



City of Boulder
Open Space and Mountain Parks

Grassland Ecosystem Management Plan

Approved by
City of Boulder Open Space Board of Trustees
August 2009

Accepted by the Boulder City Council
May 2010

Mission of the Open Space and Mountain Parks Department

The Open Space and Mountain Parks Department preserves and protects the natural environment and land resources that characterize Boulder. We foster appreciation and use that sustain the natural values of the land for current and future generations.

City of Boulder Charter Sec. 176. Open Space Purposes - Open space land.

Open space land shall be acquired, maintained, preserved, retained, and used only for the following purposes:

- Preservation or restoration of natural areas characterized by or including terrain, geologic formations, flora, or fauna that is unusual, spectacular, historically important, scientifically valuable, or unique, or that represent outstanding or rare examples of native species;
- Preservation of water resources in their natural or traditional state, scenic areas or vistas, wildlife habitats, or fragile ecosystems;
- Preservation of land for passive recreation use, such as hiking, photography or nature study, and if specifically designated, bicycling, horseback riding, or fishing;
- Preservation of agricultural uses and land suitable for agricultural production;
- Utilization of land for shaping the development of the city, limiting urban sprawl and disciplining growth;
- Utilization of non-urban land for spatial definition of urban areas;
- Utilization of land to prevent encroachment on floodplains; and
- Preservation of land for its aesthetic or passive recreational value and its contribution to the quality of life of the community.

Cover photos (from top):

Chautauqua Meadow - Mark S Johnson; Grasshopper Sparrow - Bill Schmoker; Bell's Twin Pod - Bill May; Agricultural Operations; Snakeweed and Sage - Lynn Riedel; Bronze Copper - Steve Armstead; Prairie Dog - Susan Honeycut;

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Table of Contents

Open Space and Mountain Parks Mission and Charter Purposes.....	Inside front cover
Table of Contents	iii
List of Appendices	iv
List of Figures.....	iv
List of Tables.....	v
List of Acronyms and Abbreviations.....	vii
Executive Summary.....	x
Chapter I - Plan Purpose, Scope and Target Descriptions	1
Chapter II - Plan Conservation Targets	
Nested Targets	
Extirpated Species	
Conservation in a Changing Environment-Selecting and Describing Targets	
Mixedgrass Prairie Mosaic	6
Xeric Tallgrass Prairie.....	17
Mesic Bluestem Prairie	20
Agricultural Operations	23
Black-tailed Prairie Dog and Associates	28
Wetlands.....	33
Riparian Areas.....	37
White Rocks.....	41
Chapter III - Viability Assessment	45
Chapter IV - Conservation Issues	85
Chapter V - Best Opportunity Analysis.....	95
Chapter VI - Conservation Strategies.....	113
Chapter VII - Monitoring	131
Chapter VIII - Implementation	135
Literature Cited.....	145
Glossary	165

Appendices

- Appendix A: Planning Context
- Appendix B: Nested Targets
- Appendix C: List of Scientific Names for Species Appearing in the Plan
- Appendix D: Viability Details
- Appendix E: Conservation Issue Rating Methods
- Appendix F: Conservation Issue Assessment Detailed Ratings
- Appendix G: Visitor Services in the Grassland Planning Area
- Appendix H: Black-Tailed Prairie Dog Habitat Suitability Model
- Appendix I: Black-Tailed Prairie Dog Receiving Site Relocation Criteria
- Appendix J: Best Opportunities to Conserve and Restore Wetlands and Riparian Areas
- Appendix K: Strategy Ranking Criteria and Methods
- Appendix L: Strategy Descriptions
- Appendix M: Monitoring Summary
- Appendix N: Grassland Plan Implementation Area Characteristics

List of Figures

- Figure 1: Geographic scope of the Grassland Ecosystem Management Plan
- Figure 2: Relationship of Grassland Plan to other planning and policy documents
- Figure 3: The Mixedgrass Prairie Mosaic in the Grassland Planning Area
- Figure 4: Distribution of Shale Barrens on Open Space and Mountain Parks
- Figure 5: The Xeric Tallgrass Prairie in the Grassland Planning Area
- Figure 6: Mesic Bluestem Prairie in the Grassland Planning Area
- Figure 7: Cultivated vegetation and agricultural land uses in the Grassland Planning Area
- Figure 8: Black-tailed prairie dog colonies in the Grassland Planning Area (maximum extent and 2008 mapping)
- Figure 9: Wetlands in the Grassland Planning Area
- Figure 10: Riparian Areas in the Grassland Planning Area
- Figure 11: White Rocks in the Grassland Planning Area
- Figure 12: Largest patches of Mixedgrass Prairie Mosaic and nearby public lands with potential to support conservation of this target
- Figure 13: Largest patches of Xeric Tallgrass Prairie and nearby public lands with potential to support conservation of this target
- Figure 14: Rare plants indicators of the Xeric Tallgrass Prairie (a) dwarf leadplant, (b) grassyslope sedge, (c) prairie violet
- Figure 15: Extent of active black-tailed prairie dog acreage on OSMP lands (1996-2009)
- Figure 16: Prairie dog occupancy in Grassland Preserves
- Figure 17: Cause and effect relationship of source, stress and target
- Figure 18: Weeds along OSMP trails (a) jointed goat grass (dark green) (b) burdock (large and leafy)
- Figure 19: Block size analysis for the combined Mixedgrass Prairie Mosaic, Xeric Tallgrass Prairie and Mesic Bluestem Prairie
- Figure 20: Best Opportunities for Conservation and Restoration of Upland Grassland Complex (Mixedgrass Prairie and Xeric Tallgrass Prairie) and Mesic Bluestem Prairie
- Figure 21: Significant agricultural lands in the Grassland Planning Area
- Figure 22: Irrigated fields/Best Opportunity Areas for agriculture in the GPA
- Figure 23: Results of black-tailed prairie dog Habitat Suitability Model
- Figure 24: Prairie dog colony management designations

- Figure 25: Prairie Dog Habitat Suitability in Grassland Preserves
 Figure 26: Wetland and Riparian Areas Best Opportunity Areas for conservation and restoration
 Figure 27: Grassland Plan Best Opportunity Areas
 Figure 28: Grassland Plan Implementation Areas
 Figure 29: Fiscally Constrained Funding Distribution

List of Tables

- Table 1: Approximate extent of conservation targets in the Grassland Planning Area
 Table 2: Key attributes of Grassland Plan targets
 Table 3: Grassland Plan indicators
 Table 4: Viability ratings, their meanings and their relationship to acceptable range of variation (ARV)
 Table 5: Example from Grassland Plan showing the relationship of indicator rating, acceptable range of variation and viability rating (after TNC 2007)
 Table 6: “Size” rating criteria for Central Mixedgrass Prairie (Decker 2007a)
 Table 7: Key attribute, indicator and rating for the size of the Mixedgrass Prairie Mosaic
 Table 8: Key attributes indicators and ratings for the condition of the Mixedgrass Prairie Mosaic
 Table 9: Key attributes indicators and ratings for the landscape context of the Mixedgrass Prairie Mosaic.
 Table 10: “Size” rating criteria for the Xeric Tallgrass Prairie (Decker 2007b)
 Table 11: Key attributes, indicator and rating for the size of the Xeric Tallgrass Prairie
 Table 12: Key attributes, indicators and ratings for the condition of the Xeric Tallgrass Prairie
 Table 13: Key attributes, indicator and rating for the landscape context of the Xeric Tallgrass Prairie
 Table 14: Key attributes, indicators and ratings for the condition of the Mesic Bluestem Prairie
 Table 15: Key attributes, indicator and rating for the landscape context of the Mesic Bluestem Prairie
 Table 16: Key attributes, indicators and ratings for the size of Agricultural Operations
 Table 17: Key attributes, indicators and ratings for the condition of Agricultural Operations
 Table 18: Key attributes, indicator and rating for the size of the Black-tailed Prairie Dog and Associates target
 Table 19: Prairie dog management designations
 Table 20: Key attributes, indicators and ratings for the condition of the Black-tailed Prairie Dog and Associates target
 Table 21: Commensal and predator species identified as black-tailed prairie dog associates
 Table 22: Key attributes, indicators and ratings for the landscape context of the Black-tailed Prairie Dog and Associates target
 Table 23: Key attributes, indicators and ratings for the condition of the Wetlands target
 Table 24: Key attributes, indicators and ratings for the landscape context of the Wetlands target
 Table 25: Key attributes, indicators and ratings for the condition of Riparian Areas target
 Table 26: Key attributes, indicators and ratings for the landscape context of Riparian Areas target
 Table 27: Key attribute, indicator and rating for the size of the White Rocks target
 Table 28: Key attributes, indicators and ratings for the condition of the White Rocks target
 Table 29: Rare plants and vertebrates of the White Rocks
 Table 30: Summary viability table for the GPA

- Table 31: Achieving acceptable condition for Grassland Plan targets
- Table 32: Conservation issue summary for the Grassland Planning Area
- Table 33: Lands of agricultural significance
- Table 34: Prairie dog colony designation criteria
- Table 35: Conservation objectives for the Grassland Plan
- Table 36: Criteria used for evaluating Grassland Plan conservation strategies
- Table 37: Grassland Plan strategies showing overall ranking and ratings for benefit, feasibility and cost
- Table 38: Grassland Plan funding scenarios
- Table 39: Funding gap—Fiscally Constrained versus Vision Plan scenarios

Acronyms and Abbreviations

ARV	Acceptable Range of Variation
ANS	Aquatic Nuisance Species
AMP	Area Management Plan
BCCP	Boulder County Comprehensive Plan
BCPOS	Boulder County Parks and Open Space
BOA	Best Opportunity Area
BVCP	Boulder Valley Comprehensive Plan
CAP	Conservation Action Planning
CDOW	Colorado Division of Wildlife
CDPHE	Colorado Department of Public Health and Environment
CE	Conservation Easement
CFS	Cubic Feet per Second
CIP	Capital Improvement Program
CNHP	Colorado Natural Heritage Program
CRP	Conservation Reserve Program
CU	University of Colorado
CWCB	Colorado Water Conservation Board
DOC	Department of Commerce
DPIF	Derived Partners in Flight
DWB	Denver Water Board
EIA	Ecological Integrity Assessment
EMAP	Ecological Monitoring and Assessment Program
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ESD	Ecological Site Description
EWM	Eurasian watermilfoil
FEMP	Forest Ecosystem Management Plan
GD	Grassland Dependent
GIS	Geographic Information System
GP	Grassland Preserves
GPA	Grassland Planning Area
GPS	Global Positioning Systems
HESCOM	Needle and Thread Grass/Blue Grama Herbaceous Alliance
HRV	Historic Range of Variability
HSM	Habitat Suitability Model
IBI	Index of Biotic Integrity
IPM	Integrated Pest Management

LRMP	Long Range Management Policies
MBP	Mesic Bluestem Prairie
MGPM	Mixedgrass Prairie Mosaic
MM	Marshall Mesa
MMI	Macroinvertebrate Multimetric Index
MNRC	Mean Native Relative Cover
MOA	Multiple Objective Areas
NLF	Northern Leopard Frog
NOAA	National Oceanic and Atmospheric Administration
NRC	Native Relative Cover
NRCS	Natural Resource Conservation Service
NZMS	New Zealand Mud Snail
OSBT	Open Space Board of Trustees
OSMP	Open Space and Mountain Parks
PASSMI	Western Wheatgrass Herbaceous Alliance
PCA	Prairie Dog Conservation Areas
PIF	Partners in Flight
PRA	Passive Recreation Area
RA	Relative Abundance
RAM	Rapid Assessment Mapping
RVA	Range of Variability Approach
SMTH	South Mesa Trailhead
SOP	Strategic Operating Plan
SSURGO	Soil Survey Geographic (Database)
TNC	The Nature Conservancy
TSA	Trail Study Area
UDT	Undesignated Trail
ULTO	Ute Ladies'-Tresses Orchid
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Survey
UWMP	Urban Wildlife Management Plan
VMP	Visitor Master Plan
XTGP	Xeric Tallgrass Prairie

Executive Summary

The grasslands of the City of Boulder’s Open Space and Mountain Parks (OSMP) land system are located where the Central High Plains meet the foothills of the Southern Rocky Mountains. These lands and waters have been acquired as part of a system designed to protect the agricultural, ecological, recreational, and scenic values of one of the most rapidly developing regions in North America.

Over the past decade, OSMP has developed a series of management plans to clarify how the City of Boulder will manage open space properties and provide services, including sustainable natural resource conservation and passive recreation. The Forest Ecosystem Management Plan, which guides the management of OSMP’s forested foothills, was completed in 1999. In 2005, the city council accepted The Visitor Master Plan, which outlines the vision and strategies for providing sustainable recreational activities and facilities. This **Grassland Ecosystem Management Plan (Grassland Plan)** focuses upon the conservation of the 24,000 acres of OSMP lands dominated by mixedgrass and xeric tallgrass prairie (**Figure 1**). The Grassland Plan is intended to provide a framework for on-the-ground management actions, public policies and land and water acquisition priorities to conserve the ecological values of Boulder’s grasslands and ensure on-going agricultural production.

Sidebars: Points of Interest

Sidebars like this appear throughout the document to highlight topics of interest—or share background information.

