's. Results from this monitoring would indirectly provide moderate benefits to other riparian wildlife potentially impacted by recreation and public use in sensitive habitats.

The periodic presence of humans in riparian habitat during monitoring in all alternatives may disturb or temporarily displace individual animals. The extent of the disturbance would depend on the magnitude, intensity, and duration of surveys. Alternatives C and D have the greatest potential to disturb riparian wildlife as a result of more extensive vegetation monitoring;



Invasive weeds such as dalmatian toadflax can dominate native plant communities.

however, because the low magnitude and short duration of monitoring, short-term impacts would be negligible to minor in all alternatives. No long-term adverse effects to wildlife are anticipated with planned levels of monitoring.

Xeric Tallgrass Management

The restoration or enhancement of xeric tallgrass would benefit native wildlife species in all alternatives. Alternative A would restore 1,000 acres of tallgrass habitat; Alternatives B, C, and D would restore 1,500 acres of tallgrass habitat.

The short-term, minor, adverse impacts of xeric tallgrass management would be the same for all alternatives, including direct injury or mortality of wildlife from weed control management strategies. Native wildlife, however, evolved with natural ecological processes such as fire and grazing and have developed behavioral or physiological adaptations to survive these events.

Alternative A would have the fewest short-term adverse impacts and would provide the fewest long-term benefits for native wildlife by limiting xeric tallgrass management efforts to the Rock Creek Reserve. Prescribed fire would be used only within Rock Creek Reserve resulting in minor short-term adverse impacts and because this tool would not be used Refuge-wide, long-term benefits

would also be minor. Conversely, Alternatives B and C would have moderate short-term adverse impacts from restoration tools including prescribed fire and grazing, but also would result in the moderate to major long-term benefits for native wildlife by improving the quality of the habitat.

Alternative D would manage xeric tallgrass grasslands Refuge-wide, but the tools available would be limited. Prescribed fire and large herbivore grazing are part of the natural functions of the prairie ecosystem and excluding these processes may indirectly adversely impact wildlife. Alternative D would have minor short-term direct impacts on existing wildlife and, because natural processes are suppressed, would result in negligible to minor benefits to the native prairie wildlife community. Alternatives B and C monitor ecological conditions and provide long-term minor indirect benefits to wildlife. Alternatives A and D have no monitoring and any short- or long-term benefits would not be realized.

Mixed Grassland Prairie Management

The environmental consequences of mixed grassland prairie management are covered under other wildlife and habitat management actions. The only management activity specific to mixed grassland is related to grassland restoration. Alternatives B and C would

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The intensity of weed management efforts would vary between alternatives.

restore 300 acres of monoculture hayfield and other areas to native grassland. These efforts would result in minor short-term impacts on wildlife species that use non-native grasslands or that would be directly impacted by grading or removal of existing vegetation (such as burrowing mammals). However, revegetation efforts would improve and diversify habitat conditions for a variety of wildlife species, including grassland birds and native burrowing mammals. Alternatives B and C would provide direct long-term benefits to wildlife at the Refuge. Alternatives A and D would not establish native vegetation in the existing hay meadow, and benefits to native wildlife would not be realized.

Road Restoration and Revegetation

In all alternatives, varying lengths of existing roads and stream crossings on the Refuge would be removed and revegetated. The short-term impacts of these restoration efforts on wildlife would be negligible to minor, primarily affecting species such as burrowing mammals and nesting birds that may be directly impacted by construction and grading activities. Restoration efforts, however, would result in major long-term benefits to a variety of wildlife species by reducing habitat fragmentation, increasing habitat patch size, and improving the overall quality and amount of wildlife habitat on the Refuge. In general, larger average patch sizes are considered to be a positive effect on wildlife and habitat. Alternative C would have the most beneficial effect on patch size followed by Alternatives B, D, and A (Table 11).

Weed Management

Developing and implementing an IPM plan involves various applications of weed control strategies and monitoring. Invasive weeds can dominate a native plant community, alter native habitats, reduce the

suitability of the habitat for native wildlife species, and attract non-native species. Short-term adverse impacts of weed management would be direct injury or mortality of wildlife from the various IPM strategies (such as mowing, prescribed fire, and chemical control), depending on the intensity, duration and timing of control activities. Activities conducted during summer breeding or other active periods for wildlife have the greatest potential for adverse impacts. Implementation of an IPM plan would have long-term benefits for native wildlife species and communities on the Refuge including enhanced habitat quality and a reduction in non-native wildlife species.

While the intensity of weed management efforts would vary between alternatives, the tools would be similar except neither Alternative A nor Alternative D would use grazing. Alternative A would use only limited prescribed fire in the Rock Creek Reserve. The difference in impacts between the various tools would be negligible.

Large ungulate grazing of short, intense duration is a natural process in prairie ecosystems. Controlled grazing would have short-term minor impacts on large herbivores by reducing available forage, but would result in long-term moderate benefits to wildlife by restoring native grassland vegetation and processes.

A compatibility determination would be required for any grazing program that provides an economic benefit to a private party. This would not be needed for a contract to use goats for the purpose of weed control.

Chemical control has the potential for secondary impacts caused by inadvertent application to non-target species or secondary poisoning effects. All chemicals would be

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Maintaining target populations of deer and elk would ensure healthy populations and limit habitat degradation.

applied according to strict state, Service, and EPA requirements and guidelines to minimize adverse effects. Prescribed fire may directly impact wildlife by temporarily displacing animals or disturbing important breeding or foraging areas; however, native grassland wildlife evolved with fire as an important ecosystem process and has adapted fire survival mechanisms and behavior. Biological control would be a low impact strategy, but would have inherent risks such as impacts to non-target species and introduction of non-native organisms to the ecosystem.

Implementation of Alternative A would have the fewest short-term adverse impacts and, conversely, would provide the fewest long-term benefits for native wildlife by limiting weed control efforts to the Rock Creek Reserve plus weed containment outside the Reserve. Alternatives B, C, and D would have the greatest short-term adverse impacts, but also would result in the greatest long-term benefits for native wildlife.

The establishment of interior fencing in Alternatives B and C to collect weeds would have minor long-term impacts by creating barriers for certain species. Fencing would cause minor long-term impacts by altering the microhabitat, including altering moisture regimes, changing plant species composition, and establishing linear strips, or edges, of a perpetual early seral stage community. These edge effects would benefit some species and be detrimental to others. Weeds built up along fencelines also provide temporary cover for numerous bird, mammal and reptile species. Placing fences along existing edges such as trails or roads would minimize edge effects.

Deer and Elk Management

Population Management. The concept of management for a target population level would be used to manage deer and elk populations on the Refuge. Target population levels would be established in coordination with CDOW to maintain an optimum number of animals that can be supported by their habitat without that habitat being significantly altered. As the target population is approached, deer and elk herds may begin to show signs of stress and reduced overall health. These signs may include things like poor reproduction by does and decreased or abnormal antler growth in bucks.

In all alternatives, the development and use of a target population would result in long-term benefits to deer and elk populations, and other species and their habitats. Establishing a target population level would allow the Service to be proactive in deer and elk management, maintain herd health in response to environmental variables, including chronic wasting disease, and

minimize the adverse effects of overgrazing and overbrowsing on habitat on which other species depend.

Alternative A does not have a time frame for establishing and achieving population targets, but would implement population targets in accordance with other Refuge management priorities. Alternatives B, C, and D would establish population targets within 3 years with the goal to achieve these targets within 5 years. Several population control methods would be used to achieve population targets including culling by Service staff and public hunting. Alternatives A and C would not include public hunting as a management tool.

Population targets would be the same in all alternatives (deer and elk populations would be maintained at target levels below the maximum levels that may be supported by the Refuge in the absence of other refuge goals) and the impacts to deer and elk herds on the Refuge would be similar in all alternatives. Maintaining population target levels would directly impact individual animals that are killed by culling or public hunting, but would have negligible impacts on the overall population of the CDOW's Boulder Herd Management unit, in which the Refuge is located. Culling and hunting deer and elk would have minor, short-term and long-term impacts on the remaining herd. Animals pursued for removal or physically herded would experience short-term stress and possible long-term changes in distribution and behavior, such as altering activity periods and avoiding humans.

Implementing population management measures would result in moderate, long-term benefits to the health and sustainability of deer and elk populations on the Refuge. Over the course of 15 years, the effects of culling and/or hunting, combined with the increased disturbance in Alternatives B and D from public trail use, may result in increased movement of deer between the Refuge and adjacent habitat areas. While this increased movement may benefit the population as a whole by increasing genetic diversity, reducing overuse of the habitat and reducing disease transmission, it may also result in a minor increase in ungulate mortality along the roads and highways surrounding the Refuge.

The implementation schedule for these management strategies would vary among alternatives. Alternative A has no specified implementation schedule and would risk populations exceeding targets and degrading habitat before any control measures are enacted. Population control activities under this alternative likely would be implemented after current herds have expanded. Thus, Alternative A would require greater initial population control (culling and hunting). Alternatives B, C, and D

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The Service would monitor deer and elk populations and their impacts on sensitive habitat areas.

would establish a target population within 3 years. This schedule would permit the Service to implement less drastic control measures in a timely manner and minimize impacts to vegetation and sensitive habitats from overgrazing.

Monitoring. In addition to monitoring deer and elk impacts on riparian and upland shrub communities in all alternatives, Alternatives B and C also would include monitoring of deer and elk populations and indices of herd health. Monitoring in Alternatives A and D would identify potential habitat degradation of sensitive shrub communities associated with an overabundance of deer and elk, but this may be inadequate to obtain reasonable population parameters for determining viable target populations and maintaining herd health. Without reasonable target population estimates in Alternatives A and D, the Service may implement inappropriate population control, resulting in the inadequate or unnecessary removal of animals.

In Alternative B, riparian and shrub monitoring would occur twice a year, and annual deer and elk counts would measure abundance and density. This level of monitoring would provide an adequate measure of deer and elk populations. However, monitoring in Alternative B may not be sufficient to assess seasonal movement and use patterns on the Refuge and the extent of emigration and immigration off-Refuge.

In addition to the monitoring in Alternative B, Alternative C also would include seasonal surveys of movement patterns, and annual surveys of population size, age and sex composition, fawning rates, and fawn survival. This level of monitoring would provide a moderate benefit by obtaining adequate information on population parameters necessary to establish sustainable

target population, and provide managers the ability to accurately establish population control goals. Obtaining information on fawning rates and fawn survival usually involves intensive and invasive monitoring that requires some form of mark and recapture or telemetry methods that may result in occasional direct and indirect injury or death to fawns.

Prairie Dog Management

The biodiversity and productivity of grasslands result from a mosaic of habitat types; the prairie dog town is one of those types. Alternatives B, C, and D would allow intra-Refuge relocation of prairie dogs, while Alternative D would allow the relocation of prairie dogs onto the Refuge from other jurisdictions. Prairie dog relocations require careful and detailed planning, and are very staff and labor intensive. Despite the best care, regional data collected by City of Boulder Open Space and Mountain Parks (City of Boulder 2003) show that only about 40 to 60 percent of relocated prairie dogs survive the relocation process. Prairie dog relocations also fail to address the survival of other animals that depend on their complex of burrows. When prairie dogs are live-trapped and removed, effects of habitat loss to rabbits, snakes, Woodhouse toads, salamanders, burrowing owls, and invertebrates that occupy the site are often ignored (City of Boulder 2003) resulting in minor impacts to common, widely dispersed species and moderate adverse impacts to uncommon or narrowly distributed species, such as the burrowing owl.

The prairie dog management objectives of all alternatives are similar and would vary primarily in the acreage allowed to be occupied by prairie dogs. Prairie dogs are prey for numerous avian and mammalian predators. In general, the more acreage occupied by prairie dogs, the more prey is available for larger predators, such as eagles, coyotes, and badgers.

Alternative A would permit unlimited natural expansion of prairie dogs throughout the Refuge. Because natural expansion of prairie dog colonies would occur relatively gradually, all impacts would be considered long-term impacts. Moderate impacts to wildlife species assemblages may occur on a local scale, as changes in vegetation structure would result in local reductions of species associated with taller grasslands. On a Refuge-wide or regional scale, an increase in prairie dog acreage would have only a minor effect on the relative abundance or distribution of wildlife species preferring this habitat type, but would be unlikely to change the overall species composition (gain or loss of additional species). Prairie dogs would be excluded from sensitive habitats within the Rock Creek Reserve



Wavy leaf thistle.

and recognized Preble's habitat, but not throughout the Refuge and colonies may expand unchecked into sensitive xeric tallgrass communities resulting in moderate impacts to this community.

Alternatives B, C, and D all restrict prairie dog expansion. Alternatives B and C would be more restrictive in the acreage allowed to become occupied by prairie dogs (750 and 500 acres, respectively). The expansion of the prairie dog population on the Refuge would have a beneficial effect on other wildlife species that typically inhabit prairie dog colonies, although some displacement of other mixed prairie grassland species, including bird and small mammal species, is likely. Overall, a greater diversity of wildlife is expected with expansion of prairie dog colonies. Alternatives B, C, and D would exclude prairie dogs from xeric tallgrass communities and Preble's habitat, providing a greater amount of protection and, consequently, negligible adverse impacts to these sensitive wildlife habitats.

Alternative D allows expansion of prairie dogs up to 1,000 acres. This amount of habitat conversion would have moderate beneficial impacts on wildlife species assemblages by increasing the diversity of habitats on the Refuge. Alternative D would also evaluate the suitability of accepting prairie dogs from off-site locations. This may lead to the introduction of the plague or a more rapid expansion of prairie dog populations to the 1,000-acre limit.