CHAPTER SUMMARIES

Chapter I Plan Purpose, Scope & Organization

The Grassland Plan will also be an important resource for OSMP’s TSA planning, describing the agricultural and ecological values in the 24,000-acre Grassland Planning Area.

The Grassland Plan is related to other planning documents and policy direction as one of the tools used by OSMP to focus the broad vision provided by the Boulder Valley Comprehensive Plan, the City Charter and OSMP’s own long range management policies. The Grassland Plan provides this focus by recommending practical strategies and measures of success. These strategies will be implemented through the department’s Strategic Operating Plan and annual work plans.

The planning process used to develop the Grassland Plan was adapted from the Conservation Action Planning approach of The Nature Conservancy (2007).

Chapter II Conservation Targets

The Grassland Planning Area (GPA) (**Figure 1**) is known to support more than 800 species of vascular plants, over 400 species of vertebrates and many more species in other, lesser-known

groups (e.g., insects, mosses, algae). Rather than attempt to address each part of the grassland system individually, OSMP staff worked with partner agencies, biologists, ecologists, naturalists and other community members to identify the aspects of biological diversity that would best serve as the basis for setting objectives, taking action and measuring success.

These “conservation targets” include the **Mixedgrass Prairie Mosaic** and the **Xeric Tallgrass Prairie**—the two dominant cover types in the GPA.

The **Agricultural Operations** target addresses the long-term sustainability of agriculture on OSMP lands and the conservation of native species dependent upon agricultural operations.

The ecological system centered on the black-tailed prairie dog was also identified as a separate conservation target due to the distinctive ecological conditions and community of animals associated with prairie dogs. This target, **Black-tailed Prairie Dogs and Associates**, was also called out because of the unique challenges of managing a prairie dog-based system in a highly fragmented landscape.

OSMP also identified three targets dependent upon ground or surface water: **Wetlands**—including ponds, **Riparian Areas**—including creeks, and the **Mesic Bluestem Prairie**.

The **White Rocks** cliffs were identified as a target because they support a large number of rare species—well out of proportion to the small size of the area.

Chapter III Assessing Target Viability

OSMP staff determined the viability of targets by first identifying **key attributes** of each target. Key attributes are aspects of the target, which if altered, could result in the improvement, degradation, or loss of the target. These key attributes reflect some aspect of size, structure, composition, landscape context, or an ecological process (e.g., fire, grazing, or flooding). Examples of key ecological attributes include fire frequency, animal species composition, and water quality. Key attributes for Agricultural Operations include the extent of land that is available for agriculture, availability of irrigation water, levels of commodity production, and soil chemistry.

OSMP identified at least one measurable and sensitive indicator for each key attribute so that the status of the key attributes could be assessed. Using the best available information, OSMP staff defined a range of variation for each indicator that described “acceptable” conditions. When indicators for a target are found to be within this range of “acceptable variation”, the target is considered to be successfully “conserved”. Indicators provide OSMP with the ability to assess and rate the viability of the targets, and measure progress toward achieving desired future conditions in the Grassland Planning Area.

The overall viability rating for the Grassland Planning Area is “Fair”—meaning that conditions are generally outside the range of acceptable variation. The viability ratings of Grassland Plan targets vary. Agricultural Operations, Black-tailed Prairie Dog and Associates and the White Rocks Cliffs were rated “Good” or “Very Good”, signifying that key attributes (as measured by indicators) are within the range of acceptable variation. The Mixedgrass Prairie Mosaic, Xeric Tallgrass Prairie, Mesic Bluestem Prairie, and Wetlands were rated “Fair”. A “Fair” rating means that many of the key attributes are outside the range of acceptable variation—but could be restored to a “Good” rating with a reasonable level of effort. The Riparian Areas target was rated “Poor”, a designation suggesting that it is most in need of action and will require significant investments of time and resources to conserve.

Chapter IV Conservation Issues

The purchase of land as open space protects the landscape from “development”—addressing the most significant threat facing agricultural and ecological sustainability. However, the “Fair” rating for the Grassland Planning Area points to additional conservation issues. OSMP examined the severity and scope of issues that affect the conservation targets. The most significant conservation issues were incompatible surrounding land uses, invasive non-native plant and animal species, incompatible recreational uses, incompatible dog management by guardians, incompatible water management/use, incompatible fire management and incompatible agricultural practices.

Chapter V Best Opportunity Areas

A strategic approach to improving conditions in the Grassland Planning Area requires knowing where to find the best opportunities for conserving good conditions, reducing conservation issues, and restoring targets from the impacts of historic activities. OSMP’s overall approach is to maintain good conditions where they exist and to restore selected areas to acceptable condition. The Grassland Plan recommends places where action will best conserve the targets.

Best Opportunities for the Conservation for Black-tailed Prairie Dog and Associates

IN RESPONSE to community interest and the unique ecology of prairie dogs, OSMP gave special attention to developing area-based recommendations for the conservation of the Black-tailed Prairie Dog and Associates target. These recommendations seek to provide areas where the target can be conserved, as well as areas where the values of grasslands and agricultural operations unaffected by prairie dogs are the priority. OSMP developed “Best Opportunity Areas” for conservation and restoration of the other Grassland Plan targets as well.

Chapter VI Conservation Strategies

The Grassland Plan sets 13 conservation objectives that describe specifically, and in measurable terms, what successful implementation of the Grassland Plan means. This chapter also presents and ranks 35 conservation strategies. The highest ranked strategies are those with the greatest benefit, feasibility and least discretionary costs. These objectives and strategies are organized into four strategic initiatives for taking conservation action and two initiatives to support conservation action.

Initiative 1: Large Block Habitat Effectiveness

The focus of this initiative is to improve the conservation value of large habitat blocks so they are more likely to sustain the Grassland Plan targets.

Large blocks of Open Space and Mountain Parks grasslands are more likely than small blocks to be self-sustaining. Larger blocks are more likely to provide a full range of habitat variability, and a wider range of natural disturbances, and therefore more likely to support the habitat needs of a wider range of species—both plant and animal. These areas are also necessary to conserve species requiring large areas. Large habitat blocks also tend to be the OSMP lands most distant from urbanization and represent the best opportunity to conserve

species sensitive to the effects of urbanization. OSMP can take advantage of the potential of large habitat blocks areas by adjusting policies affecting use, changing on-the-ground management and finding opportunities to establish compatible practices on adjacent lands.

Conservation Objective 1.1

By 2019, establish prairie dog, prairie dog commensal and prairie dog predator populations and population distribution within the range of acceptable variation.

Conservation Objective 1.2

By 2019, increase the bird conservation scores to at least 3.9 for the Mixedgrass Prairie Mosaic and Xeric Tallgrass Prairie.

Conservation Objective 1.3

By 2019, increase the frequency of singing male grasshopper sparrows in habitat blocks over 247 acres (100 ha) in the Mixedgrass Prairie Mosaic to 60%.

Initiative 2: Grassland Restoration

This initiative focuses on improving ecological processes and conditions to acceptable levels as defined by the viability indicator ratings for the eight Grassland Plan Targets. These improvements will benefit both ecological viability and agricultural sustainability.

Persistent effects of historic land uses are partially responsible for current unacceptable conditions of grassland targets. The Grassland Plan establishes indicator ratings that describe OSMP's best thinking about acceptable conditions and processes. A small number of high-leverage actions have been identified to return the ecosystems of the Grassland Planning Area to acceptable condition and landscape context.

Restoration objectives and strategies identified under this initiative will be folded into the OSMP Restoration Legacy Program, which is developing projects to address system-wide restoration needs. The Restoration Legacy Project was identified as a high priority initiative during a strategic planning process completed by OSMP in 2007.

In 2009, the Restoration Legacy team identified approximately 50 projects in the Grassland Planning Area. The specific projects will mobilize planting, earthmoving, hydrological modification and fencing to restore native vegetation and habitats. The Legacy Program approach to coordinating restoration on a system-wide basis is one way that the Grassland Plan strategies will be integrated into the department's annual work plan.

Conservation Objective 2.1

By 2019, reduce non-native plant species in Best Opportunity Areas of the Xeric Tallgrass Prairie, Mesic Bluestem Prairie, and Mixedgrass Prairie Mosaic targets to achieve at least a "Good" rating for prevalence.

Conservation Objective 2.2

By 2029, achieve "Good" rating for all vegetation composition and structure indicators in Best Opportunity Areas.

Conservation Objective 2.3

By 2019, increase fire frequency so that 50% of Upland Grassland Complex and Mesic

Bluestem Prairie Best Opportunity Areas will have burned within the acceptable fire return interval.

Initiative 3: Aquatic Systems Management

This initiative focuses on wetlands, riparian areas, creeks and ponds.

Aquatic systems on OSMP lands support biodiversity well out of proportion to their relatively small size. These same areas are also identified as having low viability and high level of conservation issues.

Conservation Objective 3.1

By 2019, evaluate and restore riparian hydrology in Best Opportunity Areas.

Conservation Objective 3.2

By 2019, evaluate and restore wetland, riparian and aquatic habitat in Best Opportunity Areas.

Conservation Objective 3.3

By 2015, increase by three (3) the number of bullfrog-free ponds on OSMP-managed lands supporting northern leopard frogs.

Conservation Objective 3.4

Prevent an increase in the extent and diversity of aquatic nuisance species in the Grassland Planning Area.

Conservation Objective 3.5

By 2019, reduce the undesignated trail density in northern leopard frog habitat blocks to at most 13.4 ft/ac (10 m/ha).

Initiative 4: Agro-Ecosystems

This initiative focuses on sustaining agricultural uses while integrating agricultural and ecological conservation objectives.

Agriculture has played an important and dynamic role in shaping the Grassland Planning Area and providing services for people in the Boulder Valley. OSMP staff has adjusted and will continue to adjust agricultural management in response to changing markets and interests of local agricultural producers.

When and where biodiversity conservation objectives and agricultural management goals conflict, OSMP has worked to develop compatible management strategies. The Grassland Plan identifies specific opportunities to continue balancing and blending agricultural and ecological management.

Conservation Objective 4.1

Continue agricultural operations on OSMP lands to address the Charter Purposes of OSMP.

Conservation Objective 4.2

Establish or continue agricultural management practices that support habitat for Ute ladies-tresses orchid, bobolinks and other species of conservation concern.

Initiative 5: Monitoring (see Chapter VII)

Initiative 6: Capacity Building

This initiative is intended to attract external funding sources for Grassland Conservation.

Full implementation of the Grassland Plan would require significantly greater capacity than is available with current funding and staffing. The following strategies were identified to attract additional capacity and funding.

Strategies

- Evaluate current staffing and funding allocations to address capacity needs and meet Grassland Plan priorities--make changes as appropriate
- Fund staff training and service contracts to increase expertise available to implement Grassland Plan strategies. When is it more cost-effective, expertise can be provided by consultants and contractors
- Establish an Open Space and Mountain Parks foundation to sponsor private fundraising for implementing priority Grassland Plan projects
- Pursue grants as appropriate to fund implementation of Grassland Plan strategies
- Work with volunteers and community groups as appropriate to support the implementation of any Grassland Plan strategies
- Work with other land management agencies and universities to address the research agenda in Chapter VII
- Leverage value of OSMP-owned housing to encourage needed monitoring, research or stewardship
- Establish a Grassland Plan Capital Improvement Program (CIP), or add Grassland Plan Implementation to the Strategic Operating Plan

Chapter VII Monitoring

The objective of this initiative is to implement "vital signs" monitoring of the Grassland Plan targets by OSMP staff, researchers and volunteers.

OSMP has outlined a variety of strategies to achieve its conservation objectives. Monitoring the effectiveness of the highest priority strategies will allow staff to repeat effective strategies elsewhere and refine or abandon ineffective strategies. Tracking the presence and, in some cases, abundance of threats like non-native plant and animal species will help OSMP allocate resources appropriately to conserve the Grassland Plan targets.

Monitoring also affords OSMP the means to keep track of target occurrences in good condition and to provide early warnings of potential conservation issues. Responding early is easier and less expensive than trying to improve degraded conditions later.

Monitoring Objectives

- Evaluate the effectiveness of specific strategies in achieving OSMP's conservation objectives
- Track current status and trends of conservation issues affecting the conservation targets
- Track the current status and trends of the conservation targets' viability
- Establish specific indicators and acceptable ranges of variation to fill information gaps

Monitoring of target viability, conservation issues and strategy effectiveness is at the heart of the adaptive management framework upon which the Grassland Plan is based.

Chapter VIII Implementation

The Grassland Plan will be implemented by facility improvements, the development of new programs and policies, integration with other planning efforts, especially TSA planning, and coordinated management activities on the ground. Coordinated management will be enhanced by focusing on Implementation Areas that share similarity of vegetation, agricultural characteristics and landscape context. Developing the phasing and funding of specific projects will be part of the initial implementation of the plan.

The Grassland Plan describes three funding scenarios consistent with the city's business plan model. The "Fiscally Constrained" scenario includes strategies, programs and projects that are currently funded. The "Action Plan" scenario includes the next level of projects that could be undertaken as funding becomes available for restoration or enhancement of community services. The "Vision Plan" scenario includes funding for the full range of identified projects. Capacity building measures are identified to narrow the funding gap between the fiscally constrained and vision plan scenarios.