Species Reintroductions

In Alternatives B, C, and D, the Service would work with the CDOW to evaluate the suitability of reintroducing extirpated species to the Refuge. In Alternative A, species reintroduction would be conducted at the discretion of CDOW. Species currently under consideration include native fish species and plains sharp-

tailed grouse. The CDOW would be primarily responsible for the implementation, management, and control of the consequences of introductions. While the Service would not play a leading role in these activities, it would work with CDOW and other land management agencies in providing habitat for reintroduced species and cooperating in other measures to improve the potential for successful reintroductions. The success of any reintroduction effort would depend on close cooperation with surrounding open space land management agencies.

Native Fish Species. In all alternatives the Service would continue to assist the CDOW with on-going reintroduction and monitoring of native fish species such as the common shiner and northern redbelly dace in Rock Creek and the Lindsay Ponds. The successful reintroduction and establishment of native fish species would provide long-term benefits to the survival of these species by establishing a population in its native habitat that can be a source for future reintroductions to other foothills and plains streams. Increasing the numbers and survival rates of these species in Colorado also may reduce the potential for future federal listing. Monitoring data from the reintroduction would enable Service staff to evaluate long-term population and habitat trends and respond accordingly.

All alternatives have a monitoring component. In Alternatives A and D the Service would only assist CDOW with monitoring. In Alternatives B and C, the Service would take a more active role and oversee annual monitoring. Monitoring common shiner and redbelly dace populations that were introduced in 2003 would help CDOW determine if additional reintroductions are appropriate or other management actions are necessary.

In Alternatives A, B, and D the Lindsay Ponds would remain intact, resulting in a long-term benefit for common shiner and redbelly dace. In Alternative C, additional native fish reintroductions would not occur until the Lindsay Ponds are removed and the stream habitat restored. Removal of the Lindsay Ponds in Alternative C would result in major short-term and long-term adverse impacts to common shiner and redbelly dace populations introduced in 2003. Lindsay Ponds provide both feeding and spawning habitat for these two species (Rosenlund 2003) and removing the ponds would result in a long-term loss of spawning habitat for both species in the Rock Creek drainage and eventual loss of population (Aquatics Associates 2003). Even if other suitable habitat is available for relocation of these native fish species, overall available habitat on the Refuge would be substantially reduced.

Alternative B would also evaluate reintroduction of native fish species into the Walnut and Woman Creek drainages. This provides additional long-term benefits for native species by expanding the distribution of the species and reducing the potential adverse effects of a single catastrophic event.

Plains Sharp-tailed Grouse. While the proposed plan to allow sharp-tailed grouse reintroduction to the Refuge is the same among all of the alternatives, the timing and distribution of reintroduction efforts and the frequency of monitoring would be different for each alternative depending on different rates of satisfying pre-release procedures in the CDOW Plains Sharp-tailed Grouse Recovery Plan (CDOW 1992). The long-term benefits of grouse reintroduction efforts include expanding the existing range and population stability of the grouse, increasing wildlife diversity on the Refuge, and an additional opportunity for wildlife observation and interpretation.

In Alternative A the Service would adopt a passive approach to re-introduction of grouse, assisting CDOW, but not taking the lead in reintroduction activities and monitoring. The Service would not develop site-specific management plans for grouse in Alternative A. The lack of adequate planning would likely result in poorly defined management objectives, ineffective monitoring, inadequate success criteria, and conflicting management priorities on the Refuge that may lead to the failure of grouse re-introduction. Without proper management of the habitat, Alternative A may adversely affect the success of grouse reintroductions.

In Alternatives B, C, and D, the Service would evaluate the suitability of sharp-tail grouse reintroduction and

complete a sharp-tailed grouse management plan within the first 2 to 3 years of the Refuge. This plan would benefit grouse by increasing the prospect for successful reintroduction. The success of grouse reintroduction efforts depend on the availability of suitable habitat. Sharp-tailed grouse reintroduction in habitat that is not suitable because of weed infestations or incorrect species composition may result in increased sharp-tailed grouse mortality.

Grouse reintroduction in all alternatives is unlikely to impact or displace other ground-nesting birds or wildlife species because the grouse would be filling an empty niche by occupying currently unused habitat.

Other Reintroductions. Alternative B also would evaluate the suitability for reintroduction of additional native species. This would provide an overall benefit to the Refuge by further enhancing the biodiversity of the Refuge and contributing to the overall functioning of the ecosystem.

PUBLIC USE, EDUCATION, AND INTERPRETATION ACTIONS

Public Use and Facilities

Visitor Use Facilities. Impacts to wildlife from the construction of visitor use facilities would primarily involve disturbance or alteration of vegetation, which is discussed in Section 4.4, *Vegetation Communities*.

Hunting. Alternatives B and D call for a limited youth and/or disabled hunting program focused on mule deer populations at Rocky Flats. No public hunting would occur in Alternatives A and C. The short-term impacts of this program would include direct impacts on individuals that are taken during the hunts, and the effect on the Refuge deer population from the introduction of a new disturbance. These minor short-term impacts would be offset by the long-term benefits of improved population dynamics (migration and dispersal) that may result from hunting.

Wildlife populations that are unharmed or unharrassed quickly adapt to some human disturbances such as wildlife observation and predictable levels of activity. Limited hunting on the Refuge will reinforce skittish behavior in wildlife and will result in minor to moderate impacts to wildlife observation opportunities.

New Trails. Construction of new trails can favor invasive species that may capitalize on the existence of trail corridors. These effects can include introducing a new pathway for predators, or the creation of an unnatural wildlife dispersal corridor for species such as prairie dogs. No new trails would be constructed in Alternatives



Sharp-tailed grouse would be a priority species for reintroduction efforts.

A and C; thus, there would be no effect to wildlife. New trail segments would be constructed in Alternatives B and D, resulting in long-term impacts to wildlife, primarily burrowing animals. The area disturbed by new trail construction in Alternatives B and D is small (Table 12) and minor adverse impacts are expected to be offset by the benefits of restoring and revegetating abandoned roads and converting some roads to trails.

The conversion of existing roads to trails would minimize the effects to wildlife habitat for Alternatives B and D. Trail construction along existing roadways would result in a narrowing of the tread surface and active restoration (including weed management) in the areas adjacent to the trail. Over the long term, these activities would benefit wildlife and their habitat, and would help mitigate the impacts of public use along these trails.

Trail Use. Public use of trails would result in both short- and long-term adverse effects on wildlife species due to disturbance. While most trails would be along existing roads, the frequency and nature of disturbance would increase relative to present conditions. Presently, Rocky Flats roads are used sporadically by individual maintenance and patrol vehicles, resulting in infrequent disturbance to wildlife for short durations. Public trail use in Alternatives B and D would result in more continuous disturbance from trail users during peak public use periods resulting in minor local adverse impacts to wildlife.

Wildlife responses to recreational use of trails would vary by species, habitat type, and type of recreational use. Factors that influence the amount of wildlife disturbance include:

- Time of year
- Group size
- Number of visitors
- Duration (time spent near habitat)
- Predictability and habituation to trail use
- Noise and detectability
- Natural and created noise/visual barriers

Different uses result in different types of impacts. Visitors engaging in wildlife photography and observation can cause short-term impacts to wildlife due to the long duration and unpredictability of their behavior (Knight and Cole 1995; Weir 2000). The use of established blinds and overlooks, as well as guided interpretive visits, can help mitigate these impacts.

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The use of established viewing blinds and overlooks would help reduce the impacts of public use on wildlife.

Short-term impacts generally apply to individuals rather than populations or communities, and include behavioral changes such as nest abandonment, changes in food habits, and physiological changes such as elevated heart rates during flight (Knight and Cole 1995). Repeated disturbance may result in long-term changes to the behaviors of both individuals and populations. These changes include abandonment of preferred foraging areas, alterations in energy budgets due to flight and, in some cases, abandonment of broad habitat areas (such as the Refuge itself) (Knight and Cole 1995).

Trail use disturbance to large, broad ranging species such as mule deer would result in minor adverse impacts by causing changes in movement patterns and abandonment of certain concentration areas. While elk are occasionally found in portions of Rocky Flats, their presence is limited and sporadic. Changes in public use of the Refuge are not anticipated to affect elk or their periodic use of the Refuge. Trail use in Rock Creek may

impact elk calving areas and calving behavior, although trails would be closed seasonally to protect sensitive breeding areas. The effect of trails on elk migration patterns may be construed as a positive impact if it leads to a reduction in the amount of degradation to sensitive riparian habitat from overbrowsing. For smaller species such as mice, toads, or birds, the presence and ongoing use of a trail would be a minor and localized adverse impact by creating a barrier to movement and use of nearby habitat for species such as voles (Meaney et al. 2002; Dickerson 2003; Miller and Knight 2001).

Potential Impacts of Specific Trails

Northern East-West Trail. The east-west multi-use trail in the northern portion of the Refuge (Alternatives B and D) may result in habitat fragmentation by disrupting the movement of mule deer and other wildlife species between the Rock Creek drainage and the Walnut Creek drainage. While several existing roads cross this area, public use along a single trail may create a barrier of disturbance during periods of high visitation. Such an impact would be moderate over the long term.

Rock Creek Hiking Trail. The hiking-only trail traversing the upper (western) portions of the Rock Creek drainage (Alternatives B and D) would have the potential to pose a moderate impact to the movement of wildlife between Rock Creek and the open lands to the west of the Refuge, as well as disturbance to wildlife species in the vicinity of the trail. As a newly constructed trail, this trail also would have the potential to increase weed dispersal in the area. Because low pedestrian traffic and seasonal closures are expected along this trail, the long-term impacts to wildlife are anticipated to be minor.

Plum Branch Trail. In Alternative D, a hiking trail would traverse the Rock Creek drainage along the Plum Branch. Similar to the Rock Creek trail, this trail would have minor impacts on wildlife movement within the Rock Creek drainage. This trail would follow an existing road through riparian areas and mule deer concentration areas. The effects of disturbance and habitat fragmentation from this trail would be moderate at certain times of the year. During periods of heavy public use, the cumulative effect of this and the three other trails that would traverse the Rock Creek drainage in Alternative D may result in moderate to major impacts to some species of wildlife. These impacts would be partially mitigated by the enforcement of seasonal trail closures.

Southern East-West Trail. In Alternatives B and D, public use along an east-west multi-use trail may result in some fragmentation and disturbance of wildlife movement between Antelope Springs and the Smart Ditch drainage, including mule deer concentration areas. This would constitute a minor, indirect impact to mule deer populations.

Walnut Creek, Smart Ditch, and Woman Creek Trails. In Alternative D, several trails would follow existing roads in close proximity to riparian habitat along Walnut Creek, the Smart Ditch, and South Woman Creek. Public use along these three trails would disturb potential raptor nesting habitat. In addition, public use along the Walnut Creek and Smart Ditch trails has the potential to fragment or disturb mule deer concentration areas. Individually, the indirect impacts of public use would be relatively minor. The combined impact of all three trails, however, may have a moderate impact on the availability of suitable nesting habitat for various raptor species, most notably, American kestrels, great horned owls, and red-tailed hawks.

REFUGE OPERATIONS, SAFETY AND PARTNERSHIPS

Cultural Resource Management

Cultural resource management is not anticipated to affect overall wildlife habitat, populations or species composition on the Refuge. Demolition of the Lindsay Ranch structures in Alternative C would eliminate some barn owl, bat, and invertebrate (honey bee) habitat. These effects would not occur in Alternatives A, B, or D.

Refuge Operations

Fencing

The existing barbed wire boundary fence, which would remain in all alternatives and would have negligible impacts to the movement of wildlife species.



Redwinged blackbird.

Partnerships

In Alternative A, the Service would maintain dialogue with adjacent landowners and open space management agencies, while in Alternatives B, C and D, the Service would meet annually with adjacent open space managers. These activities would benefit wildlife populations on the Refuge by allowing the Service to learn about other landowners' and agencies' wildlife and wildlife habitat management successes and failures. This regional dialogue also would benefit wildlife on the Refuge by improving the coordination of habitat management across jurisdictional boundaries to improve and expand the range of available habitat for many species. Coordination with adjacent land managers also would be useful in protecting wildlife movement corridors between properties.

Research. All alternatives would allow for compatible scientific research that focuses on habitat, wildlife, and public use. All field research would introduce additional short-term researcher disturbance. This disturbance would be offset by improved knowledge that may be directly applied to the management and conservation of habitat.

CUMULATIVE IMPACTS

Mining

The impact of future aggregate mining on wildlife corridors along the western edge of the Refuge would disrupt or alter deer and elk movement between the Refuge and areas to the west and fragment existing grassland communities. Noise and human activity related to mining also would indirectly reduce effective habitat for native wildlife using lands surrounding the Refuge. The cumulative effect of reduced effective habitat, movement barriers and fragmented habitat from mining combined with increased public use may curtail ungulate movements on and off the Refuge and would have moderate adverse impacts to elk and possibly deer use on the Refuge.