Chapter I: Plan Purpose, Scope and Organization

Chapter Summary

This chapter describes the purpose and scope of the Grassland Plan.

The purpose of the Grassland Plan is to provide a framework for on-the-ground management actions, public policies and land and water acquisition priorities to conserve the ecological values of Boulder's grasslands and to ensure on-going agricultural production.

The Grassland Plan will also be an important resource for OSMP's TSA planning, describing the agricultural and ecological values in the 24,000-acre Grassland Planning Area.

Purpose of the Grassland Plan

The purpose of the Grassland Ecosystem Management Plan (Grassland Plan) is to provide a framework for on-the-ground management actions, public policies and land and water acquisition priorities to conserve the ecological values of Boulder's grasslands and to ensure on-going agricultural production.

The Grassland Plan is also intended to provide resource information and conservation guidance for OSMP's Trail Study Area (TSA) planning process.

Geographic Scope

Open Space and Mountain Parks (OSMP) staff examined vegetation, soils, and topography to develop a western boundary for the Grassland Plan and to separate grasslands from lands managed under OSMP's Forest Ecosystem Management Plan (FEMP). The geographic scope of the Grassland Plan encompasses all Open Space and Mountain Parks lands east of this boundary. This project area contains approximately 24,000 acres of OSMP lands held in fee, and another several thousand acres protected through conservation easements held by the City of Boulder (see **Table 1** and **Figure 1**).

The conservation significance of the Grassland Plan planning area is enhanced by the proximity of other nearby protected areas. Table Mountain lies adjacent to OSMP lands north of Boulder. This 1,600-acre grassland is managed by the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). The Rocky Flats National Wildlife Refuge (ca. 6,000 acres) is located adjacent to OSMP's southern grasslands, as are several thousand acres of grasslands managed by open space programs of Boulder and Jefferson counties. OSMP will seek partnerships with these land managers and others as appropriate to achieve the objectives of the Grassland Plan.

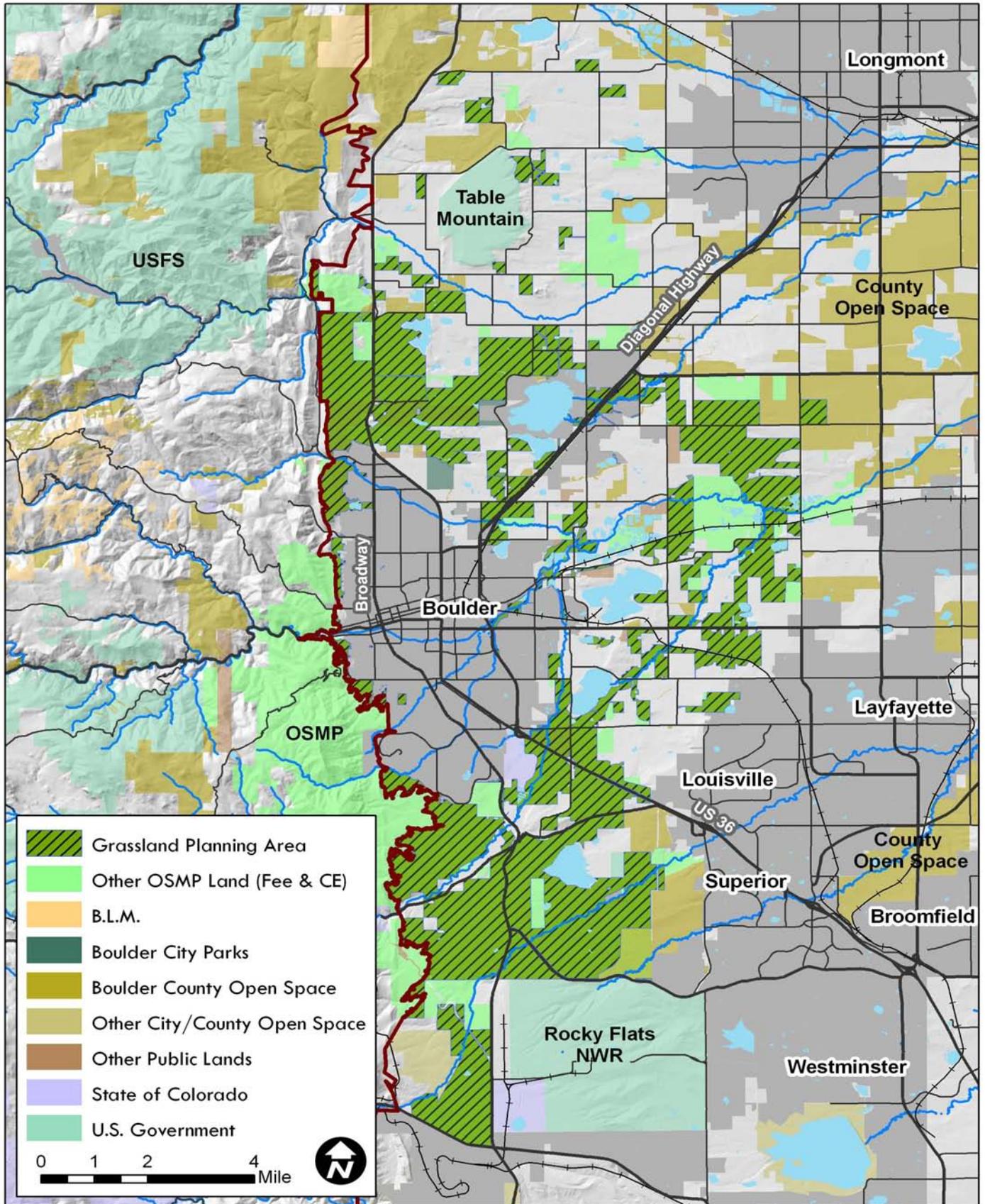


Figure 1: Geographic scope of the Grassland Ecosystem Management Plan – The “Grassland Planning Area”

Relationship to Other Planning Documents and Policy Directions

The Grassland Plan is affected by and will influence other departmental resource and program management plans. There are also relationships with other city plans and policies as well as the operational plans of neighboring land management agencies. **Figure 2** shows how these plans are related.

Establishing a Broad Vision by Setting Priorities

The City of Boulder and Boulder County have agreed upon a set of land use and management goals and policies to implement a shared community vision in a geographic area defined as the “Boulder Valley”. These goals and policies comprise the *Boulder Valley Comprehensive Plan* (BVCP). The BVCP is updated periodically and approved jointly by four public bodies including Boulder’s City Council and the Boulder County Board of Commissioners. The BVCP states a clear intention for the City to preserve the agricultural and natural values of the lands and waters of the Boulder Valley through acquisition and management of open space. The plan specifically identifies a Natural Ecosystem Overlay. This overlay includes the areas that are most important as habitat for native plants and animals or are especially valued because of their ecological, biological or geological characteristics. Almost all of the Grassland Planning Area (GPA) is included in the Natural Ecosystem Overlay. Details about the relationship of the BVCP and the Grassland Plan are provided in **Appendix A**.

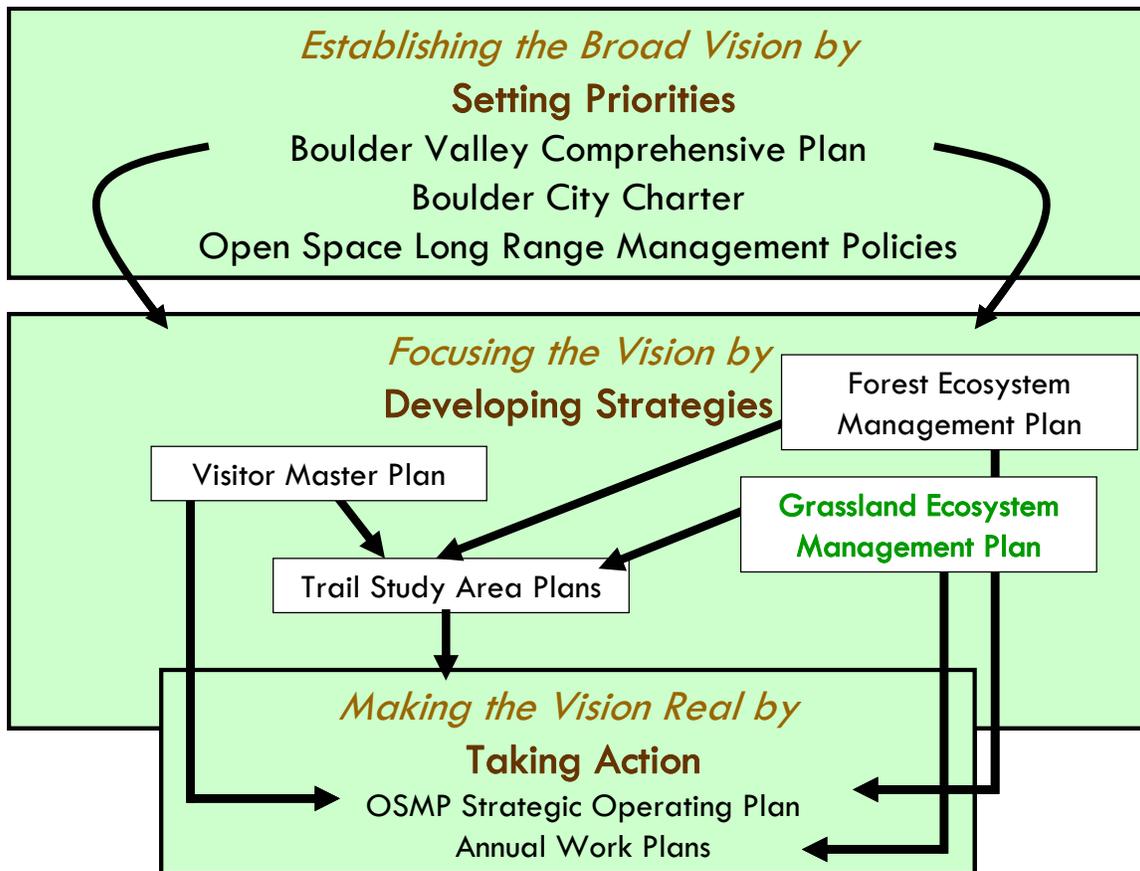


Figure 2: Relationship of Grassland Plan to other planning and policy documents

Section 176 of *Boulder's City Charter* was established by public election. It lists the purposes for which open space land can be acquired, maintained and used. The full text of this section of the charter can be found on the inside cover of the plan and in **Appendix A**. The Grassland Plan describes how OSMP will address the charter purposes calling for the preservation of natural areas, wildlife habitats, fragile ecosystems, and water resources in the Grassland Planning Area as well as providing a framework for the management of agricultural lands and agricultural land uses.

While the city charter and comprehensive plans (see below) provide broad policy guidance, the *Open Space Long Range Management Policies* (LRMP) give specific direction about program goals, decision-making processes and management techniques. The LRMP were approved by City Council in 1995. Chapters IV and V, which address natural resource management and agricultural management respectively, provided important policy guidance for the Grassland Plan.

Focusing the Vision by Developing Strategies

OSMP's *Visitor Master Plan* (VMP) (City of Boulder 2005a) developed a framework to deliver visitor services and provide visitor facilities in a manner consistent with the conservation of natural and cultural resources. The Grassland Plan used the policies and management area designations in the VMP as a starting point for examining the relationship among recreational activities and grassland/agricultural conservation.

One of the ways that the objectives of the Grassland Plan will be acted upon is through on-going integration of new grassland information in the *Trail Study Area (TSA) planning process*. The Grassland Plan provides information about areas of ecological importance that was unavailable when the VMP was developed. With the exceptions of emergency actions needed to protect critical resources, decisions about trails and visitor access in the Grassland Planning Area will be made in the context of TSA planning. The availability of specific information about the current status and desired condition of natural resources will improve OSMP's ability to balance resource protection and visitor access through TSA planning.

The Grassland Plan complements the *Forest Ecosystem Management Plan* (FEMP) (City of Boulder 1999) by providing natural resource conservation objectives and strategies for most of the OSMP land system unaddressed by the FEMP. Refinements to the FEMP will use a planning approach consistent with the Grassland Plan. OSMP will integrate the management of resources that cross the planning area boundaries (e.g., creeks, wide-ranging species) as appropriate. For example, the department is already coordinating the management of 300 acres along the forest/grassland edge. Management prescriptions were developed in the FEMP for areas that are currently forested, but where OSMP seeks to restore them to open savannah—a grassland cover type.

Making the Vision Real by Taking Action

In 2008, the Open Space and Mountain Parks department established a five-year *Strategic Operating Plan* (SOP) to describe the priority actions of the department. This document is updated annually as projects are completed and new initiatives added. Most of the projects in the SOP flow directly from actions identified in the VMP, FEMP, and TSA Plans. Upon approval of the Grassland Plan, its implementation will be incorporated into the SOP and other plans and planning efforts.

The SOP is reviewed annually and new projects are assigned to the appropriate division, workgroups and individuals on the OSMP staff. These projects as well as on-going services

combine to form the *Annual Work Plan*. The work plan is integrated with the city budgeting and OSMP budget allocation processes.