Transportation Right of Way

The transfer of Rocky Flats land to other entities for the purposes of transportation improvements may comprise a 50-, 125- or 300-foot right of way along the eastern edge of the Refuge. Habitat for a variety of wildlife species would be included within the various right of way widths. The 50-, 125-, and 300-foot rights of way would include 16, 41, and 99 acres of general wildlife habitat, respectively. None of the right of way widths would include mule deer concentration areas or potential raptor nest sites. However, all of the right of way widths may be close enough to these areas to contribute to their indirect disturbance. The effective area of disturbance

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Internal fencing would be removed.

from an expanded highway corridor also would add to the cumulative effects on wildlife movement and use of habitat near the transportation corridor.

4.6. THREATENED, ENDANGERED, AND CANDIDATE SPECIES

Potential effects to threatened and endangered species from alternative actions were evaluated based on potential impacts to Preble's meadow jumping mouse, which is found in riparian habitat on the Refuge, and bald eagles, which occasionally forage on the site. Impacts to black-tailed prairie dogs, a candidate species present at Rocky Flats, also were evaluated. The determination of effects to these species was based the likelihood for direct impacts to individuals or a loss or change in habitat used by these species. No assessment of effects for threatened or endangered plant species was conducted because none are known to exist at the Refuge.

WILDLIFE AND HABITAT MANAGEMENT ACTIONS

Preble's Habitat Management

The protection and management of riparian and adjacent upland grasslands specifically for Preble's provides long-term benefits to the mouse. The periodic presence of humans in Preble's habitat for monitoring may potentially disturb or temporarily displace individual Preble's. The extent of the disturbance would depend on the magnitude, intensity and duration of surveys, but are expected to be negligible for all alternatives. Alternatives C and D have the greatest potential to

disturb Preble's as a result of more extensive vegetation monitoring than Alternatives A and B. The magnitude and intensity of the disturbance would be substantially less than previous population monitoring of Preble's at Rocky Flats that included extensive trapping, marking and fitting individuals with radio collars.

Habitat surveys in all alternatives would facilitate more responsive management early detection of problems or positive responses to habitat restoration. These surveys would detect any habitat degradation and lead to responsive management actions such as deer and elk population management or weed control.

Road Restoration and Revegetation

Reclamation of roads and stream crossings would benefit all threatened, endangered and candidate species by:

- Improving habitat connectivity
- Reducing habitat fragmentation
- Eliminating conduits for invasive weeds and predators

Alternative A would provide the least benefit by restoring 12 miles of unused roads and seven stream crossings. Alternatives B, C, and D would restore between 25 and 29 miles of unused roads Refuge-wide and up to 13 stream crossings. These alternatives would benefit both Preble's and prairie dogs by reducing habitat fragmentation and restoring connectivity Refuge-wide. Bald eagles would indirectly benefit from reduced fragmentation that may increase the distribution, diversity, and availability of prey populations. Restoration (road restoration in all alternatives and hay meadow restoration in Alternatives B and C) and weed management efforts (all alternatives) may indirectly improve foraging habitat for the bald eagle by increasing the abundance and diversity of prey species in the grasslands at Rocky Flats.

Weed Management

Weed management would benefit threatened, endangered, and candidate species by reducing competition or degradation of habitat from invasive weeds. As discussed in Section 4.4, all forms of weed management would carry inherent short-term risk for adverse direct impacts to threatened and endangered species or their habitat. Alternative A would have the fewest short-term adverse impacts and, conversely, would provide the fewest long-term benefits for threatened and endangered species by limiting efforts primarily to the Rock Creek Reserve. Alternatives B, C, and D would have the greatest short-term adverse impacts, but also would result in the greatest long-term benefits for

threatened and endangered species.

Weed management and habitat restoration efforts would increase populations of some bird and small mammal species that provide prey for bald eagles, while populations of other species would decrease, resulting in overall negligible impacts to eagles.

Deer and Elk Management

The undefined establishment of deer and elk target populations may result in moderate adverse impacts to Preble's habitat from overbrowsing of shrub habitat. Monitoring deer impacts on riparian habitat in Alternatives B and C would benefit Preble's by identifying excessive browsing that would prompt management activities to prevent excessive damage to Preble's habitat. Impacts of deer and elk management on bald eagles and prairie dogs would be negligible in all alternatives.

Prairie Dog Management

Prairie dog management in Alternative A would be most beneficial to prairie dogs by allowing populations to expand naturally throughout the Refuge. Alternatives B and C would limit expansion to 500 and 750 acres respectively, and Alternative D to 1,000 acres. Annual monitoring in all alternatives would facilitate more responsive prairie dog management.

Prairie dog exclusion from riparian, wetland, and xeric tallgrass habitat areas (Alternatives B, C, and D) would not reduce substantially the available colonization sites for prairie dogs, and would maintain the quality of native habitat for other Refuge resources, including Preble's. Intra-Refuge relocation (Alternatives B, C, and D) may benefit prairie dog populations, but would result in an accompanying change in the composition of existing shortgrass and mesic mixed grass habitat. Accepting prairie dogs from off-site locations (Alternative D) may benefit prairie dog populations at the expense of other Refuge resources, but may possibly introduce plague and other diseases.

A moderate adverse impact would occur in Alternative A with the potential expansion of prairie dog colonies into upland foraging habitat and shrub areas that would reduce habitat suitability for Preble's. Alternatives B, C, and D would exclude prairie dog expansion into Preble's habitat resulting in negligible impacts.

Prairie dog expansion in all alternatives would improve foraging conditions for both nesting and wintering bald eagles from surrounding areas. Expanded prairie dog populations may be a particularly important winter prey resource for Front Range eagles (U.S. Fish and Wildlife

Service 1992; Gillihan 1998). The expansion of prairie dog habitat also would benefit other species by providing prey for predators, or habitat for prairie dog associates, such as burrowing owls and horned larks.

Species Reintroduction

In all alternatives, native fish reintroduction would have a negligible impact on terrestrial threatened, endangered and candidate species, including Preble's, prairie dog, and bald eagle. Creating a sustainable native fishery in Rock Creek would benefit aquatic predators such as herons and cormorants, but the native fish are typically too small to provide prey for bald eagles.

Reintroduction of sharp-tailed grouse in all alternatives likely would involve habitat restoration and weed management activities. Alternative A provides for no specific grouse management activities, while Alternatives B, C, and D would be implemented after the development of a management plan. Habitat restoration would benefit Preble's by maintaining or enhancing native grass and shrub communities. Grouse also may provide an additional prey species for both nesting and wintering bald eagles. Managing tallgrass and other grassland habitat for sharp-tailed grouse would conflict with shortgrass habitat requirements of prairie dogs.

PUBLIC USE, EDUCATION AND INTERPRETATION ACTIONS

Public Use

Trail Use. Public use may result in minor indirect impacts to Preble's populations, distribution, and behavior due to trail use in habitat areas. Meaney et al. (2002) found no strong indication that Preble's are adversely impacted by trails, although the study suggests possible negative trail effects on Preble's distribution and abundance.

Alternatives A and C would have the least impact to Preble's resulting from the conversion of existing roads into trails or other public uses. These two alternatives would have no trails or public use of riparian areas. Alternative B would have minor impacts to Preble's because some existing roads within riparian areas would be converted to pedestrian trails. While the existing number of roads would be reduced in this alternative, the use of trails will exceed the current occasional use of roads. The Ecological Services branch of the Service has previously concluded that conversion of a road or two-track did not constitute a change in land use and does not result in "take" of Preble's.

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Trail use in Alternative D could impact nesting sites for raptors.

Public use of the Refuge may displace or discourage bald eagle use of potential foraging or perching areas. Currently, the Refuge is only occasionally visited by wintering bald eagles or possibly by eagles from nearby nesting areas. As habitat restoration progresses and the availability of prey (prairie dogs) increases under the various alternatives, bald eagle use of the Refuge would be expected to increase and potential human-eagle conflicts would also increase. Alternatives A and C would have the least public use and a negligible effect on bald eagles. Alternative B would have more trails and a greater potential impact on bald eagles; however, trails in Alternative B generally avoid riparian areas and other suitable eagle foraging or perching habitat. Alternative D would likely have the highest visitor use, the most diverse uses, and the most widely dispersed human use. Several trails specific to Alternative D would follow existing roads in close proximity to riparian habitat along Walnut Creek, the Smart Ditch,

and South Woman Creek, and public use along all three of the trails may indirectly impact bald eagles by human activity near potential perch sites. Alternatives B and D are expected to have a minor effect on bald eagle because of their limited current use of Refuge habitat.

Trails and visitor use of the Refuge would have negligible to minor impacts on prairie dogs from disturbance or displacement from human disturbance. The experience from trails located within or near prairie dog colonies on City of Boulder and Boulder County open space suggest that prairie dogs adapt to adjacent trails.

Trail Construction. In Alternative B, approximately 0.4 mile of existing roads within Preble’s habitat would be converted to trails and 0.1 mile of new trail construction would occur in Preble’s habitat. In Alternative D, 0.6 mile of existing roads would be converted to trails and 0.1 mile of new trail construction would occur in Preble’s habitat (Table 15).

Construction of a new hiking trail in the Rock Creek area may fragment some habitat as it descends from the pediment top into the Short Ear Branch of Rock Creek (Alternative D). To avoid adverse impacts to Preble’s, construction activities for new trails would be conducted outside of the Preble’s active season (May through September). Adverse impacts would be minor if trails are constructed during Preble’s hibernation. Alternative D has the most human disturbance within Preble’s habitat, the most new trail construction, and the greatest potential for secondary impacts associated with erosion caused by equestrian and bicycle use. New trail construction for Alternatives B and D would have a minor effect on Preble’s because of the limited extent of construction in Preble’s habitat.

Because no new trails would be constructed for Alternatives A and C, there would be no effect on Preble’s habitat. A beneficial effect would occur for all alternatives with the conversion of roads to trails and revegetation of the narrower corridor. Monitoring for recreation impacts in Alternatives B and D would benefit

Table 15. Trail Lengths Within Preble’s Habitat

	Alternatives	
	B	D
Existing Road	0.4 mi.	0.6 mi.
New Trail	0.1 mi.	0.1 mi.
TOTAL	0.5 mi.	0.7 mi.

Mileage based on riparian and wetland vegetation types that supports Preble’s habitat. Upland grassland habitat is not included.

Preble’s through adaptive management prescriptions implemented in response to recreation impacts.

Trail construction in Alternatives B and D may directly impact some prairie dog colonies due to disturbance and fragmentation in their habitat areas. This activity also would indirectly impact bald eagles by eliminating or curtailing use of some potential foraging areas.

Hunting

Limited deer hunting would have no direct impact on any threatened, endangered or candidate species. Indirect short-term impacts would result from disturbance caused by the additional human presence in unpredictable locations and noise from gunshots.

Visitor Use Facilities

Construction of visitor use facilities such as parking areas, overlooks, and viewing blinds would be located in areas of previous disturbance. These facilities for all alternatives would have a negligible effect on threatened, endangered and candidate species.

REFUGE OPERATIONS, SAFETY AND PARTNERSHIP ACTIONS

Minor to negligible adverse impacts to threatened and endangered species would be expected from most Refuge operations, including staffing, office and maintenance facilities and cultural resources management. Alternatives C and D would realize the most benefits from monitoring and adaptive management prescriptions, due to staff available to implement monitoring efforts. These benefits would be reduced in Alternative B. Staffing levels in Alternative A would be inadequate for effective monitoring and management.

Partnerships

In Alternative A, the Service would maintain a dialogue with adjacent landowners and open space agencies. Alternatives B, C, and D would entail annual meetings with Refuge neighbors. These activities would benefit threatened, endangered and candidate species populations on the Refuge by allowing the Service to learn about successes and failures of other landowners and agencies in matters regarding threatened and endangered species habitat management. This regional dialogue also would benefit threatened and endangered wildlife and sensitive plant species on the Refuge by improving coordination of habitat management across jurisdictional boundaries to improve and expand the range of available habitat for many species.

Fencing

The existing stock fence that surrounds the Refuge would be maintained in all alternatives. This would permit wildlife movement, and maintain habitat

connectivity and the exchange of genetic information between species, including Preble’s and prairie dogs.

CUMULATIVE IMPACTS

Mining

Future aggregate mining may directly or indirectly affect Preble’s habitat through habitat loss, introduction of noise and disturbance adjacent to habitat, and by changes to the hydrology that supports riparian habitat used by Preble’s.

Transportation Right of Way

As discussed in the *Reasonably Foreseeable Activities* section in Chapter 2, the transfer of Rocky Flats land to other entities for the purposes of transportation improvements may comprise a 50-, 125-, or 300-foot right of way along the eastern edge of the Refuge. Preble’s habitat, suitable prairie dog habitat and an existing prairie dog colony, and potential bald eagle nesting habitat would be included within the right of way. Construction of a highway between the Refuge and Standley Lake may pose a physical barrier to Preble’s movement and psychological barrier to bald eagle movement. The amount of each habitat type for the various right of way widths is described in Table 16.

Table 16. Habitat Within Various Right of Way Widths

Habitat Type	50-foot right of way	125-foot right of way	300-foot right of way
Preble’s habitat	0.9	2.8	8.5
Prairie dog suitable habitat	12.7	31.9	76.6
Prairie dog colony	< 0.1	0.4	1.9

All areas in acres.

4.7. CULTURAL RESOURCES

The analysis of cultural resource effects was based on known cultural resources present on the site and anticipated disturbances. Effects were evaluated on a site’s integrity of location, design, setting, materials, workmanship, feeling, and association. Site-specific impacts to cultural resources would be determined during final design and layout prior to surface disturbance. As discussed in Chapter 3, no identified cultural resources are recommended as eligible for listing in the National Register of Historic Places.