Coordination with Other Plans

OSMP also works with Boulder County to implement the policies and goals of the *Boulder County Comprehensive Plan* (BCCP). The BCCP policies on open space are similar to and consistent with the City Charter and the BVCP. The BCCP also provides specific information about species of concern and the location and extent of a variety of natural and agricultural features of interest—many of which are on OSMP lands. OSMP used this information to identify conservation targets and to prioritize places to take action. **Appendix A** includes more information about the goals and designations of the BCCP with relevance to the Grassland Plan.

City of Boulder Open Space Grassland Management: Black-Tailed Prairie Dog Habitat Conservation Plan (City of Boulder 1996) was approved by the Open Space Board of Trustees in 1996. This plan provides guidance on the management of grasslands to protect, preserve, and enhance habitat suitable for black-tailed prairie dogs and was intended as a component in a broader grassland conservation plan. The Grassland Plan integrated several components of this plan, such as the need to conserve prairie dogs in the context of broader grassland conservation goals, the focus on large Grassland Preserves for conserving prairie dogs and their associates and the protection of smaller, more isolated colonies to help ensure some level of survivorship after a plague epizootic. The Grassland Plan replaces the Black-Tailed Prairie Dog Habitat Conservation Plan as the guiding document for OSMP prairie dog management.

The Open Space Board of Trustees approved two area management plans (AMP) in the late 1990's: the *North Boulder Valley AMP* in 1997 (City of Boulder 1997) and the *South Boulder Creek AMP* in 1998 (City of Boulder 1998). These plans provide goals, objectives and site-specific actions for ecological and agricultural management in the GPA. Implementation of the Grassland Plan will continue many of the on-going actions identified in the AMP's, and integrate other actions identified in those plans but not yet started. The department suspended the development of new Area Management Plans in 1998.

OSMP manages two state natural areas in the GPA under *State Natural Area Management Plans*. The South Boulder Creek AMP serves as the management plan for the South Boulder Creek State Natural Area. The Colorado Tallgrass Prairie Management Plan was developed by the City and the Colorado Natural Areas Program in 1986. Although the Tallgrass Prairie Management Plan is generally consistent with the Grassland Plan, OSMP intends to recommend updates to the 1986 plan using the information developed over the past twenty years. Although not managed by OSMP, a portion of the White Rocks cliffs is also a designated state natural area.

In 2006, Boulder's city council accepted the vision, goals and guiding principles of Boulder's *Urban Wildlife Management Plan* (UWMP) and the first species-specific management component of the UWMP—dealing with black-tailed prairie dogs (City of Boulder 2006). The prairie dog component of the UWMP described how and where to protect and remove prairie dogs within Boulder's city limits while balancing costs and humane treatment. The prairie dog component of the UWMP identified approximately 150 acres of prairie dog colonies for long-term protection and about 100 acres for near-term removal. An additional 370 acres were designated for interim protection—a designation that anticipated potential future development and the need for

prairie dog removal. Prairie dog management designations in the Grassland Plan are consistent with the UWMP's designation of OSMP colonies.

The prairie dog component of the UWMP identified the development of the Grassland Plan as a priority action. The Grassland Plan complements the UWMP by:

- Describing how prairie dog conservation fits into the broader context of OSMP's grassland conservation efforts,
- Identifying areas where OSMP can best conserve prairie dogs and their associated species,
- Identifying areas where the activities of prairie dogs are inconsistent with other grassland conservation objectives,
- Developing relocation criteria that are tied to ecological sustainability objectives for prairie dogs' grassland habitat, and
- Establishing a process by which the prairie dog management objectives of the Grassland Plan and the UWMP can be integrated.

Organization of the Grassland Plan

The Grassland Plan has adapted a planning approach developed by The Nature Conservancy known as the Conservation Action Planning (CAP) Framework. The Grassland Plan is organized around the following steps drawn from the CAP process. The general organization is presented below. Greater detail is provided in the corresponding chapters in the plan.

1. Define Project Scope & Conservation Targets (Chapters I and II)
 - Define the extent of the planning area
 - Select the specific aspects of the planning area (systems, species, and community services) that will be used as representatives of the relevant community services (agricultural conservation) and the overall biodiversity of the project area
2. Assess the Viability of Conservation Targets (Chapter III)
 - Determine how to measure each target's "health" over time
 - Identify how the target is doing now
 - Describe what a "healthy state" might look like (desired future conditions)
3. Identify and Rank Conservation Issues (Chapter IV)
 - Identify the various factors that immediately affect the project's targets
 - Rank conservation issues to allow focus on where action is most needed
4. Identify Best Opportunity Areas³ (Chapter V)
 - Identify the places a target's viability would most benefit from protection or having conservation issues addressed

Conservation Action Planning

THE NATURE CONSERVANCY has been developing a framework for planning, implementing, and measuring conservation success over the past 20 years. This framework, called "Conservation Action Planning" (CAP), has been tested with a wide range of projects throughout the world. Hundreds of partner agencies have been involved in projects using the CAP framework. Its development has led to the establishment of standards for the practice of conservation in use by the world's leading conservation organizations.

³ Not a part of TNC's CAP process.

- Identify the places where restoration is most likely to benefit a target's viability
5. Develop Strategies: Objectives and Actions (Chapter VI)
 - State specifically and measurably what successful implementation of the plan looks like
 - Develop practical strategies to achieve success
 - Prioritize the strategies that provide the most impact for the available resources
 6. Establish Measures (Monitoring) Chapter VII
 - Identify how to measure results
 - Identify how to track target viability
 - Identify how to track conservation issues
 7. Develop Work Plans⁴ (Implementation) Chapter VIII
 - Develop business plan scenarios for strategies and monitoring activities
 - Identify staffing for projects
 - Identify funding and other resources for projects

⁴ The City's master plan business plan framework was integrated with the "Work Planning" step described in the CAP process.

Chapter II: Target Descriptions

Chapter Summary

Conservation “targets” have been selected to be representative of biodiversity and agricultural production in the Grassland Planning Area. These targets include agricultural operations as well as the native species, natural communities and ecological systems that encompass the biodiversity of OSMP grasslands. Each target includes a number of nested targets: plants, plant associations and animals of conservation concern in the Boulder Valley. The Grassland Plan targets form the basis for the subsequent steps of assessing conditions, setting desired future conditions, identifying conservation issues, developing strategies, and measuring success. The eight targets are:

- Mixedgrass Prairie Mosaic
- Xeric Tallgrass Prairie
- Mesic Bluestem Prairie
- Agricultural Operations
- Black-Tailed Prairie Dog and Associates
- Wetlands
- Riparian Areas
- White Rocks

Focusing Conservation Attention

The grasslands of Boulder’s Open Space and Mountain Parks are known to support more than 800 species of vascular plants and over 400 species of vertebrates. In addition, many species of invertebrates (insects, spiders, crustaceans, etc.) and non-vascular plants (algae, mosses, etc.) inhabit these grasslands, yet relatively few of these have been looked for or documented on OSMP lands. In order to develop specific conservation strategies, staff posed the question “What biodiversity are we trying to conserve?”

To answer this question, OSMP, with input from local and statewide experts, identified a set of “conservation targets”. Conservation targets are the native species, natural communities and ecological systems that represent and encompass the biodiversity of OSMP grasslands. These conservation targets are the basis for setting specific objectives, taking action on the ground and measuring success.

Identifying targets involved examining vegetation mapping and historical accounts of the Boulder Valley to describe the terrestrial, wetland and aquatic communities that dominate the project area. The planning team then determined which communities and species would not be adequately captured within the broad-scale ecological systems or species groups. OSMP staff’s preliminary ideas about conservation targets were shared with a group of grassland ecologists and conservation professionals during a daylong workshop in the winter of 2006. The recommendations from this experts’ workshop were used to establish the following list of conservation targets:

Table 1: Approximate extent of conservation targets in the Grassland Planning Area

Conservation Targets	Approximate Acreage
• Mixedgrass Prairie Mosaic	9,850 acres
• Xeric Tallgrass Prairie	5,650 acres
• Agricultural Operations ⁵	5,400 acres
• Wetlands	1,500 acres
• Riparian Areas	1,200 acres
• Mesic Bluestem Prairie	350 acres
• White Rocks	60 acres
• Black-Tailed Prairie Dog and Associates	See note ⁶
Other	
• Developed Areas (farmsteads, trailheads, etc.)	80 acres
• Forest Stands (managed under Forest Ecosystem Management Plan)	300 acres
Total	ca 24,000 acres

Nested Targets

Each of the major grassland conservation targets includes habitat for many species of plants and animals as well as a variety of plant associations. Some of these are of conservation concern in the Boulder Valley. Conservation concern means that a species is threatened or endangered according to state or federal law, that they are considered rare or imperiled by the Colorado Natural Heritage Program, or that they have been found to be rare or in need of special conservation action at the local level. Local level conservation status is documented in the Boulder County or Boulder Valley comprehensive plans, or in documents developed by OSMP staff. A list of the species of conservation concern found in the planning area along with their conservation status rankings is included as **Appendix B**. The species of concern are “nested” beneath the major conservation target(s) with which they are associated. This nested target table will be updated and revised throughout implementation of the Grassland Plan as needed.

Nested targets should be conserved if the conservation targets with which they are associated are conserved. In cases where nested target status provides valuable information on the target’s health or has unique conservation requirements, these individual species appear in the attributes, indicators, or strategies associated with the larger target.

⁵ Acreage of OSMP lands where agricultural operations (irrigation, seeding, annual cropping systems, etc.) have resulted in a dominance of non-native vegetation. Other OSMP lands are also in use for agriculture (e.g., livestock grazing). Some agricultural lands show up in other categories because irrigation practices support a distinct *native dominated* vegetation (e.g., some wetlands and some mesic tallgrass prairie). See Target Descriptions (Chapter II) for more information.

⁶ Since the extent of occupied prairie dog acreage fluctuates, and prairie dogs occupy many of the other targets, no acreage figures are given here. Information about the extent of prairie dog occupation is included in the description of the “Black-Tailed Prairie Dog and Associates” target.

Extirpated Species

Some species, such as bison⁷, prairie wolves and grizzly bears, which once occurred in the Grassland Planning Area, no longer reside here. OSMP staff and experts' group considered a variety of ways to address these extirpated species. Some felt that all extirpated species such as wolves, grizzly bears, black-footed ferrets and bison should be grouped together as a single target because of their ecological importance. OSMP staff also heard from those who felt that including extirpated species would inappropriately divert resources from the species currently inhabiting the planning area that are in need of conservation.

Appendix B shows the relationship of extirpated species with conservation targets in a nested target table. While the restoration of most of these species is currently beyond the scope of OSMP-specific management, staff proposes to participate in restoration efforts whenever the city's grasslands can reasonably make a meaningful contribution to reintroduction efforts for species extirpated from the Boulder Valley, or broader geographic areas.

Conservation in a Changing Environment - Selecting and Describing Targets

The following descriptions provide a non-technical summary of the nature, distribution, composition, and ecology of the Grassland Plan conservation targets. When referring to "natural" conditions or processes, OSMP has attempted to illustrate the conditions or processes that most closely reflect the range of variation under which the target and the nested plant and animal species evolved. The planning approach recognizes that most ecosystems on OSMP land have been significantly altered in the past—especially during the past 150 years. Although the conditions and processes have changed, and are likely to continue to change, an understanding of how these systems were originally "put together" offers insight for re-establishing sustainability.

Looking to the past however will not be sufficient to address the challenges of conserving OSMP grasslands. There is a growing awareness among conservation ecologists and land managers that efforts focused on restoring ecosystems to some original or "historic range of variability" (HRV) are likely to be unsuccessful because of changing environmental conditions (e.g., climate change, increased deposition of nitrogen from the atmosphere, invasive species). An emerging



photo – Ann Duncan

paradigm for the management of novel ecosystems recommends that managers describe and consider current conditions when describing the targets (systems and species) that are the focus of management and when setting conservation objectives for those targets (Seastedt et al. 2008).

⁷ Scientific names of plants and animals mentioned in the plan can be found in **Appendix C**.

The Conservation Action Planning process used in the development of Grassland Plan seeks to integrate modifications to “natural” conditions that have occurred and that are likely to occur over the ten-year planning horizon. The descriptions that follow consider natural, historical, current conditions and future trends affecting the composition, structure and landscape setting of the Grassland Plan targets.

Agricultural Operations

Background and Attributes of OSMP Agriculture

Ensuring on-going agricultural production is a well-established function of Open Space and Mountain Parks lands. The city charter lists the “preservation of agricultural uses and land suitable for agricultural production” and “preservation of water resources in their natural or traditional state” as open space purposes. “Water resources in a traditional state” includes the use of water rights for agricultural production on OSMP. Irrigated land and water resources available for agricultural production are critical for maintaining viable agricultural operations on OSMP lands. Approximately 14,600 acres of OSMP lands are leased for agricultural production (Figure 7). Of that, about 5,400 acres are irrigated. The primary uses of OSMP agricultural land are hay production and livestock grazing. Annual crops are grown on 300-600 acres of OSMP land each year. Crops currently grown include wheat, corn and barley.

Beef cattle and small grains have long been standard products for Boulder County agricultural producers. Hay as feed for horses has become a significant commodity in the last two decades with the increase in numbers of rural residential homes where people keep horses. Increasing numbers of homeowners are keeping horses on acreages too small to meet year-round forage needs creating a year-round demand for hay.



photo – Dave Sutherland

Marketing organic produce for sale to local restaurants and at farmers’ markets is a growing trend in the Boulder Valley. OSMP lessees are involved with natural beef production, but not the production of organic fruits or vegetables. OSMP conservation easements have been used for organic farming in the past.