WILDLIFE AND HABITAT MANAGEMENT ACTIONS

Some weed management tools, such as burning and mowing, have the potential to disturb, destroy, or otherwise impact cultural resource sites throughout

the Refuge. Using these tools may adversely affect the integrity of some resources.

REFUGE OPERATIONS, SAFETY AND PARTNERSHIPS

Cultural Resources

Lindsay Ranch. In Alternatives A, B and D, the Service would stabilize the Lindsay Ranch barn and allow other features, including the ranch house, to deteriorate. The barn would be interpreted in Alternatives B and D. These actions would maintain the scenic, historical, and interpretive value of the barn. The integrity of the ranch house and other features would be lost over time. Alternative C would remove all Lindsay Ranch structures. This action would affect the integrity of the site as a historic, scenic, and interpretive resource.

Other Resources. Construction of new trails or facilities in all alternatives would not affect any identified sites. Disturbance and vandalism associated with improved public access to portions of the Refuge may indirectly affect some resources. In all alternatives, the Service would maintain an inventory of other cultural resources (such as the apple orchard) on the Refuge. None of the additional cultural resources would be maintained or restored. Over the long term, the value of these resources for historical interpretation would be adversely affected. In Alternatives B and D, some of these resources would be interpreted to the public through signage and/or programs. Such interpretation would mitigate the long-term effects of not maintaining such resources.

CUMULATIVE IMPACTS

Transportation Right of Way

As discussed in the *Reasonably Foreseeable Activities* section in Chapter 2, the transfer of Rocky Flats land to other entities for the purposes of transportation



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In Alternatives A, B, and D, the scenic, historic, and interpretive value of the Lindsay Ranch would be maintained.

improvements may comprise a 50-, 125- or 300-foot right of way along the eastern edge of the Refuge. One known cultural resource site would be within in all three right of way widths.

Rocky Flats Cold War Museum

The proposed establishment of the Rocky Flats Cold War Museum near the Refuge would benefit cultural resources associated with the site by providing a venue to present and interpret the history of the site as former ranchland and a nuclear weapons production facility.

4.8. TRANSPORTATION

VISITATION/ACCESS

Visitation in Alternatives A and C would be similar to existing visitation unrelated to site cleanup. Annual visitation in Alternative A is estimated to be about 300 people per year and 1000 people per year in Alternative C, and would be limited to guided tours (Table 17). Because of the public use component of Alternatives B and D, visitation would be considerably higher than Alternatives A and C. In Alternative B, annual visitation is estimated to be 10,000 visitors in the first 3 to 5 years, increasing to 85,000 visitors after year 5 as more public use development occurs. Similarly, Alternative D would have less visitation anticipated in years 1 through 3, and would increase to 135,000 visitors after year 5. In all alternatives, weekend visitation is expected to be twice as much as weekday visitation (Table 17).

Vehicles per day would range from less than 1 in Alternatives A and C to 325 on a weekend in Alternative D (Table 17). For analysis purposes, it was assumed all visitors in all alternatives would access the site by vehicle. Non-motorized access would not occur in Alternatives A and C; the proportion of non-motorized access, such as by foot, bike, or horse, in Alternatives B and D is not known. Vehicles per day estimated for Alternatives B and D probably would be lower than those shown due to non-motorized access.

Alternative B would include three parking areas: a north trailhead parking lot with access off of SH 128; and a central parking lot and west parking lot with a single access off of SH 93 at the location of the existing Rocky Flats Environmental Technology Site gate. Alternative D would include three more parking areas in addition to the parking proposed with Alternative B: a northeast trailhead parking lot with access off of Indiana Street; a southeast trailhead parking lot with an access off of Indiana Street; and an additional west parking area with a visitor center that would use the SH 93 access (David Evans 2003).

Effect on SH 93

The existing access road leading into Rocky Flats Environmental Technology Site carries about 2,700 vehicles per day. In all alternatives, this volume is expected to decrease substantially when the site is converted to a wildlife refuge. Alternative D, which would place the most traffic onto SH 93, would include a visitor center and about 70 parking spaces on the access road. Alternative D would result in an estimated 422 vehicles per day using the SH 93 access on a weekend day after year 5 (Table 18). This is a decrease of almost 85 percent from the current daily traffic. The SH 93 access intersection would not warrant signalization through 2021.

The existing deceleration and acceleration lanes would be beneficial to the safety of the intersection if the traffic signal is removed. The sight distance at the intersection appears adequate for stop control on the SH 93 access. Traffic capacity and operations would also be improved along SH 93 with the removal of the traffic signal (David Evans 2003).

Effect on SH 128

Alternative D would include a roadside overlook at an existing pull off on the south side of SH 128 across from an existing unimproved Boulder County trailhead. The overlook would be improved and paved to match the grade of SH 128. The sight distance is good at this

Table 17. Estimated Visitation and Associated Vehicles Per Day

Period	Alternative A		Alternative B		Alternative C		Alternative D	
	Annual Visitation	Vehicles/day						
Weekday Years 1-3	100	<1	3,300	12	333	<1	8,000	30
Weekend Years 1-3	200	<1	6,700	24	667	<1	17,000	60
Weekday Years >5	100	<1	28,000	102	333	<1	45,000	162
Weekend Years >5	200	<1	57,000	204	667	<1	90,000	325



Habitat restoration in the mixed grassland prairie communities would help enhance internal views on the Refuge.

location and it would be improved with grading improvements. The Boulder County trailhead may provide informal spillover parking for the overlook. Placing pedestrian crossing warning signs would improve safety.

Alternatives B and D would include a trailhead with parking along SH 128 in the vicinity of Rock Creek. The location would provide adequate sight distance from the horizontal curve to the west and good sight distance to the east.

Alternative B would include a pedestrian crossing of SH 128 west of McCaslin Boulevard, contingent on the establishment of connecting trails. Locating the crossing at a signalized intersection would protect pedestrians. Pedestrian signals and push buttons would help crossing pedestrians (David Evans 2003).

Effect on Indiana Street

The existing access for the Rocky Flats Environmental Technology Site from Indiana Street is not proposed for public use in any alternative. Therefore, the existing signal would not be warranted and would likely be removed. Although sight distance is poor looking north from the access, it would be adequate for infrequent use by Service or DOE vehicles. Reducing the existing wide access road approach to the signal would discourage public use for parking or turn around maneuvers. Modifying pavement markings on Indiana Street would

eliminate the existing intersection turn lanes. Traffic capacity and operations would be improved along Indiana Street with the removal of the traffic signal.

Alternative B would include a pedestrian crossing on Indiana Street south of SH 128, contingent on the provision of connecting trails by neighboring entities. This crossing would connect the wildlife refuge trail system to the future Great Western Trail in the Broomfield Open Space east of Indiana Street. Due to the rolling terrain along Indiana Street, the pedestrian crossing would be located north of Walnut Creek to maintain good visibility for approaching vehicles.

Another pedestrian crossing on Indiana Street north of 96th Avenue would be included in Alternative B. This crossing would connect the Refuge trail system to the future Westminster trail system in the Westminster Open Space east of Indiana Street. The proposed location of the crossing south of Woman Creek in the area of the monitoring station has good visibility for approaching vehicles.

Alternative D would include a trailhead with parking along Indiana Street in the vicinity of Walnut Creek. Similar to the potential pedestrian crossing, it is recommended that the trailhead be located north of Walnut Creek to achieve good sight distance with the vertical curves on Indiana Street. Alternative D would include another trailhead with parking along Indiana Street north of the signal at 96th Avenue. The traffic volumes expected to use the accesses would not require acceleration or deceleration lanes for right turning traffic on Indiana Street.

The two trailhead access intersections proposed with Alternative D would need the minimum 40-foot storage length, so the total length of left turn lane required would be 540 feet at each access. Due to the limited distance to the 96th Avenue signal, the left turn lane at the southern trailhead access would be coordinated with the existing left turn lane at the 96th Avenue intersection.

If the roadway improvements at the Indiana Street trailhead accesses require replacement of the drainage structures located near the trailheads, the Service would consult with CDOT to determine if an expanded underpass structure would be needed to accommodate both drainage and pedestrian/bicyclists. This would remove crossing pedestrians and bicyclists from the vehicular travel lanes and lower the possibility of pedestrian and vehicle conflicts (David Evans 2003).

Table 18. Daily and Peak Hour Traffic Volume for Access and Trailheads Proposed in Alternatives B and D

Scenario	Total Site	SH 93 Access		SH 128 Trailhead		N. Indiana Trailhead		S. Indiana Trailhead	
	Daily Volume	Daily Volume	Peak Hour Volume	Daily Volume	Peak Hour Volume	Daily Volume	Peak Hour Volume	Daily Volume	Peak Hour Volume
Alternative B									
Years 1 - 5	48	48	6	-	-	-	-	-	-
Years > 5	409	266	35	143	19	-	-	-	-
Alternative D									
Years 1 - 3	120	78	10	18	2	6	1	18	2
Years 4 - 5	409	266	35	61	8	20	3	61	8
Years > 5	649	422	55	97	13	32	4	97	13

CUMULATIVE IMPACTS

Urban Development

Urban development south of the Refuge would likely increase traffic on the roads and highways that surround the Refuge. Traffic associated with the Refuge and urban development would contribute to the overall traffic.

Transportation Right of Way

The transfer of Rocky Flats land for the purposes of transportation improvements would remove a 50-, 125- or 300-foot right of way along the eastern edge from the Refuge. The right of way would only be transferred if the transportation improvements for which the land is to be made available:

- Are carried out so as to minimize adverse effects on the management of Rocky Flats as a wildlife refuge
- Are included in the regional transportation plan of the metropolitan planning organization designated for the Denver metropolitan area

The transfer of a 50-foot right of way would make the right of way along Indiana Street 100 feet wide, wide enough for a four-lane, undivided road. Similarly, the transfer of a 100-foot right of way would make the right of way along Indiana Street 200 feet wide. A 100-foot or 200-foot wide right of way would not be wide enough for a four-lane, divided highway, such as C-470. Typical right of way widths for a four-lane, divided highway, such as C-470, are 300 to 400 feet. The transfer of a 300-foot right of way would make the right of way along Indiana Street 350 feet wide, wide enough for a four-lane, divided highway. The transfer would be designed to assist in meeting the transportation needs of the northwest corridor.

4.9. OPEN SPACE, RECREATION AND TRAILS

Refuge establishment would make a significant contribution to a nearly contiguous block of open space in northern Jefferson County and southern Boulder County. In all alternatives, the protection of the site from development would help conserve the interconnected natural resources of the Rocky Flats area for the long term. This section provides an analysis of the regional consequences or benefits of the proposed alternatives, and how they would affect resources on adjacent open space lands and trails.

WILDLIFE AND HABITAT MANAGEMENT ACTIONS

Preble's Habitat Management

Successful protection and enhancement of riparian habitat on the Refuge would benefit wildlife species on adjacent open space lands. Protection of riparian habitat also would provide a potential source of Preble's for downstream areas on Rock Creek, and open space to the east (Standley Lake). Recreational users would benefit from riparian area management by maintaining vegetation and scenic diversity.

Xeric Tallgrass Management

Several adjacent open space areas support xeric tallgrass habitat that is similar to the habitat at Rocky Flats. In all alternatives, the Service would develop a vegetation management plan and work with adjacent open space agencies towards regional xeric tallgrass conservation. This management planning and collaboration would benefit both the Service and nearby open space management agencies in their management and restoration of the xeric tallgrass community.

Weed Management

In general, on-going weed management efforts in all alternatives would benefit adjacent open space lands. In Alternative A, the Service would focus weed

management and reduction efforts in the Rock Creek Reserve. Efforts outside of Rock Creek Reserve would be limited to containing existing weed infestations. Adjacent open space lands would be adversely affected if weeds are not adequately contained in Alternative A. The proposed reduction of weed infestations in Alternatives B, C, and D would benefit adjacent open space lands by reducing the spread of weeds onto adjacent lands and by providing a source of information for regional weed management strategies.

Deer and Elk Management

In all alternatives, developing a target population for the Refuge and managing that population would benefit adjacent open space areas by reducing the potential effects of overgrazing or overbrowsing on adjacent open space areas. Alternatives B, C and D would include extensive monitoring of deer and elk populations, deer and elk habitat impacts, and fawning rates and survival in Alternative C. This monitoring would provide long-term benefits to adjacent open space managers by providing a growing base of scientific information that would be used in developing wildlife and habitat management strategies in other areas.

Prairie Dog Management

The Refuge has the potential to support many more prairie dog colonies and individuals than currently occupy the site. A healthy prairie dog population on the Refuge would provide a genetic base for the region if populations on nearby open space lands were eliminated due to plague, predation, or other reasons. In Alternative D, the Service would consider accepting unwanted prairie dogs onto the Refuge from off-Refuge locations. If deemed appropriate, relocations from off-site would benefit nearby open space managers by providing a non-lethal option for prairie dog removal.

Species Reintroduction

Species reintroduction would benefit wildlife diversity on open space lands throughout the area. Any expansion of wildlife populations also would provide a long-term benefit to adjacent open space, and recreational opportunity by improving wildlife viewing opportunities.

PUBLIC USE, EDUCATION AND INTERPRETATION ACTIONS

Public Use

Recreation Opportunities. The wildlife-dependent public use programs proposed in Alternatives B and D would enhance the availability and diversity of outdoor recreation opportunities in the Rocky Flats area. These programs, including environmental education, interpretation, wildlife observation, and trail use, would complement recreational opportunities on nearby open space lands.