In addition to agricultural products, ranchers and farmers are turning increasingly to agricultural *services*. Such services represent a small percentage of farm/ranch income for OSMP lessees. OSMP leases include a horse boarding operation and a therapeutic riding facility. Currently there are no community-supported agriculture (CSA) projects, no agro-tourism operations on OSMP, and no seasonal attractions such as dude ranching, Halloween pumpkin patches, or corn mazes.

OSMP staff has rarely influenced the production choices of agricultural users other than prohibiting the use of genetically modified organisms (GMOs). Lessee’s choices of specific agricultural commodities are influenced by local commodity markets and their ability to sell a product profitably. Ranch and farm operators have freedom to decide what to grow and to a large degree how to grow it. OSMP lease managers are involved in decisions about specific management practices (stocking rates, seasons of use, herbicide use, etc.) to ensure the sustainability of the land, protect public safety, and to minimize the need for special infrastructure specific to a particular crop or service.

In 1991 (most recent data available—cited in the Boulder County Comprehensive Plan-Online Resource), local commodity prices were identified as one of the major obstacles to farming in Boulder County. However, the growth in the horse hay market and the ability to market natural beef has improved local markets recently. Oil seed crops for biofuels and human consumption may be another opportunity for diversification by traditional agricultural users. Small-scale organic production will also be a viable alternative in the future.

As part of the same 1991 analysis, land prices and speculation by developers for agricultural land was identified as a threat to the future of agriculture in Boulder County. The protection of open spaces is one of several strategies in place to abate this threat. As early as 1986 Boulder's city charter identified two of the key attributes of agriculture—**land** and **water**. Without these two elements, OSMP would not be able to contribute to the continuation of agriculture in Boulder. The department has been very successful in purchasing both lands and water rights to conserve open space in the Boulder Valley, and has used agricultural practices successfully as land management tools. One measure of land suitability for agricultural production is the number of acres that is leased to farmers or ranchers. Currently OSMP leases approximately 14,600 acres of land for agricultural production. There are additional OSMP properties that are suitable for agricultural production, but for a variety of reasons are not leased. This includes small isolated parcels, lands that have agricultural facilities in a state of disrepair, places where agricultural values have been degraded by prairie dogs and places where OSMP is pursuing management objectives incompatible with on-going agricultural operations.



Irrigation Diversion

OSMP's portfolio of water rights arises from the four major creek drainages in the Boulder Valley, springs and groundwater. These water rights are used to irrigate over 5,500 acres for hay and pasture production. This portfolio contains many senior water rights establishing a reliable source of irrigation in most years.

Another attribute for sustainability of Agricultural Operations is the availability of operators to lease open space agricultural properties. According to the 2002 Census of Agriculture (USDA 2004), the majority (88%) of agricultural operations in Boulder County were operated by a family or individual (rather than a corporation). OSMP is one of the largest agricultural landowners in Boulder County (the other is Boulder County Parks and Open Space)—yet OSMP employs no staff to farm or ranch. OSMP depends upon local farmers and ranchers to ensure the on-going agricultural production on 14,600 acres of land.

The availability of operators depends upon having competent, flexible individuals who are willing to agree with the city's lease requirements. Competency is typically assessed by learning about an operator's past experience farming or ranching successfully either on OSMP lands or elsewhere. In addition, the OSMP Long Range Management Policies state that OSMP staff will perform a fiscal analysis of the lessee's ability to perform according to the terms and conditions of the lease.

Flexibility is often a function of the size of the farmer or rancher's operation beyond lands leased from OSMP. Because OSMP has a variety of purposes, it may be necessary from time to time to manage for priorities other than agricultural production or efficiency. At these times, farmers or ranchers who have alternative lands to address their needs offer advantages over operators who are restricted to only lands they lease from OSMP—or even a single OSMP property. Operators with capacity to take on larger areas also reduce the number of leases that the department must track, reducing administrative costs.

Willingness to farm on OSMP lands is affected by the stresses associated with farming in an urbanizing area, and farming on lands open to public use. A 1985 Colorado State University - Boulder County Agricultural Survey revealed that the number one factor discouraging continued agriculture was not market economics but the stresses and impacts created from urban influences (Boulder County Comprehensive Plan 1997). To date, willingness to lease open space properties has been measured by the



Haying

response of operators to lease offerings (requests for proposals) or the number of people who contact OSMP during the course of the year interested in leasing land for agriculture. One measure that can be used to forecast long-term availability of lessees is the average age of farm operators. For Boulder County, the average age is 56. This suggests that there are probably more farmers near the end of their farming careers than near the beginning.

Managing for Agriculture in the Context of Multiple Use

In 1967, the City of Boulder began the purchase of open space lands, many of them in the Grassland Planning Area. With few field staff and little on-the-ground management capacity, the city leased properties to local farmers and ranchers to address day-to-day management. Recognizing a long-term responsibility to set management objectives, city-commissioned agricultural management plans were developed in 1975. These plans informed the city's leases with farmers to ensure long-term sustainability of the land.

As the open space staff grew newly hired agricultural managers, rangers, wildlife and plant ecologists developed a better understanding of how agricultural practices were affecting biodiversity conservation. Agricultural activity was recognized as not only a charter purpose but also a tool to enhance the ecological values of the city's natural areas.

Agricultural operations on lands that are currently managed as open space have created novel ecosystems over the past century. Irrigation and livestock grazing have been major sources of change to ecological systems in the Grassland Planning Area. Since natural precipitation alone

cannot support agriculture in many settings in the planning area—especially the higher terraces, mesa sides and mesa tops, significant inputs of irrigation water are needed. This water, diverted from creeks supports not only agricultural production but also a wide range of semi-native moist meadows and wetlands dominated by native species. A common occurrence in irrigated pastures is the accumulation of “tail water” (irrigation water that drains from the lower ends of fields) in depressions where marshes and other wetlands are supported.

Semi-native hayfields and pastures and the associated agricultural practices support wildlife not commonly found elsewhere on OSMP lands such as bobolinks, as well as species which are more widespread elsewhere on OSMP but still of conservation concern. These include grasshopper sparrows, lark sparrow, savannah sparrow, northern harrier, and Swainson’s hawk. The federally threatened Preble’s meadow jumping mouse is present on OSMP lands managed for agriculture. Irrigated pastures and the ditches that serve them support plant species of concern such as the federally threatened Ute ladies’-tresses orchid and the locally sensitive American groundnut and showy prairie gentian. OSMP staff has been working with lessees for several decades to operate in a manner consistent with the conservation of these species.



Bobolink photo – Dave Sutherland

Agricultural management of OSMP has provided significant advantages for the conservation of native species. However there are ecological costs associated with the transformation of land into agricultural uses and agricultural practices can be incompatible with the protection of native biodiversity. Agricultural land uses on OSMP have been increasingly multifunctional. The Grassland Plan will provide more information about how agriculture and ecological conservation interact.



Chapter III: Viability Assessment

Chapter Summary

This chapter describes the current and acceptable conservation status for each target.

Targets can be described by *key attributes*. Key attributes are aspects of the target, which if altered, could result in the improvement, degradation or loss of the target over the next thirty years. Key attributes can be thought of as characteristics of the target's size, condition, or context in the landscape. *Indicators* are developed to measure, document the condition of and track the status of key attributes, and targets over time.

Successful conservation of the Grassland Plan targets requires an understanding of their viability status. Much like a doctor uses heart rate and blood pressure to evaluate the health of a patient, the viability assessment gives OSMP the ability to “take the pulse” of the Grassland Plan targets and assess the overall viability of the Grassland Planning Area.

Key Attributes

In order to assess the viability of the conservation targets, OSMP first identified a limited number of key attributes for each planning target. **Key attributes** are aspects of the target, which if altered, could result in the improvement, degradation or loss of the target. Key attributes relate to a target's size, condition, or landscape context. Examples of key attributes:

- Because of the importance of native plants and animals, vegetation composition or animal species composition are key attributes for the targets.
- Since fire has been important in the development of the grassland ecosystems, fire regime is a key attribute.
- Wetlands and riparian areas are dependent upon water; consequently, hydrologic regime and water quality are key attributes for these systems.

The key attributes developed for the Grassland Plan targets are listed in **Table 2**. Details about the selection of key attributes in the Grassland Plan can be found with the other viability assessment information in **Appendix D**.

Table 2: Key attributes of Grassland Plan targets

<u>Target</u>	<u>Key Attributes</u>
Mixedgrass Prairie Mosaic	Animal Species Composition Block/Complex Size Fire Regime Habitat Effectiveness Vegetation Composition Vegetation Structure
Xeric Tallgrass Prairie	Animal Species Composition Block/Complex Size Fire Regime Vegetation Composition Vegetative Structure
Mesic Bluestem Prairie	Animal Species Composition Fire Regime Vegetation Composition Vegetation Structure
Agricultural Operations	Agricultural Production Animal Species Composition Physical And Chemical Soil Regimes Vegetation And Soil Conditions
Black-Tailed Prairie Dog & Associates	Animal Species Composition Block/Complex Size Prairie Dog Occupancy
Wetlands	Animal Species Composition Connectivity Hydrologic Regime Vegetation Composition Water Quality
Riparian Areas	Animal Species Composition Connectivity Habitat Effectiveness Habitat Structure Hydrologic Regime Vegetation Composition Vegetation Structure Water Quality
White Rocks	Animal Species Composition Block/Complex Size Vegetation Composition

Table 3: Grassland Plan Indicators and Conservation Targets
(Key attributes as shaded rows)

	Mixedgrass Prairie Mosaic	Xeric Tallgrass Prairie	Mesic Bluestem Prairie	Agricultural Operations	Bark-tailed Prairie Dog & Associates	Wetlands	Riparian Areas	White Rocks
Agricultural Production								
Acres in agricultural production				X				
Irrigable land leased for agriculture				X				
Animal Species Composition								
Bird conservation score							X	
Fish index of biotic integrity							X	
Macroinvertebrate index of biotic integrity							X	
Management of class A and class B bobolink nesting habitat				X				
Native frog presence						X	X	
Number of colonies with successful burrowing owl nests					X			
Predator community composition/abundance					X			
Percent occurrence of grassland dependent & sensitive lepidopterans (2)	X (2)	X (2)	X (2)					
Percent of colonies with territorial horned larks					X			
Percent of target with acceptable bird conservation score	X	X						
Presence of barn owls								X
Presence of six-lined racerunner								X
Relative cover of host plants for skipper/butterfly species of concern		X	X					
Species richness of sensitive breeding birds			X					
Submerged aquatic nuisance species richness (see Vegetation Comp.)							X (0.5)	
Block/Complex Size								
Size/distribution of blocks	X	X						X
Acres occupied by prairie dogs					X			
Connectivity								
Buffer width						X	X	
Distance to nearest wetland/riparian area						X	X	
Undesignated trail density in northern leopard frog habitat blocks						X	X	
Impediments to fish passage (#)							X	
Fire Regime								
Percent of target area experiencing an appropriate fire return interval	X	X	X					
Habitat Effectiveness								
Proportion of habitat blocks over 100 ha with singing male grasshopper sparrows	X							
Number of active bald eagle nest sites							X	
Habitat Structure								
Physical instream and riparian metric							X	
Hydrologic Regime								
Instream flow							X	
Number of over-bank flooding events							X	
Physical and Chemical Soil Regimes								
Percent soil organic matter				X				
Prairie Dog Occupancy								
Percent of total occupied land in protected status					X			
Percent of grassland preserves with occupancy between 10 and 26%					X			
Vegetation and Soil Conditions								
Percent of grazed areas in good condition according to an integrated measure of range quality				X				
Vegetation Composition								
Abundance of black spleenwort								X
Management of Ute ladies-tresses orchid habitat			X			X		
Percent of target dominated by exotic species	X	X	X			X	X	
Percent of target with prevalence of exotic species	X	X	X			X	X	
Native species relative cover	X	X	X			X	X	
Native species richness	X	X	X					
Presence of local suite of rare species								X
Presence of populations of Ute ladies-tresses orchid			X			X		
Size of grassyslope sedge populations		X						
Size of Bell's twinpod populations	X							
Size of dwarf leadplant populations		X						
Size of prairie violet population		X						
Richness of selected conservative plant species	X	X	X					
Submerged aquatic nuisance species							X (0.5)	
Vegetation Structure								
Absolute cover bare ground	X	X	X					
Cottonwood regeneration							X	
Water Quality								
Total phosphorus						X	X	
Dissolved oxygen							X	
Secchi disk depth						X		

Indicators

The next step in assessing viability was to develop indicators to track the status of the target over time. **Indicators are entities that are measurable and specifically related to a key attribute.**

Examples of indicators for key attributes:

Criteria for a Good Indicator (from TNC 2007)

1. **Measurable:** The indicator can be assessed in quantitative or discreet qualitative terms by a procedure that produces reliable, repeatable, accurate information.
2. **Precise & Consistent:** The indicator means the same thing to all people and does not change over time (although status of indicator is expected to change).
3. **Specific:** The indicator is unambiguously associated with the key attribute of concern and is not significantly affected by other factors.
4. **Sensitive:** The indicator shows detectible and proportional changes in response to changes in threats or conservation actions.
5. **Timely:** The indicator detects change in the key attribute quickly enough that you can make timely decisions on conservation actions.
6. **Technically Feasible:** The indicator is one that can be implemented with existing technologies, not one that must await some big future conceptual or technological innovation.
7. **Cost Effective:** The indicator should provide more or better information per unit cost than alternatives.
8. **Publicly Relevant:** The indicator should be useful for publicly communicating conservation values and progress to the community.