The guided tours and interpretive programs in Alternative C would also complement other outdoor recreation and learning opportunities in the Rocky Flats area. However, these opportunities at the Refuge would be limited to 1,000 visitors per year. In Alternative A, visitation would be limited to 300 visitors per year and recreational opportunities would be significantly less than in the other three alternatives.

Wildlife Displacement. Increased human presence, visitor use, and hunting in the Rocky Flats buffer zone in Alternatives B and D have the potential to displace some wildlife species, especially mule deer, and cause them to migrate onto adjacent open space lands. Wildlife displacement onto adjacent lands would decrease wildlife viewing opportunities on the Refuge. The displacement, however, may benefit adjacent open space areas by increasing their native wildlife diversity and opportunities for wildlife viewing, depending on visitor use and habitat conditions on those lands.

Recreation Facilities

Trail Development. Recreational trails exist or are planned on open space parcels to the south, east, and north of Rocky Flats. A segment of the regional Front Range Trail is conceptually planned for the SH 93 corridor on the west side of the Refuge. In Alternatives A and C, which would not have publicly accessible trails, Rocky Flats would continue to be a barrier to regional open space trail connections. In Alternatives B and D, the trail system at Rocky Flats would provide regional connections between Broomfield, Westminster, and Arvada trails, as well as the proposed Front Range Trail. These alternatives would not provide a direct connection to the City of Boulder or Boulder County's trails to the

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Stream crossings would be restored and many roads revegetated.

northwest, and would not provide connections for trail users with dogs. Alternative B would provide less trail connectivity for equestrians than Alternative D because it would not allow horse use on the northern multi-use trails that connect to Broomfield and Superior.

Trailhead Facilities. In addition to trail connections from adjacent open space areas, access to the trails and other wildlife observation facilities at the Refuge would be provided from the main entrance on Highway 93, and trailhead facilities on the periphery. Alternative B would provide a single peripheral trailhead along Highway 128, while Alternative D would provide additional trailhead facilities along Indiana Street. These facilities would benefit public access to the Refuge. However, these outlying access points have the potential to impact the Service's ability to manage visitors and visitor use on the Refuge. In addition, the proposed parking and trailhead location along the north edge of the Refuge has the potential to impact nearby open space resources due to trespass to the north across Highway 128.

Refuge Operations, Safety, and Partnerships Partnerships

Regional Coordination. In Alternative A, the Service would maintain dialogue with adjacent landowners and open space management agencies, while in Alternatives B, C and D, the Service would meet annually with adjacent open space managers. These efforts would benefit both the Refuge and surrounding open space by improving collaboration and coordination in resource and visitor use management plans, strategies and techniques.

Research. Alternatives B, C and D would support research related to wildlife, habitat and public use. Over the long term, this research would benefit nearby open space managers by providing an expanded foundation of scientific knowledge on which they can base resource and public use management decisions.

CUMULATIVE IMPACTS

Trails

The cities of Arvada, Westminster, and Broomfield have future trails planned that can connect to the Refuge and to each other. The Refuge trail systems proposed in Alternatives B and D would contribute to this enhanced network of regional open space trails. In Alternatives A and C, which would not have publicly accessible trails, Rocky Flats would remain a barrier to regional open space trail connections.

Transportation Right of Way

As discussed in the *Reasonably Foreseeable Activities* section in Chapter 2, the transfer of Rocky Flats land to other entities for the purposes of transportation

improvements may comprise a 50, 125 or 300-foot right of way along the eastern edge of the Refuge. The transfer of a right of way would not affect trails or other facilities in Alternatives A and C.

If Alternative B is implemented, two multi-use trails as well as their connections to adjacent open space areas would be included in the right of way. The length of proposed trail would range from about 1,300 feet in the 50-foot right of way to about 2,000 feet in the 300-foot right of way. If Alternative D is implemented, the following public use and recreation facilities would be included in the various right of way widths:

- Three multi-use trails – 6,000 feet in a 50-foot ROW, 6,184 feet in a 125-foot right of way, and 6,572 feet in a 300-foot right of way
- Two off-site trail connections
- Two parking areas
- One trailhead/restroom facility

The transfer of a right of way and subsequent development of a larger roadway would adversely affect some recreational users of the Refuge. Higher noise levels than existing noise levels would be audible on the eastern portion of the Refuge. Elevated levels would affect users seeking solitude at the Refuge.

4.10. VISUAL RESOURCES

Visual resources on the Refuge generally comprise views from surrounding areas, views from Rocky Flats to surrounding landmarks, and internal views. This section evaluates the impacts of the CCP alternatives on these resources. Given the qualitative nature of visual resources, the descriptions of the effects in this section attempt to account for differences in visual preferences.

WILDLIFE AND HABITAT MANAGEMENT ACTIONS

Xeric Tallgrass Management

Habitat Maintenance and Enhancement. In all alternatives, the Service would focus weed management and habitat restoration tools to maintain and enhance the xeric tallgrass communities. Alternative A would focus these efforts on xeric tallgrass habitat within the Rock Creek Reserve. Successful maintenance and restoration of the xeric tallgrass community would likely result in a taller, more robust grassland that would benefit the quality and diversity of views within the Refuge.

Prescribed Fire. Smoke associated with prescribed fire in all alternatives except D would result in short-term visual impacts. Such impacts would include impaired

views of the Rocky Flats/mountain backdrop area from surrounding communities, and obscured views within the Refuge during fires. Blackened stubble that would likely follow fires would be a short-term visual impact.

Grazing. The use of grazing as a grassland management tool may result in short-term visual impacts to some areas due to manure, trampling, and dust. Some may consider the use of livestock on Rocky Flats grasslands to be benefit to internal visual resources, as it may contribute to a pastoral view of Colorado's agricultural heritage. Livestock grazing would not be visible from surrounding communities.

Mixed Grassland Prairie Management

In Alternatives B and C, the 300-acre hay meadow in the southeast corner of the Refuge would be restored to native prairie. During the restoration process, the removal of non-native grasses and the establishment of native grasses would result in short-term visual impacts to the area, which would be bare or patchy for several years. These impacts would affect internal views and distant views from the Refuge looking southeast, where the hay meadow provides a vegetated foreground to panoramic views. However, successful prairie restoration in this area would benefit the visual quality and diversity in the long term.

Road Restoration and Revegetation

In all alternatives, some roads and stream crossings would be removed and revegetated. Once completed, the revegetation efforts would benefit visual aesthetics on the Refuge and views from within the Refuge by creating larger patches of undisturbed grasslands and shrublands.

Deer and Elk Management

In all alternatives, the Service would monitor browse impacts to riparian and upland shrub areas throughout the Refuge. This monitoring, and subsequent actions to prevent overbrowsing, may indirectly benefit internal visual quality in some riparian areas by facilitating healthy, robust vegetation in those areas.

Prairie Dog Management

In all alternatives, prairie dogs would be allowed to naturally expand within their habitat areas. To some, prairie dog colonies add to the natural diversity of the prairie landscape; to others, they are an eyesore. Depending on their location and arrangement, expanded prairie dog colonies may impact the visual quality of Rocky Flats grasslands as they pertain to internal views and as a foreground for distant views toward the east. These impacts would be the most pronounced in Alternatives A (unlimited expansion) and D (where prairie dogs may expand to 1,000 acres) and

less pronounced in Alternatives B and C (750 and 500 acres, respectively).

PUBLIC USE, EDUCATION AND INTERPRETATION ACTIONS

Public Use Facilities

Public use facilities such as trails, parking lots, restrooms, kiosks, viewing blinds and overlooks would be constructed in Alternatives B, C, and D. These facilities would be designed and located to minimize their visual impact both within the Refuge and from outside of its boundaries. Most of these facilities, however, would be visible from surrounding roads. The extent of the visual impact of these facilities would be proportional to their quantity, ranging from negligible in Alternative C to minor in Alternatives A, B and D.

CUMULATIVE IMPACTS

Urban Development

The planned Vauxmont development, as described in the *Reasonably Foreseeable Activities* section in Chapter 2, will be south of the Refuge boundary. This development will change the visual character of the Rocky Flats area, and may result in long-term impacts to the quality of views of the Refuge and the mountain backdrop from nearby communities. This development may also affect views from the Refuge to the south. Refuge facilities and management would not contribute to the visual impacts of adjacent development.

Transportation Right of Way

The transfer of Rocky Flats land to other entities for the purposes of transportation improvements may comprise a 50, 125 or 300-foot right of way along the eastern edge of the Refuge. The transfer of a right of way and subsequent development of a larger roadway would adversely affect easterly views from portions of the Refuge.

Mining

The existing mining areas on the western edge of the Refuge have the potential to expand onto the Refuge in other permitted areas. If all of the permitted areas were mined, the visual quality of the western edge of the Refuge would be affected by aggregate mining operations. Visual resources on the Refuge would be affected, including views of the mountain backdrop from the Refuge, and internal views in the western portion of the Refuge. While expanded mining operations may be visible from surrounding communities, the impact on distant views of the Refuge would be less substantial than more local views from the Refuge.

Wind Technology Center

Located adjacent to the Refuge to the northwest, the National Wind Technology Center operates tall wind turbines for research on wind power generation. From many areas on the Refuge, these turbines interrupt the views of the mountain backdrop and Eldorado Canyon. To some visitors, however, the turbines may be a visual attraction in itself that adds to the character of the Rocky Flats area.

4.11. NOISE**WILDLIFE AND HABITAT MANAGEMENT ACTIONS**

In all alternatives, the Service and/or CDOW may use culling to manage deer and elk populations. Hunting rifles may be used for culling, resulting in occasional gunshots that may be audible throughout the Refuge and off the Refuge. Infrequent gunshots during deer and elk culling would result in a minor increase in noise levels within and around the Refuge.

Public hunting programs in Alternatives B and D may allow the use of short-range weapons such as muzzle-loaders and shotgun slugs. Gunshots associated with the use of such weapons would be audible from within and may be audible on- and off-Refuge, depending on hunter location, wind, and topography. Public hunting on the Refuge would result in short-term minor increase in noise levels in some areas of the Refuge. However, areas in the Refuge used for hunting would be closed to other visitors during hunting periods, and it is unlikely that noise from gunshots would adversely affect the surrounding communities. Noise levels would return to existing levels after hunting ceases.

The removal and revegetation of roads and stream crossings in all alternatives would require the use of heavy equipment to regrade some areas. This equipment would result in short-term minor increase in noise levels in the immediate vicinity of the restoration activities. Noise levels would return to existing levels after construction ceases.

PUBLIC USE, EDUCATION AND INTERPRETATION ACTIONS***Recreation Facilities***

Construction of trails, overlooks, parking lots and other visitor use facilities would require the use of heavy equipment for site excavation and grading. This equipment would produce higher, short-term noise levels in the immediate vicinity of the construction activities. Noise levels would return to existing levels after construction ceases.

CUMULATIVE IMPACTS***Urban Development***

Construction of the proposed Vauxmont development to the south of Rocky Flats will require the use of heavy equipment for site excavation and grading. This equipment will produce higher, short-term noise levels in the immediate vicinity of the construction activities and may add to the cumulative noise levels on the Refuge. Noise levels will return to existing levels after construction ceases.

Transportation Right of Way

The transfer of Rocky Flats land for the purposes of transportation improvements would remove a 50-, 125- or 300-foot right of way along the eastern edge from the Refuge. Transferring a right of way and subsequent development of a larger roadway would increase noise levels on the eastern portion of the Refuge.

4.12. AIR QUALITY**DUST AND EMISSIONS**

Implementation of all alternatives would result in varying levels of equipment usage. Construction of public use facilities, habitat restoration activities, and on-going Refuge management would likely require the use of motorized equipment, which would result in localized carbon monoxide and hydrocarbon emissions. Construction activities also would create fugitive dust. Impacts of equipment usage on the Refuge would have a negligible effect on air quality in the Rocky Flats region, and would be mitigated by best management practices. Increased emissions and dust would cease after construction is completed.

Public access to the Refuge would occur in all alternatives, with Alternative D having the highest public use and Alternatives A and C having the lowest. Some visitors would access the Refuge using automobiles. Auto emissions would be higher in Alternative D and lower in Alternatives A and C.

Prescribed Fire

Prescribed fire has been identified as a grassland management tool in all alternatives except D. This prescription would apply to lands managed by the Service and not lands retained by the DOE. Prescribed fires would be subject to approved plans, and factors such as weather conditions, fuel conditions, adequate firebreaks, and the preparedness of fire management and emergency response crews. Prescribed fire would

be conducted in accordance with approved vegetation management plans, and an approved Fire Management Plan. These step-down plans would be subject to NEPA review and would be developed with the involvement of the public and nearby communities. Any prescribed fire would be conducted in accordance with Service policy, and would adhere to state air quality regulations.

The periodic use of fire may result in short-term increases in particulates and decreased visibility in nearby areas. The amount of smoke and particulates generated by a prescribed fire would depend on several variables, such as wind, soil and vegetation moisture, and fire intensity.

For possible contamination issues outside of the DOE-retained area, the EPA and the CDPHE believe the use of fire is an appropriate management tool on Refuge lands (Appendix D). In accordance with Service and DOE policies, any naturally occurring or human-caused wildfires on the Rocky Flats site, regardless of whether they are on Refuge lands or DOE-retained areas would be aggressively controlled and extinguished.

CUMULATIVE IMPACTS

Urban Development

Urban development south of the Refuge will likely require the use of motorized equipment, which result in localized carbon monoxide and hydrocarbon emissions. Construction activities also create fugitive dust. Cumulatively, construction activities on- and off-Refuge are not expected to adversely affect regional air quality. Increased emissions and dust will cease after construction is completed.

Transportation Right of Way

The transfer of a right of way and subsequent development of a larger roadway would adversely affect air quality near the Refuge. Concentrations of gaseous pollutants near the right of way would increase. The increased concentrations are expected to be minor.

Urban Development

Continued mining adjacent to the Refuge will likely increase dust blowing across the Refuge. Best management practices will reduce the amount of dust generated. Rocky Flats is a very windy location, and best management practices will not be able to be totally effective.

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Views from Rocky Flats to downtown Denver.

4.13. SOCIOECONOMICS

EMPLOYMENT, INCOME, AND HOUSING

Staffing levels at the Refuge would range between two full-time employees in Alternative A to eight employees in Alternative D. Annual staffing income is estimated to range from \$77,000 in Alternative A to \$468,000 in Alternative D. Additional temporary employment as well as indirect employment may be generated during construction of Refuge facilities. These anticipated staffing levels would have a negligible effect on local employment, income or housing conditions in the communities surrounding Rocky Flats, or in the Denver metropolitan region.

Community

Over the long term, the establishment and successful management of Rocky Flats as a National Wildlife Refuge may alter the public perception of the site. While current public perception is dominated by its history as a former nuclear weapons facility with contamination issues, future perceptions may associate the site with wildlife habitat and protected open space. Such a change would benefit Rocky Flats and the surrounding communities. Rocky Flats serves as both a gateway and a backdrop to several surrounding communities, including Boulder, Arvada, Superior, and Broomfield. The open, rural visual character of all alternatives would benefit these communities.

Environmental Justice

Rocky Flats is not located in an area predominated by minority and low-income populations. None of the alternatives would result in disproportionately high and adverse human health or environmental effects on a minority population, low-income population, or Native American tribe.

CUMULATIVE IMPACTS

Urban Development

Construction of the Vauxmont development south of the Refuge along with the Refuge Development may benefit economic and employment conditions in Arvada as well as other nearby communities. While Refuge establishment may make development of adjacent lands more attractive, it would not cumulatively affect any land use, employment or income conditions outside of the Refuge.

Transportation Right of Way

The socioeconomic consequences of DOE transferring the right of way is beyond the scope of this EIS.

4.14. WILDERNESS REVIEW

A wilderness review is the process used by the Service to determine whether to recommend lands or waters in the NWRS to Congress for designation as wilderness. The Service is required to conduct a wilderness review for each refuge as part of the CCP process. Land or

waters that meet the minimum criteria for wilderness are identified in a CCP and further evaluated to determine whether they merit recommendation for inclusion in the Wilderness System. According to Section 13 of the Service's Director's Order No. 125 (July 2000), in order for a refuge to be considered for wilderness designation, all or part of the Refuge must:

- Be affected primarily by the forces of nature, with the human imprint substantially unnoticeable
- Have outstanding opportunities for solitude or primitive and unconfined type of recreation
- Have at least 5,000 contiguous acres or be sufficient in size to make practical its preservation and use in an unimpaired condition, or be capable of restoration to wilderness character through appropriate management, at the time of review
- Be a roadless island

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Future aggregate mining may impact wildlife habitat.

Rocky Flats NWR does not meet the above criteria and is not recommended for inclusion in the Wilderness System. The Refuge has considerable evidence of past human use; does not have outstanding opportunities for solitude or unconfined recreation; and is not roadless.

4.15. FENCING CONSIDERATIONS

The Refuge Act (Appendix A) directs the Service to consider “the characteristics and configuration of any perimeter fencing that may be appropriate or compatible for cleanup and closure purposes, refuge purposes, or other purposes.” Fencing options that were considered during the planning process include:

- Chain-link security fence
- Barbed-wire stock fence (existing)

After consideration of the two fencing options, the maintenance of the existing stock fence was retained for all alternatives, as described in Objective 6.3 - *Fencing*. The chain-link security fence was not recommended because of the cost and ecological impacts and it would not be consistent with the Refuge purpose and goals. These costs and impacts are described as follows.

Fencing Costs

The estimated cost of installing a 6-foot chain-link security fence around the perimeter of the Refuge (a distance of about 13.5 miles) is about \$4 million. A

barbed-wire stock fence, which is currently in place, would have no installation costs. Costs of materials needed to maintain a chainlink fence would be approximately \$7.50 per linear foot while barbwire fencing materials would be only \$.17 per linear foot. Fence maintenance costs would be included in the Refuge operations budget.

Fencing Impacts

Wildlife

A chain-link security fence would result in major, long-term impacts to the movement of wildlife between the Refuge and surrounding areas. The fence would directly impact several mammal species such as deer, elk, fox, and coyote, while it may indirectly impact many other species due to changes in predator-prey relationships and habitat conditions. Such a fence may be an annoyance to prairie dogs, but would not likely create a barrier to movement for Preble’s, prairie dogs, or bald eagles.

The existing barbed wire boundary fence would have negligible impacts to the movement of wildlife species, habitat connectivity, and the exchange of genetic information between species, including Preble’s and prairie dogs.

Visual Resources

A chain-link boundary fence would be visible from within the Refuge and from neighboring areas, changing the character of the Refuge from rural to semi-industrial. This change in the visual character of the Refuge and its surroundings would have a long-term major impact on visual resources in the immediate Rocky Flats area. However, this change would not be discernable from greater distances and would have a negligible impact on views of the mountain backdrop from surrounding communities.

The existing barbed-wire stock fence would maintain the rural character of the Refuge, would not be visible from most areas, and would not impact views of or from the Refuge.

4.16. ADHERENCE TO PLANNING GOALS

Goal 1. Wildlife and Habitat Management

Conserve, restore, and sustain biological diversity of the native flora and fauna of the mountain/prairie interface with particular consideration given to threatened and endangered species.

While basic resource management would occur Refuge-wide under Alternative A, it would not be sufficient to satisfy this goal. However, the resource management

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Sparrow

activities for the Rock Creek Reserve (as directed by the 2001 Rock Creek Reserve Integrated Natural Resources Management Plan) would satisfy Goal 1.

Alternatives B, C, and D would all satisfy Goal 1. The habitat restoration and resource management programs in all of these alternative are sufficient, though they would be the strongest in Alternative C, followed by B and D.

Goal 2. Public Use, Education, and Interpretation

Provide visitors and students high quality recreational, educational, and interpretive opportunities and foster and understanding and appreciation of the Refuge's xeric tallgrass prairie, upland shrub, and wetland habitats; native wildlife; the history of the site; and the NWRS.

While limited guided tours and interpretation would occur in Alternatives A and C, these programs would not be sufficient to satisfy Goal 2. Alternatives B and D both satisfy this goal, with the programs in D having the strongest adherence to the goal.

Goal 3. Safety

Conduct operations and manage public access in accordance with the final Rocky Flats cleanup decision documents to ensure the safety of the Refuge visitors, staff, and neighbors.

All alternatives would ensure the safety of visitors, staff, and neighbors, and would satisfy Goal 3.

Goal 4. Effective and Open Communication

Conduct communication outreach efforts to raise public awareness about Refuge programs, management decisions, and the mission of the U.S. Fish and Wildlife Service and the NWRS among visitors, students, and nearby residents.

Outreach efforts in Alternative A would be minimal, and would only partially satisfy Goal 4. Efforts in

Alternatives B and D would be much more extensive and would satisfy this goal. Outreach efforts in Alternative C would be similar, but would not reach many visitors.

Goal 5. Working with Others

Foster beneficial partnerships with individuals, government agencies and non-governmental organizations and others that promote resource conservation, compatible wildlife-related research, public use, site history, and infrastructure.

Alternatives B, C, and D would satisfy Goal 4, while the reduced partnership efforts in Alternative A would partially satisfy the goal.

Goal 6. Refuge Operations

Based on available funds, provide facilities and staff to fulfill the Refuge vision and purpose.

While the staffing levels in Alternative A would be sufficient to manage the proposed activities, the alternative would not fulfill the Refuge vision and purpose. Alternatives B, C, and D would all provide sufficient facilities and staff to satisfy Goal 6.

4.17. RESOURCE COMMITMENTS COMMON TO ALL ALTERNATIVES

NEPA requires a discussion of any irreversible or irretrievable commitment of resources that would result from implementing the alternatives. An irreversible commitment of resources means nonrenewable resources are consumed or destroyed. These resources are permanently lost due to plan implementation. In contrast to an irreversible commitment of resources, an irretrievable commitment of resources is the loss of resources or resource production, or use of renewable resources during the 15-year life of the plan.

Table 19. Adherence to Planning Goals

GOAL	A L T E R N A T I V E S			
	A	B	C	D
1. Wildlife and Habitat Management	-	‘	‘	‘
2. Public Use, Education and Interpretation	3	‘	3	‘
3. Safety	‘	‘	‘	‘
4. Effective and Open Communication	-	‘	-	‘
5. Working with Others	-	‘	‘	‘
6. Refuge Operations	3	‘	‘	‘
‘ = The alternative satisfies the goal.				
- = The alternative partially satisfies the goal.				
3 = The alternative does not satisfy the goal.				

All alternatives would result in an irreversible commitment of soil resources. Topsoil would be removed before trail and facility construction for use in revegetation of disturbed areas, but some irreversible soil loss due to erosion would occur. The soil productivity of trails over the long term would be less than original undisturbed conditions, which would be an irreversible commitment of resources. Loss of soil productivity and vegetation, as well as changes to visual resources due to facility development would be an irretrievable commitment of resources.

Federal funding for staff and operations would be an irretrievable commitment of resources. These resources would not be available for other federal programs or projects.

Fossil fuels used during construction of facilities would represent an irreversible commitment of resources because their use is lost for future generations.

Rocky Flats lands transferred from the DOE to the Service would be retained as “public lands” unavailable for private use or development, with the exception of the transportation right of way. DOE also may transfer up to a 300-foot right of way. These transfers would be an irretrievable commitment of resources.

4.18. SHORT-TERM USES OF THE ENVIRONMENT AND MAINTENANCE OF LONG-TERM PRODUCTIVITY

Historical uses of the Refuge, including early settlement, the manufacture of nuclear weapons components, and cleanup of soil and ground water contamination, have affected the long-term productivity of the Refuge’s ecological environment. Short-term uses of the Refuge associated with implementing the CCP include the construction of facilities and modifications and enhancement of the natural environment. The effects of implementing the CCP would contribute to the maintenance and enhancement of long-term productivity of the Refuge environment.

4.19. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Adverse environmental effects associated with implementation of the CCP would be short term and minimal. During construction of additional facilities on the Refuge, wildlife would be disturbed and temporarily displaced. Facilities construction also would result in

minor, short-term disturbance of soils and erosion. The long-term effects of implementing the CCP would be beneficial to the biological community and the diversity and productivity of the Refuge ecosystem.

4.20. COMPARISON OF ALTERNATIVES

On the following pages, Table 20 compares the effects of the alternatives relative to the resources discussed in Chapter 3. Summary statements in this table are abbreviated and taken out of context to provide a quick comparison by resource. The reader is encouraged to review the supporting analysis in Chapter 4.

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Table 10. Impact Threshold Definition

Impact Topics	Negligible	Minor	Moderate	Major
GEOLOGY AND SOILS	Change to the landscape or geologic formations would not be noticeable. Soils would not be affected or the effect would be below or at the lower end of detection. Any effects to soil productivity or fertility would be slight.	The effects to the landscape, geologic formations, and soils would be detectable. Changes to the landscape and geologic features would be small in size or area. The extent and magnitude of effects to soil productivity or fertility would be small or short-lived.	The effect to the landscape, geology, and soils would be readily apparent. Effects would result in a change to the landscape, geology, and soil character over a relatively large area or multiple locations.	The effect on the landscape, geology, and soils would be readily apparent and would substantially change the character of these resources over a large area.
WATER RESOURCES	Changes in water quality or quantity would not be measurable.	Changes in water quality or quantity would be measurable, although the changes would be small and the effects would be localized. Water quality standards would not be exceeded.	Changes in water quality or quantity would be measurable, affecting water resources on Rocky Flats. Water quality standards would be exceeded on the Refuge.	Changes in water quality or quantity would be readily measurable, and would be noticed off of Rocky Flats. Water quality standards would be exceeded off the Refuge.
VEGETATION COMMUNITIES	Some individual native plants would be affected, but there would be no effect on native species populations. The effects would be on a small scale.	Some individual native plants would be affected over a relatively small area and minor portion of that species' population. A minor introduction or spread of non-native plant species is possible over a small area and eradication or control would be easily achieved.	Some individual native plants would be affected over a relatively wide area or multiple sites and would be readily noticeable. There would be limited impact to the species population, but for individual species, a sizeable segment of the species' population could be affected. The introduction or spread of non-native plant species would occur at multiple locations and extensive weed control measures would need to be implemented.	Native plant populations would be affected over a relatively large area. A widespread introduction or spread of non-native plant species would occur resulting in the likely establishment of exotic species and the need for aggressive weed control.
WILDLIFE AND AQUATIC SPECIES	Wildlife and aquatic resources would not be affected or the changes would be so slight that they would not be of any measurable or perceptible consequence to a species' population on a regional or local scale.	Effects to individual wildlife and aquatic species are possible, although the effects would be localized, small, and of little consequence to the species' population on a regional or local scale.	Effects to individual wildlife and aquatic species are likely and localized, with consequences at the population level.	Effects to wildlife and aquatic resources would have substantial consequences to species populations on both a local and regional scale.