- o Native plant relative cover is an indicator for “vegetation composition”
- o Time between fires (fire return interval) for “fire regime”
- o Discharge or “instream flow” rate of a creek for “hydrologic regime”
- o Total phosphorus, dissolved oxygen and Secchi disk depth for “water quality”

The indicators and associated key attributes for the Grassland Plan are listed in **Table 3**. The rationale and justification for these indicators are included in **Appendix D**.

Acceptable Range of Variation

The attributes of ecological systems and agricultural operations fluctuate over time. Much like a person can be healthy within a range of body temperatures or pulse rates, a target will persist over time within some range of variation in a key attribute. Outside “healthy” limits a person becomes sick and may eventually die. Similarly, a target is degraded and potentially destroyed when a key attribute falls outside its indicators’ acceptable range of variation (ARV).

There are few references for the standard key attributes and ARV’s for ecological and agricultural targets. OSMP staff developed the Grassland Plan ARVs based upon best available data, general ecological concepts, professional experience and recommendations and opinions from experts. In some cases, there was little or no baseline data, little published research and few experts to provide guidance. In such cases, ARV’s were based upon OSMP staff’s best professional judgment. All the ARVs

should be considered credible first iterations subject to change with the experience gained from plan implementation.

It is also worth noting the use of *acceptable* rather than *natural* ranges of variation. This distinction is made purposefully to avoid the need to define “natural conditions” and communicate that the ARV recognizes that OSMP will be considering factors beyond the department’s direct control

such as surrounding land use, large scale ecological changes (climate change, atmospheric deposition), persistent non-native species, other OSMP management objectives, etc.

Viability Ratings

A simple four rating system is used to communicate the status of the indicators. The two higher ratings, “Good” and “Very Good”, are used when the indicator measurement is within the ARV. The two lower ratings are used when the measurement is outside the ARV. “Very Good” is used to describe the most desirable state, where little management intervention is required on an ongoing basis. In other words, the indicator is measuring a key attribute that appears to be self-sustaining. “Good” refers to measurements that fall within the ARV, but are not self-sustaining, so some management is needed. “Fair” reflects a situation that requires management, but can be restored to a “Good” or “Very Good” rating with reasonable effort. “Poor” ratings describe a situation in which improvement to “Good” or “Very Good” is unlikely and the loss of the target is likely without timely and intense intervention (Table 4). Indicators outside or trending outside of the acceptable range of variability reflect the need for management action.

Viability ratings are also used to communicate the status of the target and the entire planning area (by combining the targets). The process of computing these ratings is described in the CAP Handbook (TNC 2007).

Table 4: Viability ratings, their meanings and their relationship to acceptable range of variation (ARV)

Viability Rating	Description	
Very Good	Ecologically desirable status; requires little intervention for maintenance.	Within ARV
Good	Indicator within acceptable range of variation; some intervention required for maintenance.	
Fair	Outside acceptable range of variation; requires human intervention.	Outside ARV
Poor	Restoration increasingly difficult; may result in extirpation or loss of target.	

An example:

Table 5 shows that “Fire Regime” is a key attribute of the Mixedgrass Prairie Mosaic. The ARV is that greater than half (> 51%) of the target experiences fire no less frequently than one in 30 years and no more frequently than once in five years. The indicator selected for this attribute is the proportion of the target experiencing fire within this return interval. Detailed information describing the derivation of ARV and viability ratings for each indicator is available in **Appendix D**.

Table 5: Example from Grassland Plan showing relationship of indicator rating, acceptable range of variation and viability rating (after TNC 2007)

Target	Key Attribute	Indicator	Indicator Ratings			
			Poor	Fair	Good	Very Good
Mixedgrass Prairie Mosaic	Fire Regime	Percent of target area experiencing a 5-30 year fire return	<25%	26-50%	51-75%	76-100%

The next step in the viability assessment is to determine the current status and set the desired status of each indicator. The current status ratings reflect where the indicators and key attributes are now based upon best available information. In some cases, OSMP lacks the information to characterize current status.

Viability of Grassland Plan Targets

The section that follows contains the viability assessment for each target. The assessment is organized by key attribute grouping. These groupings are Size, Condition and Landscape Context.

- **Size** includes aspects of a target related to extent or number (e.g., 50 breeding pairs, or 1,000 acres)
- **Condition** refers to some aspect of structure, composition, or biotic interaction (e.g., animal species composition, density of vegetation, cover by bare ground, presence or diversity of predators)
- **Landscape Context** refers to aspects of the target that affect the movement of species, the impacts of surrounding lands, and target wide ecological processes such as fire, flooding, or grazing

Table 30 summarizes the viability ratings for the targets and the Grassland Planning Area. It can be found at the end of the chapter on page 77.

How are Targets, Attributes, and Indicators Related?

- **Targets** broadly define what we are planning for—those natural and agricultural resources that we are trying to protect, provide, and manage.
- **Attributes** define essential qualities or components of targets that, when present, result in long-term sustainability of the target. When these attributes are absent or are severely compromised, the target is no longer sustainable without significant management effort and could be lost completely.
- **Indicators** are quantitative and qualitative measures of the attributes; they are what we measure to track conditions of the attributes. One or more indicators are selected for each attribute. Indicators help us characterize existing and desired future conditions for the attributes and inform us of their status or health. Thresholds can be set for indicators to help identify at what point conditions are acceptable or within the range of desired conditions.

Examples:

Target	Attribute	Indicator
Mixedgrass Prairie Mosaic	Fire Regime	% of Target Experiencing Fire every 5-30 years
Black-tailed Prairie Dog and Associates	Prairie dog occupancy	Total area occupied by prairie dogs

1995). Management over the past 20 years has successfully sustained populations in Mesic Bluestem Prairie and Wetlands.

Cover of bare ground falls within the range of acceptable variation. This contrasts with conditions in the Xeric Tallgrass Prairie and Mixedgrass Prairie Mosaic where cover by bare ground was found to be too high. Greater available soil moisture and higher levels of productivity are probably responsible for lower bare ground cover.

Although *dominance* by non-native plants is rated “Good”, over 15% of the target has a *prevalence* of exotic plant species. The availability of moisture in the Mesic Bluestem Prairie creates conditions conducive to the establishment and growth of a number of aggressive weeds not found in the surrounding uplands. The prevalence of non-native plants is also reflected in the lower than acceptable species richness, relative cover of native plants and conservative plant richness in particular.

Mesic Bluestem Prairie supports populations of butterfly and skippers that are uncommon throughout their range. OSMP’s grasslands represent an opportunity to conserve these species in the Southern Rocky Mountain ecoregion (Neely et al. 2001). OSMP staff considers the occurrence of sensitive and grassland-dependent butterflies to be too low. The relative cover of host plants for skipper/butterfly species of concern is just above the threshold of acceptability. Increased cover of the host plants may improve habitat for sensitive and grassland-dependent butterflies.

Landscape Context (Fair)

OSMP identified fire and hydrologic regimes as the key attributes for the Mesic Bluestem Prairie. As with the preceding targets, the fire return interval was selected as the indicator of an acceptable fire regime. A shorter return interval (5-10 years) was used for the Mesic Bluestem Prairie because higher rates of productivity replenish fuel loads more quickly in Mesic Bluestem Prairie (Table 15).

Table 15 : Key attribute, indicator and rating for the landscape context of the Mesic Bluestem Prairie

Key Attribute	Indicator	Rating
Fire Regime	Percent of target area experiencing a 5-10 year fire return	Fair

No indicators or standards have yet been identified for the hydrologic regime. A system-wide hydrologic assessment could allow OSMP to develop meaningful size- and hydrology-based key attributes and indicators.

Agricultural Operations

Size (Good)

Agricultural production was identified as the sole size-based attribute of Agricultural Operations. OSMP identified two measures to assess the level of agricultural production: acres in production and the percent of irrigable land leased for agriculture (Table 16).

Agricultural Operations

Overall Viability Rank-Good

Size-Good

Condition-Fair

Landscape Context-Not Rated

Table 16 : Key attributes, indicators and ratings for the size of agricultural operations

Key Attribute	Indicator	Rating
Agricultural Production	Acres in agricultural production	Good
Agricultural Production	Percentage of Irrigable land leased for agriculture	Good

Note: Indicators in **bold** are considered within the acceptable range of variation. (Indicator rating details are included in **Appendix D**.)

OSMP currently leases approximately 14,600 acres for agricultural production. This acreage includes almost all irrigated lands, lands in dryland annual cropping systems, those lands that OSMP grazes prescriptively to achieve viability objectives for other targets, and other grazed properties. In addition, agriculture is the dominant use on approximately 3,000 acres of conservation easements protected by OSMP.

Agricultural lands protected by City of Boulder OSMP (fee ownership and easements) account for about 22% of the estimated 80,000 acres in agricultural use in Boulder County (Environment Colorado 2006). Together, the City and Boulder County account for about half the agricultural acreage in Boulder County. One estimate predicts that by 2020 there will be approximately 40,000 acres of land in agricultural use in Boulder County (Environment Colorado 2006). This amount is equal to the extent of land managed for agriculture by Boulder’s city and county open space programs in 2008. It is not known whether existing open space agricultural lands alone could support a diverse and sustainable local agricultural economy.

From 1992-2002, most of the 28% decrease in agricultural land in Boulder County was caused by conversion of land to residential, commercial and industrial developments. Increasing land and water values put economic pressure on ranchers and farmers to sell their property. Urbanization also creates a greater number and variety of jobs—many less demanding than farming or ranching. This in turn reduces the availability of farm/ranch labor. Sale of agricultural land reduces the number of operating farms, and reduces the number of people farming thereby decreasing the demand for local businesses that support farming/ranching (i.e. feed stores, tractor parts dealers, farm equipment repair shops, etc.). These merchants and vendors then leave the area—making it more difficult for the remaining farmers and ranchers to obtain goods and services. With the reduction in number of farms and farmers, the local social network of farmers deteriorates reducing the amount of cooperation and availability of assistance. Agricultural producers who remain face challenges from their new neighbors, who are often unaccustomed to the noises, smells and other attributes of agricultural production. Urbanization can also lead to direct impacts to farmers through the trampling of crops, tampering with ditches, gates left open, theft and vandalism.

These factors can interact with each other to create a downward spiral in the number of agricultural operations and the extent of land in agricultural productivity. There is some thought that this feedback loop operates especially quickly once the amount of agricultural land in a region crosses a threshold. After crossing that threshold, the rate of loss of farmland accelerates. Where there is sufficient value or profit associated with a crop such as locally produced organic vegetables or ornamental flowers, agriculture land uses may persist and even increase. There is, unfortunately, no formula to calculate the “critical mass” for land in agricultural production. However, agricultural economists have noted that the rates of agricultural loss and amount of farmland in a county are directly related (Lynch and Carpenter 2003).

Irrigated parcels are the most agriculturally productive in the Boulder Valley. Under Colorado water law, if OSMP or any water right owner fails to use their water rights, those rights can be

abandoned, partially abandoned, reduced by decree at the time of a water transfer, and/or reduced in value. Such a loss or reduction would represent unacceptable disposition of OSMP real property, and financial and opportunity costs for OSMP’s land and water management programs. OSMP works in partnership with lessees to run water on departmental lands, and uses staff to run water on irrigated properties that are not currently leased. In order to maximize production and protect water rights, OSMP seeks to ensure that irrigable lands are leased to the maximum extent possible. Currently about 85% of irrigable, and nearly all irrigated lands, are leased for agricultural production.

Condition (Fair)

Condition ratings for Agricultural Operations (**Table 17**) are OSMP staff’s best professional judgment. No quantitative data have been collected to characterize or estimate physical and chemical soil conditions. Open Space and Mountain Parks is also evaluating existing multi-metric indicators developed to assess grazing land soil stability, hydrologic function, as well as structural and functional resilience to disturbance (Gerrish 2004 and Pellant et al. 2000). OSMP staff has estimated conditions to be within the range of acceptable variation based upon experience with the methodology and familiarity with conditions on the ground.

Table 17: Key attributes, indicators and ratings for the condition for Agricultural Operations

Key Attribute	Indicator	Rating
Physical and Chemical Soil Regimes	Percent soil organic matter	Good
Vegetation and Soil Conditions	Percent of grazed areas in good condition according to an integrated measure of range quality	Good
Animal Species Composition	Management of bobolink nesting habitat	Fair

Note: Indicators in **bold** are considered within the acceptable range of variation. (Indicator rating details are included in **Appendix D**.)

Soil organic matter supports agricultural productivity. Organic matter is important as a source of plant nutrients, and improves soil structure, maintains soil aggregation and minimizes erosion. It is possible for grazing or other types of harvest to result in organic soil matter depletion faster than rates of accumulation. When soil organic matter removal exceeds plant growth and decomposition, long-term soil productivity decreases. When soil organic matter is not conserved, soils may degrade to a lower steady state. Restoring higher levels of productivity are often difficult and expensive. OSMP has not yet sampled percent soil organic matter on a regular basis or according to a protocol that would allow staff to estimate trends. However, the indicators use current conditions as a starting point, and include both “stable” and “increasing” levels of soil organic matter in the acceptable range of variation.