Table 10. Impact Threshold Definition (continued)

Impact Topic	Negligible	Minor	Moderate	Major
THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONCERN	No federally listed species would be affected, or an individual of a listed species or its critical habitat would be affected, but the change would be so small that it would not be of any measurable or perceptible consequence to the protected individual or its population. Negligible effect is the same as a "no effect" determination in a U.S. Fish and Wildlife Service Biological Opinion.	Individuals of a listed species or its habitat would be affected, but the change would be small or short-lived. Minor effect is the same as a "may effect" determination in a U.S. Fish and Wildlife Service Biological Opinion and would be accompanied by a statement of "not likely to adversely affect" the species.	An individual or population of a listed species, or its habitat would be noticeably affected. The effect could have some long-term consequence to the individual, population, or habitat. Moderate effect is the same as a "may effect" determination in a U.S. Fish and Wildlife Service Biological Opinion and would be accompanied by a statement of "likely to adversely affect" the species or a "not likely to adversely affect with mitigation and conservation measures."	An individual or population of a listed species, or its habitat would be noticeably affected with a long-term, consequence to the individual, population, or habitat. Major effect is the same as a "may effect" determination in a U.S. Fish and Wildlife Service Biological Opinion and would be accompanied by a statement of "likely to adversely affect" the species or critical habitat. Mitigation and conservation measures would lessen the affect, but would not completely remove the adverse affect."
CULTURAL AND HISTORIC RESOURCES	Impact is at the lowest level of detection, with no perceptible consequences, either adverse or beneficial, to archeological or historic resources. For purposes of Section 106, the determination of effect would be no adverse effect.	Disturbance of a site would be confined to a small area with little, if any, loss of important information potential. Impact would not affect a character-defining feature of a structure or building listed or eligible for listing in the National Register of Historic Places. For purposes of Section 106, the determination of effect would be no adverse effect.	Disturbance of a site would not result in a substantial loss of important information. Impact would alter a character-defining feature of the structure or building, but would not diminish the integrity of the resource to the extent that its National Register eligibility is jeopardized. For purposes of Section 106, the determination of effect would be adverse effect or no adverse effect.	Disturbance of a site is substantial and results in the loss of most or all of the site and its potential to yield important information. Impact would alter a character-defining feature of the structure or building, diminishing the integrity of the resource to the extent that it is no longer eligible to be listed in the National Register. For purposes of Section 106, the determination of effect would be an adverse effect.
OPEN SPACE, RECREATION AND TRAILS	Changes in visitor use or recreation opportunity would be below the level of detection.	Changes in visitor use or recreation opportunity would be detectable, but the changes would be slight.	Changes in visitor use or recreation opportunity would be apparent, but temporary.	Changes in visitor use or recreation opportunity would be readily apparent and long-lasting.
VISUAL RESOURCES	Effects would not result in any perceptible changes to existing viewsheds.	Changes to visual resources would be short-lived or affect a small portion of the Refuge.	Effects would be readily apparent and would change the character of the visual resources in the area.	Effects would be highly noticeable and permanent, affecting significant views of or from the Refuge.
NOISE	New noise sources would be below existing levels.	New noise sources would be above existing levels, but would be temporary and not adversely affect visitors or wildlife.	New noise sources would be substantially above existing levels and would adversely affect visitors and wildlife for short periods of time.	New noise sources would be substantially above existing levels and would adversely affect visitors and wildlife for long periods of time.

Table 10. Impact Threshold Definition (continued)

Impact Topic	Negligible	Minor	Moderate	Major
TRANSPORTATION	Changes in traffic at or around the Refuge would not be noticeable.	Traffic at or around the Refuge would increase above existing conditions, but would not be noticeable to most travelers on surrounding public roads.	Traffic to and from the Refuge would increase above existing conditions. The additional traffic would cause an unacceptable level of service at some locations.	Traffic to and from the Refuge would increase substantially, causing an unacceptable level of service at many locations.
AIR QUALITY	Change in existing air quality or visibility would not be measurable or noticeable.	Increased airborne pollutants would be slight, but measurable. Changes in visibility would be observable at local sites. Air quality standards would not be exceeded.	Increased airborne pollutants would be readily measurable. Impacts to visibility would be readily observable and widespread. Air quality standards would be exceeded on the Refuge.	Increased airborne pollutants would be readily measurable. Visibility at the Refuge or surrounding areas would be reduced. Air quality standards would be exceeded off the Refuge.
SOCIO-ECONOMIC RESOURCES	No effects would occur or the effects to socio-economic conditions would be below or at the level of detection.	Effects to employment, income and housing would be insignificant in relation to the local economy. Effect on low income and minority populations would be similar to the surrounding area.	Effects to employment, income and housing would be measurable, altering the local economy. Impacts borne by low income and minority populations would be slight, but larger than average in the surrounding area.	Effects to employment, income, and housing would have substantial impacts to the regional population or economy. Impacts borne by low income and minority populations would be significantly larger than the average in the surrounding area.

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Table 20. Summary of Environmental Consequences

	ALTERNATIVE A – <i>No Action</i>	ALTERNATIVE B – <i>Wildlife, Habitat, & Public Use (Proposed Action)</i>
Geology and Soils	<ul style="list-style-type: none"> • Deer and Elk Management: Population control would reduce potential for soil erosion due to overgrazing. • Prairie Dog Expansion: May result in increased soil erosion. These impacts may be offset by the increased nutrient cycling and soil stability provided by prairie dog colonies. Effects could be Refuge-wide. • Road Restoration and Revegetation: Removal and revegetation of roads and stream crossings would result in short-term soil disturbance and erosion. Long-term benefits of revegetation would offset the short-term effects. <ul style="list-style-type: none"> - 12 miles of road and 7 stream crossings restored - Rock Creek Reserve only 	<ul style="list-style-type: none"> • Prairie Dog Expansion: Same effects as A, up to 750 acres. • Mixed Prairie Grassland Management: Restoration of hay meadow and other disturbed areas would result in short-term soil disturbance and long-term benefits. • Road Restoration and Revegetation: Road removal would result in short-term soil disturbance and erosion. Long-term benefits of revegetation would offset the short-term effects. <ul style="list-style-type: none"> - 25 miles of road and 13 stream crossings restored • Public Use and Maintenance Facilities: New trails and facilities would result in localized soil disturbance and erosion during construction, and long-term impacts from use. <ul style="list-style-type: none"> - Soil loss on 1.1 acres from facilities - Soil disturbance from 1.7 miles of newly constructed trail
Water Resources	<ul style="list-style-type: none"> • Preble’s Habitat Management: Protection and maintenance of riparian habitat and vegetated buffer would benefit water resources. • Road Restoration and Revegetation: Road removal in Rock Creek Reserve may result in short-term impacts due to sedimentation, and long-term benefits due to improved bank vegetation, stream channel, etc. Outside of Rock Creek Reserve, lack of restoration may result in long-term sedimentation from existing roads. 	<ul style="list-style-type: none"> • Weed Management: Localized, short-term erosion may occur following prescribed fire or grazing. • Road Restoration and Revegetation: Road removal Refuge-wide may result in short-term impacts due to sedimentation, and long-term benefits due to improved bank vegetation, stream channel, etc. • Public Use: Trail use and off-trail use near streams may result in bank destabilization and erosion. Facility construction may result in short-term impacts due to erosion and sedimentation.

ALTERNATIVE C – <i>Ecological Restoration</i>	ALTERNATIVE D – <i>Public Use</i>
<ul style="list-style-type: none"> • Prairie Dog Expansion: Same effects as A, up to 500 acres. <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> • Road Restoration and Revegetation: Same as B, except: <ul style="list-style-type: none"> - 29 miles of road and 13 stream crossings restored <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> • Public Use and Maintenance Facilities: Same as B, except: <ul style="list-style-type: none"> - Soil loss on 0.2 acres from facilities - No newly constructed trails 	<hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> • Prairie dog expansion: Same effects as A, up to 1,000 acres. <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> • Road Restoration and Revegetation: Same as A, except: <ul style="list-style-type: none"> - 25 miles of road and 6 stream crossings restored <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> • Public Use and Maintenance Facilities: Same as B, except: <ul style="list-style-type: none"> - Soil loss on 1.7 acres from facilities - Soil disturbance from 3.3 miles of newly constructed trail
<hr style="border-top: 1px dashed black;"/> <hr style="border-top: 1px dashed black;"/> <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> • Lindsay Pond: Pond removal would result in a long-term loss of aquatic habitat, water storage, and sediment removal. 	<ul style="list-style-type: none"> • No grazing or prescribed fire. <hr style="border-top: 1px dashed black;"/> <hr style="border-top: 1px dashed black;"/> <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> • Public Use: Same effects as B.

Table 20. Summary of Environmental Consequences (continued)

	ALTERNATIVE A – <i>No Action</i>	ALTERNATIVE B – <i>Wildlife, Habitat, & Public Use (Proposed Action)</i>
Vegetation Communities	<ul style="list-style-type: none"> • Deer and Elk Management: Population management by CDOW and vegetation monitoring would benefit vegetation by reducing impacts of overbrowsing/ overgrazing. Benefits more uncertain by lack of a timeframe. • Prairie Dog Management: Exclusion of prairie dogs from riparian and xeric tallgrass habitat in Rock Creek Reserve would benefit these communities. Outside of Rock Creek Reserve, prairie dogs could degrade plant communities. • Preble’s Habitat Management: Maintenance and protection of riparian and wetland habitat would benefit these communities. <ul style="list-style-type: none"> - Exclusion of ungulates would benefit riparian habitat • Xeric Tallgrass Conservation: Management planning and regional conservation efforts would benefit xeric tallgrass community. Benefits would be limited to Rock Creek Reserve. • Road Restoration and Revegetation: Road removal would benefit vegetation communities within the Rock Creek Reserve by reducing fragmentation. Removal of stream crossings would result in short-term impacts to wetlands and riparian habitat. Would result in: <ul style="list-style-type: none"> - 22 acres of additional habitat - Average patch size of 58 acres • Weed Management: Weed management efforts in Rock Creek Reserve would benefit vegetation communities. <ul style="list-style-type: none"> - Chemical, biological, and mechanical control may have short-term adverse impacts that would be offset by long-term benefits. Benefits may be reduced by lack of grazing as a management tool - Outside of Rock Creek Reserve, benefits would be greatly reduced 	<ul style="list-style-type: none"> • Deer and Elk Management: Same benefits as A, except benefits would be increased by the Service’s larger role and the 5-year target population timeframe. • Prairie Dog Management: Prairie dogs may impact some plant communities. Exclusion of prairie dogs from riparian and xeric tallgrass habitat Refuge-wide would benefit these communities. • Preble’s Habitat Management: Maintenance, protection, and improvement of riparian and wetland habitat would benefit those communities. <ul style="list-style-type: none"> - Exclusion of ungulates would benefit riparian habitat - Monitoring recreation impacts only may provide insufficient information for effective riparian habitat management • Xeric Tallgrass Conservation: Same as A, except benefits would be Refuge-wide. • Mixed Grassland Prairie Management: Restoration of hay meadow and other areas would benefit grassland communities. • Road Restoration and Revegetation: Road removal would benefit vegetation communities Refuge-wide by reducing fragmentation. Removal of stream crossings may result in short-term impacts to wetlands and riparian habitat, with long-term benefits. Would result in: <ul style="list-style-type: none"> - 45 acres of additional habitat - Average patch size of 98 acres • Weed Management: Same as A, except benefits and impacts would be Refuge-wide. <ul style="list-style-type: none"> - Benefits may be increased because of Refuge-wide use of prescribed fire and grazing • Public Use Facilities: New trails and facilities would directly impact vegetation, and indirectly impact adjacent vegetation. Impacts include: <ul style="list-style-type: none"> - 2 acres of impacts to xeric tallgrass grassland - 2.6 acres of mixed grassland • Off-trail Use: Minor impacts to vegetation due to trampling, social trails, and weed dispersal. • Public Use Monitoring: Monitoring impacts of public use on riparian habitat would provide long-term benefit. • Regional Coordination: Coordination with adjacent landowners would benefit vegetation through better management. • Research: Habitat-related research would benefit vegetation and habitat management.

ALTERNATIVE C – <i>Ecological Restoration</i>	ALTERNATIVE D – <i>Public Use</i>
<ul style="list-style-type: none"> • Preble’s Habitat Management: Same as B, except: <ul style="list-style-type: none"> - Vegetation surveys would benefit riparian habitats 	<ul style="list-style-type: none"> • Prairie Dog Relocation: Accepting unwanted prairie dogs from other jurisdictions may impact grassland communities. • Preble’s Habitat Management: Same as B.
<ul style="list-style-type: none"> • Road Restoration and Revegetation: Same as B, with a larger reduction in fragmentation. Would result in: <ul style="list-style-type: none"> - 53 acres of additional habitat - Average patch size of 121 acres 	<ul style="list-style-type: none"> • Road Restoration and Revegetation: Same as B, except no benefits from hay meadow restoration. Would result in: <ul style="list-style-type: none"> - 46 acres of additional habitat - Average patch size of 97 acres
<ul style="list-style-type: none"> • Public Use Facilities: Same as B, except: <ul style="list-style-type: none"> - 0.01 acre of impacts to xeric tallgrass grassland 	<ul style="list-style-type: none"> • Weed Management: Same as A, except benefits and impacts would be Refuge-wide. Benefits may be reduced due to a lack of grazing and prescribed fire as management tools. • Public Use Facilities: Same as B, except: <ul style="list-style-type: none"> - 2.9 acres of impacts to xeric tallgrass grassland - 3.2 acres of mixed grassland
	<ul style="list-style-type: none"> • Off-trail Use: Same as B.
	<ul style="list-style-type: none"> • Public Use Monitoring: Same as B.