Bobolinks are ground-nesting songbirds that nest primarily in wet meadows in the Boulder Valley (Thompson and Strauch 1987). They are protected under the Migratory Bird Treaty Act and are considered “vulnerable to extirpation” (“S3B”) by Colorado National Heritage Program and “rare breeding species” by the Boulder County Comprehensive Plan. Bobolink populations in the western United States are unique in that they are separated from the main breeding range of bobolinks further to the east (Hamilton 1962). Bobolinks originally nested in tallgrass or mixed-grass prairie of the mid-western United States and south-central Canada (Bent 1958), but because of land conversion, have now increased their use of irrigated hayfields throughout their range (Martin and Gavin 1995). The bobolink is of particular interest to land managers because of its extreme population decline during the past thirty years and its affinity to breed late in the summer when much of the mowing typically occurs (Martin and Gavin 1995). Bollinger et al.

(1990) documented a 90-100% failure rate of bobolink nests because of hayfield mowing. The consensus is that postponing mowing until July 15 allows for the majority of fledglings to be able to sustain flight and hence avoid mowing impacts (Thompson and Strauch 1987, Vierling 1997, Roeder 1998). The indicator for bobolink management refers to the proportion of high quality breeding habitat in grasslands on which mowing is deferred until after July 15, or the actual date of bobolink fledging as determined by monitoring.

Landscape Context (not rated)

Soil conditions and the availability of water have been the primary landscape drivers for agriculture in the GPA. Lands with productive soils and available water rights are considered most agriculturally significant. Maintaining agricultural uses in these areas was described as a viability factor for Agricultural Operations under “Size”.

Although landscape context plays an important role in determining the type of agriculture likely to be found in the GPA, agricultural producers have been able to overcome landscape limitations and have used almost the entire Boulder Valley for agriculture at one time or another. Because there is such a wide range of acceptable conditions for agriculture, no landscape context-based key attributes were identified for the Agricultural Operations target.

Black-tailed Prairie Dog and Associates

Size (Good)

OSMP staff identified “active prairie dog colonies” as a size-based attribute to track the viability of this target. The indicator for this attribute is the number of acres of active prairie dog colonies in the Grassland Planning Area (**Table 18**). OSMP maps the extent of active colonies annually. Due to resource and time constraints, the department does not count or estimate the numbers or density of individual animals or burrows as part of the annual mapping project. OSMP has conducted mapping of active prairie dog colonies since 1996.

Black-tailed Prairie Dog and Associates

Overall Viability Rank-Good

Size-Good
Condition-Good
Landscape Context-Fair

The extent of prairie dogs in the GPA has fluctuated due to open space acquisitions, natural population growth, relocation, predation, disease—including plague and other sources of mortality (**Figure 15**). Although the extent of active prairie dogs colonies has declined precipitously in the GPA during periodic plague outbreaks, populations have repeatedly recovered due to a small number of survivors re-establishing colonies or migration of animals from surrounding unaffected colonies. OSMP has also relocated prairie dogs from outside the GPA into areas vacated by plague.

AGRICULTURAL OPERATIONS

Conservation Target: Agricultural Operations

Category: Condition

Key Attribute: Animal Species Composition

Key attribute comment: As written, this indicator was developed to be applicable to irrigated hayfields (part of the Agriculture Operations Conservation Target). However, as OSMP expands its survey of nesting bobolinks to include non-irrigated sites (i.e., wet meadows and wetlands), this indicator may be modified.

Bobolinks are ground-nesting songbirds which nest primarily in wet meadows in the Boulder Valley (Thompson and Strauch 1987). They are protected under the Migratory Bird Treaty Act and are considered “vulnerable to extirpation” (“S3B”) by Colorado National Heritage Program and “rare breeding species” by the Boulder County Comprehensive Plan. Bobolink populations in the western United States are unique in that they are separated from the main breeding range of bobolinks further to the East (Hamilton 1962).

Bobolinks originally nested in tallgrass or mixedgrass prairie of the mid-western United States and south-central Canada (Bent 1958), but because of land conversion, have now increased their use of irrigated hayfields throughout their range (Martin and Gavin 1995). The use of this habitat creates a potential management conflict as most irrigated hayfields are managed under maximum yield principles, which translates to several harvests (i.e., mowing) each season. The bobolink is of particular interest to land managers because of its extreme population decline during the past thirty years and its affinity to breed late in the summer when much of the mowing typically occurs (Martin and Gavin 1995). Bollinger et al. (1990) documented a 90-100% failure rate of bobolink nests because of hayfield mowing. On OSMP hayfields, Roeder (1998) documented no breeding bobolink mortality at four nests and attributed this to the fact that mowing did not occur until after the young had fledged and parental activity ceased.

Efforts by OSMP staff to manage irrigated hayfields to conserve bobolinks began in 1993 when the Burke II property was closed to visitor use. However, records date to 10 years before that which document successful breeding attempts by bobolinks on the Burke II property. Thompson and Strauch (1987) reported a mean fledgling date of July 8th for nests on the Burke I, Burke II, and Gephard OSMP properties, but the general consensus is that postponing mowing until July 15th will allow for the majority of fledglings to be able to sustain flight and hence avoid mowing impacts (Thompson and Strauch 1987, Vierling 1997, Roeder 1998). The incubation period for bobolinks is about two weeks and nestlings leave the nest between 10 and 14 days later (Martin and Gavin 1995). Male bobolinks usually arrive in Boulder County around the end of May and females tend to arrive one week later (Thompson and Strauch 1987). However, exact time of nesting is not known for OSMP properties.

OSMP managers seek to maintain traditional agricultural land use (haying, grazing) while preserving and maintaining natural systems and native species. In order to identify key bobolink breeding sites and thus inform management decisions, OSMP initiated a hayfield bird monitoring program in 2000. Using these data, staff identified key breeding sites in terms of abundance and density of singing male bobolinks, a common metric used to assess grassland bird abundance. These highest density breeding areas were designated as “Class A Bobolink Management Areas”. OSMP staff also designated a set of second tier breeding areas as “Class B Bobolink Management Areas”.

Indicator: Management of bobolink nesting habitat

Indicator Ratings:

Poor: ≤100% of Class A Bobolink Management Areas mowed after 7/15 annually and <30% of Class B Bobolink Management Areas mowed after 7/15 in one out of three years

Fair: 100% of Class A Bobolink Management Areas mowed after 7/15 annually and 30 - 75% of Class B Bobolink Management Areas mowed after 7/15 in one out of three years
Good: 100% of Class A Bobolink Management Areas mowed after 7/15 annually and >75% of Class B Bobolink Management Areas mowed after 7/15 in one out of three years
Very Good: 100% of Class A Bobolink Management Areas mowed after 7/15 annually and 100% of Class B Bobolink Management Areas mowed after 7/15 in one out of three years
Indicator ratings comment: Recent research in New York suggests that bobolinks prefer older (>8 years since plowing) and larger (≥ 30 ha) hayfields (Bollinger and Gavin 1992).

In 2007, OSMP staff and volunteers detected bobolinks at 42% (n=70) of all hayfields sampled (n=165).

Using abundance and density information from the hayfield bird monitoring program, staff chose four top-tier fields to be designated Class A Bobolink Management Areas (in these areas, mowing would only occur after 15 July annually) and identified 14 second-tier fields as candidates for consideration as Class B Bobolink Management Areas. In these areas, mowing would only occur after 15 July in one of every three years.

OSMP staff determined that five of the 14 fields identified as candidates for designation as Class B Bobolink Management Areas were either already being managed in a manner consistent with the Class B Management Area Criteria or could easily be managed in such a manner. Agricultural production was identified as the appropriate priority management activity at four of the sites. No determination was made at the remaining five sites because of complexities in land use.

OSMP staff will explore other options in some of the Class B Bobolink Management fields including land-use changes (i.e., winter grazing). Staff will also examine bobolink use of un-mowed habitats (i.e., wet meadows and wetlands) and may focus on studying local fledging dates.

Indicator Measurements:

Date: 4/15/2008
Current Rating: Fair
Trend: Unknown
Source: Rapid Assessment
Current rating comment: Bobolink (BOBO) data from hayfield bird surveys conducted in 2006 and 2007 along with management designations.

42% (n=70) fields censused had Bobolinks (of 165 total fields)
 Total acres currently hayed = 3159
 Total acres of fields with Bobolinks = 1539
 Total acres in Class A Bobolink Management Areas = 267 (17 % of total acres with Bobolinks)
 Total acres in Class B Bobolink Management Areas = 366 (24 % of total acres with Bobolinks)
 Total acres recommended for Bobolink conservation = 633 (41% of total acres with Bobolinks, 20% of all acres currently hayed)

Class A Bobolink Management Areas (4)

Property	Field	# of BOBO per year	BOBO density/ yr (/10 acres)	Area (acres)	Management Designation
Church	355	33/2	1.75	96	Class A
Burke II	263	32/2	3.0	54	Class A
Van Vleet	315	39/2	2.1	92	Class A
Van Vleet	331	23/2	4.6	25	Class A

Candidate Class B Bobolink Management Areas (14)

Property	Field	# of BOBO per year	BOBO density/ yr (/10 acres)	Area	Management
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				(acres)	Designation
Deluca	13	9/2	1.4	32	See Note 1
Deluca	14	11	2.0	27	
Deluca	19	12	3.3	18	
Hester	18	13	2.6	25	
Campbell	21	20	2.6	39	
Swartz	254	8/2	5.0	8	See Note 2
St. Walburga	303	2/2	1.0	22	See Notes 2,3
Baseline 75	285	5	2.0	13	
Baseline 75	280	12/2	6.0	10	See Notes 2, 4
Gallagher	133	11	1.4	39	Class B
Spicer	260	19	3.3	29	Class B
Teller Farm N.	186	5/2	0.75	38	Class B
Bell II	194	10/2	1.25	40	Class B
Bell II	199	17/2	3.3	26	Class B

Note 1: Complicated land uses preclude decision; some options available including land-use shift.

Note 2: Managed primarily for agricultural productivity.

Note 3: Adjacent field (#308) may be an option to manage for BOBO.

Note 4: There is potential to only winter graze.

Note 5: Already managed consistently with Class B Management Area criteria.

Desired Rating: Good

Conservation Target: Agricultural Operations

Category: Condition

Key Attribute: Physical and Chemical Soil Regimes

Key attribute comment: Organic matter is living plant tissue and decomposed or partially decomposed material from living plants and animals. Organic matter is important as a source of plant nutrients, and improves soil structure, maintains soil aggregation and minimizes erosion. These functions are all associated directly with agricultural productivity.

Agricultural practices must be managed to conserve soil organic matter. It is possible for grazing or other types of harvest to deplete organic soil matter faster than it can accumulate. When removal exceeds plant growth and decomposition, long-term soil productivity decreases. When soil organic matter is not conserved, soils may transform from a higher steady state of productivity to a lower steady state. Restoring higher levels of productivity are often difficult and expensive.

Indicator: Percent soil organic matter

Indicator Ratings:

Fair: Decreasing soil organic matter

Good: Stable soil organic matter

Very Good: Increasing soil organic matter

Indicator ratings comment: OSMP will use the first few years of monitoring this indicator to determine the range of variability across the system. When that information is available, ratings may be refined.

Confidence of these indicator rating descriptions: High

Indicator Measurements:

Date: 3/15/2008

Current Indicator Measurement: Unknown

Current Rating: Good

Current rating comment: OSMP has not yet sampled percent soil organic matter on a regular basis or according to a protocol that would allow staff to estimate trends.

Desired Rating: Good

Desired rating comment: Conserving soil organic matter is one means of maintaining the long-term sustainability of grasslands for agricultural and ecological values.

Other comments: Because different types of agricultural management affect soil organic matter differently, the effect of these practices can be compared by system-wide sampling that includes each of the three types of agricultural land use on OSMP:

- Annual Cropping Systems in Drylands
- Irrigated Pasture/Hayfield
- Grazing of native grasslands

Conservation Target: Agricultural Operations

Category: Condition

Key Attribute: Vegetation and Soil Conditions

Key attribute comment: The use of qualitative information (e.g., observations) to determine range and soil conditions has a long history of use in land management inventory and monitoring. Because it is qualitative this approach has limitations. It is suitable for use only by people knowledgeable and experienced in grassland management. Visual assessments can be an efficient way of conducting preliminary evaluations of soil/site stability, hydrologic function, and integrity of the biotic community and help identify areas that are potentially at risk of degradation. This indicator is intended to provide early warnings of potential problems and opportunities rather than to identify the cause of resource problems. This indicator is not intended to be the basis for making long-term or wide-ranging management decisions.