Table 20. Summary of Environmental Consequences (continued)

	ALTERNATIVE A – <i>No Action</i>	ALTERNATIVE B – <i>Wildlife, Habitat, & Public Use (Proposed Action)</i>
Wildlife	<ul style="list-style-type: none"> • Native Fish Reintroduction: Would provide long-term benefits to fish populations and survival rates. • Sharp-tailed Grouse Reintroduction: Lack of management plan may result in conflicting management priorities and adverse impacts on introduced grouse. • Deer and Elk Management: Passive approach to population management by CDOW with no set timeframe; may impact ungulates and other resources. <ul style="list-style-type: none"> - Culling would impact individual animals due to mortality, but would provide long-term population benefits. - Monitoring levels would be inadequate for effective population management. • Preble’s Habitat Management: Habitat protection would benefit other riparian wildlife species. • Prairie Dog Management: Colony expansion could result in long-term impacts to vegetation structure and local extirpation of some species over large areas of the Refuge. • Road Restoration and Revegetation: Road revegetation would benefit various wildlife species in Rock Creek Reserve. • Vegetation and Wildlife Monitoring: May result in short-term impacts (disturbance/displacement) to individual animals. • Xeric Tallgrass Management: Efforts in Rock Creek Reserve may have short-term adverse impacts to wildlife and long-term benefits due to habitat enhancement. • Weed Management: Various management tools have the potential to cause direct mortality or injury to individual animals. Impacts would be offset by long-term benefits of improved habitat. • Regional Coordination: Coordination with other land managers would improve wildlife and habitat management. 	<p style="text-align: right;">-----></p> <ul style="list-style-type: none"> • Sharp-tailed Grouse Reintroduction: Management planning and weed management efforts would benefit grouse reintroduction efforts. • Deer and Elk Management: Population targets would be realized within 5 years, providing moderate benefits. <ul style="list-style-type: none"> - Culling and hunting would impact animals due to mortality or stress, would provide long-term benefits. - Monitoring would be minimum necessary for effective population management. • Preble’s Habitat Management: Same as A, plus: Minor impacts to riparian wildlife species due to greater Preble’s monitoring. • Prairie Dog Management: Same as A except reduced magnitude of change (750 acres). • Road Restoration and Revegetation: Road revegetation would benefit various wildlife species Refuge-wide. <p style="text-align: right;">-----></p> <ul style="list-style-type: none"> • Xeric Tallgrass Management: Efforts Refuge-wide may have greater short-term adverse impacts to wildlife and long-term benefits due to habitat enhancement. • Mixed Grassland Prairie Management: Restoration of disturbed areas may impact some resident wildlife; would result in long-term habitat benefits to wildlife. <p style="text-align: right;">-----></p> <ul style="list-style-type: none"> • Public Use: Trail use throughout the Refuge may adversely affect wildlife in the following ways: <ul style="list-style-type: none"> - Creating a new disturbance that may disrupt wildlife movement and fragment habitat areas. - New trails may provide a conduit for predators and weeds. - Short-term stress and adjustment for mule deer; followed by long-term benefits of increased deer movement that may improve genetic diversity and decrease habitat impacts. • Regional Coordination: Same as A, except more pronounced benefits due to better coordination. • Research: Short-term wildlife disturbance would be offset by improved knowledge of wildlife management. • Fence Removal: Removal of unnecessary interior stock fencing would benefit wildlife species by facilitating open movement through Refuge.

ALTERNATIVE C – <i>Ecological Restoration</i>	ALTERNATIVE D – <i>Public Use</i>
<ul style="list-style-type: none"> • Native Fish Reintroduction: Same as A, except: Removal of the Lindsay Ponds would result in major adverse impacts to common shiner and redbelly dace populations on the Refuge. 	<ul style="list-style-type: none"> • Native Fish Reintroduction: Same as A.
<ul style="list-style-type: none"> • Deer and Elk Management: Same as B, except: <ul style="list-style-type: none"> - No hunting. - Monitoring would provide adequate information for effective population management. - Fawn monitoring may result in injury or death of some fawns. 	<ul style="list-style-type: none"> • Deer and Elk Management: Same as B, except: <ul style="list-style-type: none"> - Monitoring levels would be inadequate for effective population management.
<ul style="list-style-type: none"> • Prairie Dog Management: Same as A except reduced magnitude of change (500 acres). 	<ul style="list-style-type: none"> • Prairie Dog Management: Same as A except moderate magnitude of change (1,000 acres).
<ul style="list-style-type: none"> • Vegetation monitoring: May result in short-term impacts (disturbance/displacement) to individual animals. More extensive monitoring may have greater impacts. 	
<ul style="list-style-type: none"> • Public Use: Impacts in Alternative C would be negligible. • Lindsay Ranch: Removal of structures would eliminate some habitat for barn owl, bats, and other species. 	<ul style="list-style-type: none"> • Public Use: Same as B, except: <ul style="list-style-type: none"> - Additional impacts to raptor nesting habitat. - General impacts to wildlife more pronounced.

Table 20. Summary of Environmental Consequences (continued)

	ALTERNATIVE A – <i>No Action</i>	ALTERNATIVE B – <i>Wildlife, Habitat, & Public Use (Proposed Action)</i>
Threatened, Endangered and Candidate Species	<ul style="list-style-type: none"> • Grouse Reintroduction: Grouse habitat management would benefit Preble’s habitat, provide additional eagle prey; may conflict with prairie dog habitat management. • Deer and Elk Management: Delayed population management may impact Preble’s through overbrowsing. • Prairie Dog Management: Unlimited colony expansion acres would benefit prairie dogs, and improve foraging for bald eagles, but could impact Preble’s habitat. • Preble’s Habitat Management: Exclusion of grazing from habitat may have moderate benefits to Preble’s. Monitoring could lead to short-term disturbance. Habitat management may benefit bald eagle foraging perches. • Road Restoration and Revegetation: Revegetation of unused roads and stream crossings would benefit all species. • Weed Management: Short-term habitat impacts from management tools followed by long-term habitat improvements. 	<ul style="list-style-type: none"> • Deer and Elk Management: More aggressive population management could benefit Preble’s by reducing overbrowsing. • Prairie Dog Management: Same benefits and impacts as A but reduced in magnitude (750 acres). <p style="text-align: right;">→</p> <ul style="list-style-type: none"> • Weed Management: Same as A, except impacts and benefits would be more pronounced. • Public Use: Trail development and use in riparian areas may impact Preble’s (mitigated by seasonal closures). Facility development may impact prairie dogs and associated foraging habitat for eagles.
Cultural and Historic Resources	<ul style="list-style-type: none"> • Lindsay Ranch: Stabilization efforts would benefit barn, but value of house would be lost. 	<p style="text-align: right;">→</p>
Open Space, Recreation, and Trails	<ul style="list-style-type: none"> • Wildlife Management: Species reintroductions and deer and elk population management on the Refuge may result in long-term benefits to wildlife populations and wildlife viewing opportunities on adjacent open space lands. • Preble’s Habitat Management: Refuge could provide a core reserve for Preble’s and other species that would benefit populations on adjacent open space lands. • Vegetation Management: Efforts such as xeric tallgrass management planning, and regional collaboration could benefit adjacent open space areas by improving knowledge and coordination. • Weed Management: Reduced diligence outside of Rock Creek Reserve may impact adjacent open space areas by potentially contributing to spread of weeds. • Trail Facilities: Rocky Flats would continue to be a barrier for regional trail connectivity. 	<ul style="list-style-type: none"> • Wildlife Management: Same as A, but benefits would be more pronounced. <p style="text-align: right;">→</p> <ul style="list-style-type: none"> • Weed Management: Weed reduction efforts on the Refuge could benefit adjacent open space by reducing spread of weeds and increasing management knowledge. • Recreation Opportunities: Recreation programs would compliment but not duplicate opportunities on nearby open space lands. • Trail Facilities: Trails and trailheads would benefit the regional connectivity of trails, but would lack a direct connection to Boulder trails.

ALTERNATIVE C – <i>Ecological Restoration</i>	ALTERNATIVE D – <i>Public Use</i>
<ul style="list-style-type: none"> • Prairie Dog Management: Same benefits and impacts as A but reduced in magnitude (500 acres). • Preble’s Habitat Management: Same as A, except increased magnitude of disturbance due to monitoring. 	<ul style="list-style-type: none"> • Prairie Dog Management: Same benefits, impacts, and similar magnitude as A (1,000 acres). • Public Use: Same as B, except: <ul style="list-style-type: none"> - More extensive impacts from additional trail use. - Potential impacts to bald eagle habitat due to trail use adjacent to riparian areas.
<ul style="list-style-type: none"> • Lindsay Ranch: Removal of all structures would impact historical and interpretive value of site. 	<ul style="list-style-type: none"> • Lindsay Ranch: Stabilized barn would have greatest benefits for site; house would be lost.
<ul style="list-style-type: none"> • Wildlife Management: Same as A, but benefits would be greatest. • Trail Facilities: Same impact as A. 	<ul style="list-style-type: none"> • Wildlife Management: Same as B. • Recreation Opportunities: Same as B, except more pronounced. • Trail Facilities: Same effects as B, but greater trail connectivity.

Table 20. Summary of Environmental Consequences (continued)

	ALTERNATIVE A – <i>No Action</i>	ALTERNATIVE B – <i>Wildlife, Habitat, & Public Use (Proposed Action)</i>
Visual Resources	<ul style="list-style-type: none"> • Deer and Elk Management: May reduce visual impacts of overgrazing/overbrowsing. • Prairie Dog Management: Colonies would be a visual impact to some, a benefit to others. Greatest effects in Alternative A (unlimited). • Prescribed Fire: Short-term visual impacts associated with smoke and burned areas from prescribed fires. • Grazing: May result in short-term visual impacts; though some may consider livestock to be a benefit for landscape views. • Road Removal and Revegetation: Revegetation would benefit visual aesthetics within Rock Creek Reserve. 	<ul style="list-style-type: none"> • Prairie Dog Management: Same effects as A, but less pronounced (750 acres). • Road Removal and Revegetation: Revegetation would benefit visual aesthetics Refuge-wide. • Mixed Grassland Prairie Management: Revegetation would likely cause short-term visual impacts followed by long-term benefits. • Public Use Facilities: May result in minor visual impacts.
Noise	<ul style="list-style-type: none"> • Deer and Elk Management: Occasional gunshots associated with culling may be audible from within Refuge, but would not impact overall noise levels. • Excavation and Construction: Heavy equipment for road restoration and facility development would result in short-term noise impacts in nearby areas. 	<ul style="list-style-type: none"> • Deer and Elk Management: Same as A, except additional gunshots from public hunting.
Transportation	<ul style="list-style-type: none"> • Highway 93: Contribution of Refuge traffic to Highway 93 would be much less than pre-Refuge conditions. Would not warrant a traffic signal at access road intersection. 	<ul style="list-style-type: none"> • Highway 93: Contribution of Refuge traffic to Highway 93 would be much less than pre-Refuge conditions. Would not warrant a traffic signal, but existing acceleration/ deceleration lanes would be beneficial. • Highway 128: No impacts from trailhead location. Potential trail crossing at McCaslin would require pedestrian signals. • Indiana Street: Potential pedestrian crossings should include warning signs for safety. Recommended locations are north of Walnut Creek, and south of Woman Creek.
Air Quality	<ul style="list-style-type: none"> • Dust and Emissions: Equipment usage would result in short-term localized emissions and fugitive dust. • Prescribed Fire: Would result in short-term increases in particulates and decreased visibility nearby. 	
Socio-economics	<ul style="list-style-type: none"> • Staffing: Staffing levels would have no impact on regional employment, income or housing conditions. • Community: Change from past use to Refuge would benefit community perceptions of Rocky Flats. • Environmental Justice: No adverse effects on minority or low-income populations, or Native Americans. 	

ALTERNATIVE C – <i>Ecological Restoration</i>	ALTERNATIVE D – <i>Public Use</i>
<ul style="list-style-type: none"> • Prairie Dog Management: Same effects as A, but least impact (500 acres). 	<ul style="list-style-type: none"> • Prairie Dog Management: Same effects as A, with moderate impact (1,000 acres).
<ul style="list-style-type: none"> • Public Use Facilities: Negligible visual impact from facilities. 	<ul style="list-style-type: none"> • Public Use Facilities: Same as B.
<ul style="list-style-type: none"> • Deer and Elk Management: Same as A. 	<ul style="list-style-type: none"> • Deer and Elk Management: Same as B.
<ul style="list-style-type: none"> • All Roads: Same as A. 	<ul style="list-style-type: none"> • Highway 93: Same as B. • Highway 128: Same as B. • Indiana Street: Same effects as B from potential trail crossings. Trailhead access may require left turn lanes.