The rapid assessment methodology of Gerrish (2004) provides a subjective measure of grassland condition. Areas ratings are based upon ten critical pasture, grazing, and soil factors. A single evaluation provides a “snapshot” of condition. Repeated observations can help managers track the trend of an area and provide a leading indicator of responses to management changes. The evaluation criteria are:

- Desirability of Plant Population
- Plant Diversity
- Plant Density
- Plant Vigor
- Legumes in Stand
- Severity of Use
- Uniformity of Use
- Soil Resources
- Undesirable Canopy
- Plant Residue

This indicator is proposed as a provisional measure. OSMP recognizes that it relies heavily upon subjective judgment that it may not be easily repeatable, and that the methods require further documentation. The work of Pellant et al. (2000) describes an alternative method that is more fully documented and potentially less subjective.

Indicator: Percent of grazed areas in good condition according to an integrated measure of range quality

Indicator Ratings:

Poor: <40%

Fair: 40-60%

Good: 60-80%

Very Good: >80%

Indicator ratings comment: The ratings represent the direct relationship between sustainability of agricultural operations and a suite of related site conditions.

Confidence of these indicator rating descriptions: High

Indicator Measurements:

Current Indicator Measurement: Unknown

Current Rating: Good

Current rating comment: The methodology has not yet been applied across OSMP's agricultural lands.

Desired Rating: Good

Desired rating comment: It is OSMP's objective to have the majority of lands in agricultural use with "Good" or "Very Good" site stability.

Conservation Target: Agricultural Operations

Category: Size

Key Attribute: Agricultural Production

Key attribute comment: The extent of land in farms in Boulder County has decreased by 28% between 1992 and 2002. Current estimates indicate there are about 80,000 acres of agricultural land in the county (Environment Colorado 2006). One model used to generate estimates of agricultural land predicts that by 2020 there will be approximately 40,000 acres—equal to the extent of land currently (2008) managed for agriculture by Boulder's city (15,000 acres) and county (25,000 acres) open space programs. If current trends continue, OSMP lands will be an increasingly critical component of agriculture land in the county.

Much of the loss of agricultural land is caused by conversion of land to residential, commercial and industrial developments. Urbanization often results in a negative feedback loop. Conditions in an increasingly urbanizing landscape tend to increase land and water values, creating economic pressure on landowners to sell their farms. Urbanization also creates a wider range of employment opportunities and reduces the availability of farm/ranch labor. Sale of agricultural land results, in turn, in the loss of farms and farmers. As farming and ranching becomes less common, there are fewer farmers and ranchers in the local social network. This can reduce the amount of cooperation and assistance shared by agricultural producers adding additional stressors to agricultural operations. Agricultural producers face challenges from urban dwellers, who are often impatient or intolerant of the noise and smell associated with production practices. Impacts from activities of urban dwellers include trampling crops, leaving gates open, theft, vandalism and contamination of ditches.

These factors can interact with each other to create a downward spiral in a region's amount of agricultural land. There is the potential for this feedback loop to operate especially quickly once the amount of agricultural land in a region crosses a threshold. After this point, the rate of loss of farmland increases more quickly and agriculture soon disappears from the region. Where there is sufficient value or profit associated with a crop such as locally produced organic vegetables or ornamental flowers and plants, agriculture land uses may persist. These tend to be small operations in an urban context.

The effect of land and water values is locally diminished or eliminated when open space programs acquire land and water for conservation—including agricultural conservation. When there is strong community support for purposes of the open space program, there is pressure to retain rather than dispose of land and water in agricultural use. Farmers and ranchers still face issues of labor, commodity and service availability as well as the social factors that make farming in an urbanizing landscape more difficult.

OSMP currently leases approximately 15,000 acres for agricultural production. This acreage includes almost all irrigable lands, lands in dryland annual cropping systems, those lands that OSMP grazes prescriptively to achieve viability objectives and additional grazing of available forage.

OSMP's agricultural lands account for about 18% of the estimated 80,000 acres in agricultural use the county. Together the city and county account for about half the land used for agriculture in the county. While the current situation appears to be sustainable, it is likely that the amount of private lands in agricultural use will decline in the future. It is unknown whether existing open space agricultural lands alone could support a diverse and sustainable local agricultural economy. Increasing the amount of OSMP lands in agricultural use could further stabilize the agricultural economy while providing areas for experimentation and additional, localized prescriptive use.

Indicator: Acres in agricultural production

Indicator Ratings:

- Poor:** <8,000 acres
- Fair:** > 8,000 and <12,000 acres
- Good:** 12,000-16,000 acres
- Very Good:** >16,000 acres

Indicator ratings comment: OSMP staff began the development of indicator ratings examining the current situation. The "Poor"/"Fair" threshold was set to the extent of currently irrigated lands (approximately 5,500 acres) plus the acreage that would need to be grazed in association with prescribed burning (approximately 2,500 acres). (For the purposes of this indicator, staff assumed the desired fire return interval would be approximately 7 years. A fire return interval of 7 years would mean approximately 2,500 acres of the XTGP, MGPM, MBP and Wetland targets would be burned each year.) The department has acquired lands and water for irrigated agriculture as part of its long-term agricultural conservation strategy. OSMP leases these lands and waters to farmers and ranchers who provide the labor to irrigate. The cost of irrigation is borne by the lessee and is recouped when the crop is sold. OSMP lacks the capacity, and probably could not afford to hire staff, to run this irrigation water. If OSMP were to fail to use its water rights, the department could lose them. This would represent unacceptable financial and opportunity costs for OSMP's land and water management programs.

The "Fair"/"Good" threshold was set to include irrigated lands plus the acreage that would need to be grazed in association with prescribed burning, as described above, and those lands where livestock grazing or other agricultural management is needed to conserve the viability of other Grassland Plan targets. The "Very Good" rating includes the land included in the "Good" rating as well as additional lands where grazing could occur without adversely affecting OSMP's conservation goals. Placing additional land in agricultural use may be beneficial in the future to offset development of private agricultural land and to provide greater flexibility in the use of agriculture as prescriptive management tool.

Rating	Description	Acres
Poor	Less than Fair	<8,000
Fair	Irrigated lands plus minimum associated with prescribed burns	8-12,000
Good	Land in "Fair" plus lands grazed to conserve viability of other targets	12-16,000
Very Good	Land in "Good" plus other areas where grazing would not adversely affect conservation of other targets	>16,000

Confidence of these indicator rating descriptions: Medium

Indicator Measurements:

Date: 3/15/2008

Current Indicator Measurement: Currently there are approximately 15,000 acres of OSMP leased for agricultural production.

Current Rating: Good

Current rating comment: Inventory of OSMP lands

Confidence of the current rating: High

Desired Rating: Good

Desired rating comment: At this point staff feels that there is no compelling reason to change the amount of OSMP land in agricultural use. Without a county-wide definition of agricultural sustainability, staff cannot estimate how much OSMP land might be needed. Nor can staff predict the rate at which private lands are likely to be converted from agriculture to other uses.

It is likely that OSMP may add or remove some areas from agricultural use to implement the plan. The grassland plan establishes new ecological viability objectives. Several of these objectives are likely to be achieved through the application of agricultural management practices such as grazing and irrigation. It will take OSMP time to establish new understanding or confirm existing ideas about using agricultural practices most effectively to conserve grasslands. Some areas might be best managed by either temporarily or permanently removing agricultural uses. On the other hand, increasing the extent of leased areas may be needed to provide greater flexibility in when and where grazing is used as a management tool.

Conservation Target: Agricultural Operations

Category: Size

Key Attribute: Agricultural Production

Key attribute comment: Irrigable lands and associated water rights are a fundamental component of OSMP's agricultural operations. There are three principle types of agricultural land use on OSMP properties: livestock grazing, livestock forage production, and a small amount of dry land farming. Livestock forage production depends entirely upon the availability of irrigable land and irrigation water. Some agricultural operations are solely focused upon forage production. Others, mostly livestock producers, lease a combination of irrigated lands for forage production and unirrigated lands for grazing. Dry land farming takes place on about 300-600 acres of OSMP. Such farming does not require irrigable land or water rights.

OSMP's water rights and infrastructure of ditches and headgates were acquired and developed primarily to support agriculture in the Boulder Valley. They represent a significant investment of community resources. Irrigable land provides the highest per acre yields and under most market conditions, the greatest per-acre revenue. OSMP lacks the staffing resources to irrigate many or large areas. Leasing water and irrigable lands to local farmers and ranchers has been an effective way to maintain water rights and agricultural land values and provide a modest source of revenue for the OSMP department.

In addition to their value as productive agricultural lands, irrigated pastures and hayfields support a number of ecological values including habitat for rare plant and animal species. Natural conditions have been significantly altered, yet ecological functions persist in these "novel ecosystems".

Indicator: Irrigable land leased for agriculture

Indicator Ratings:

Poor: <60% of irrigable land

Fair: 60-80% of irrigable land

Good: 80-90% of irrigable land

Very Good: > 90% of irrigable land

Indicator ratings comment: The ratings represent the direct relationship between sustainability of agricultural operations and the proportion of irrigable land available to agricultural producers.

Indicator Measurements:

Date: 4/15/2008

Current Indicator Measurement: 0.85

Current Rating: Good

Current rating comment: The current rating was derived by using GIS to calculate which irrigable lands are included in an active lease.

Confidence of the current rating: High

Desired Rating: Good

Desired rating comment: The characteristics of irrigable lands vary across the OSMP system. Variables include soil quality, soil depth, infrastructure condition, season and amount of available irrigation water. OSMP staff has chosen to apply irrigation water in amounts and at times of year to maximize agricultural efficiency and production, and to enhance the associated ecological values of agricultural lands where appropriate. Consequently, water may not be available for some irrigable lands which then go unleased.

Agricultural Operations

Interest in locating the best opportunities for agriculture dates from the 1970's when federal, state and local agencies developed agricultural land designations in response to unprecedented rates of farmland loss. These designations were used to prioritize lands for agricultural preservation by local municipalities and non-governmental organizations. In Boulder County, significant agricultural lands (sometimes referred to as "prime farmland") are generally irrigated lands with adequate water supply.

Figure 21 shows designations of national, statewide and local agricultural significance. **Table 33** summarizes the criteria used by government agencies to identify the significant agricultural land. The Boulder County Comprehensive Plan Environmental Resources Element (Boulder County 1986) contains details of agricultural land significance criteria. Some lands shown as significant agricultural lands are not irrigated. These discrepancies are due to coarse level mapping, changes in irrigation practices since the designations were made and the inclusion of unirrigated rangelands, high potential dry croplands (Gunbarrel Hill) and lands with high potential for irrigated agriculture but which lack an adequate water supply.



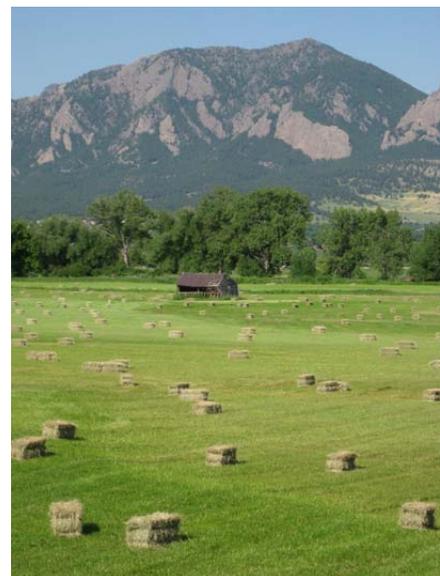
Irrigation

OSMP staff's analysis identified irrigated lands as the best opportunity for agriculture. Even though variations in soil and water availability create a diversity of conditions in irrigated fields, taken as a whole, irrigated lands are the most agriculturally productive in the GPA.

Managing irrigated lands for agriculture also lowers OSMP's management costs and protects the value of the city's water rights. Applying irrigation water is time-consuming, difficult work that requires special skills and knowledge. Although staff irrigates some areas, it would be extremely expensive to hire staff to run water on the extensive areas of irrigated land.

Managing irrigated lands for agriculture protects the value of OSMP's water rights by helping to ensure the water will be used. As

long as irrigated lands are managed for agriculture, lessees are motivated to use the associated water rights diligently. However, water rights can be endangered when they are not exercised. Water rights can be jeopardized when irrigated fields are managed in a manner that is incompatible with agricultural production and lessees do not irrigate or irrigate fully. **Figure 22** shows the BOAs for Agricultural Operations (i.e. irrigated lands).



Irrigated Hay Field photo – Whit Johnson

Table 33: Lands of agricultural significance

Significance/Responsible Agency	Basis of Designation	Extent in GPA
<u>National</u> "Prime Farmland" US Department of Agriculture Soil Conservation Service (SCS-now Natural Resource Conservation Service)	Soil moisture regime, soil temperature regime, drainage characteristics, slope, erodibility, soil chemistry, rockiness soil profile, irrigation, and length of growing season.	1,950 acres (788 ha)
<u>State</u> "Lands of Agricultural Significance" Colorado Departments of Agriculture and Natural Resources	<i>Soils that did not meet prime farmland criteria</i> and are important for the production of food, feed, fiber, forage or oilseed crops including: <ul style="list-style-type: none"> a) Irrigated lands b) Lands that would be prime farmland but lack adequate water supply c) High potential dry croplands 	4,199 acres (1700 ha)
<u>County</u> "Agricultural Lands of Local Significance" Boulder County Extension Office Longmont office of the SCS	Three categories of lands, which because of current and historic use and inherent soil properties are the County's most productive agricultural lands: <ul style="list-style-type: none"> a) Irrigated cropland b) Dry cropland c) Rangeland 	2,323 acres (940 ha)

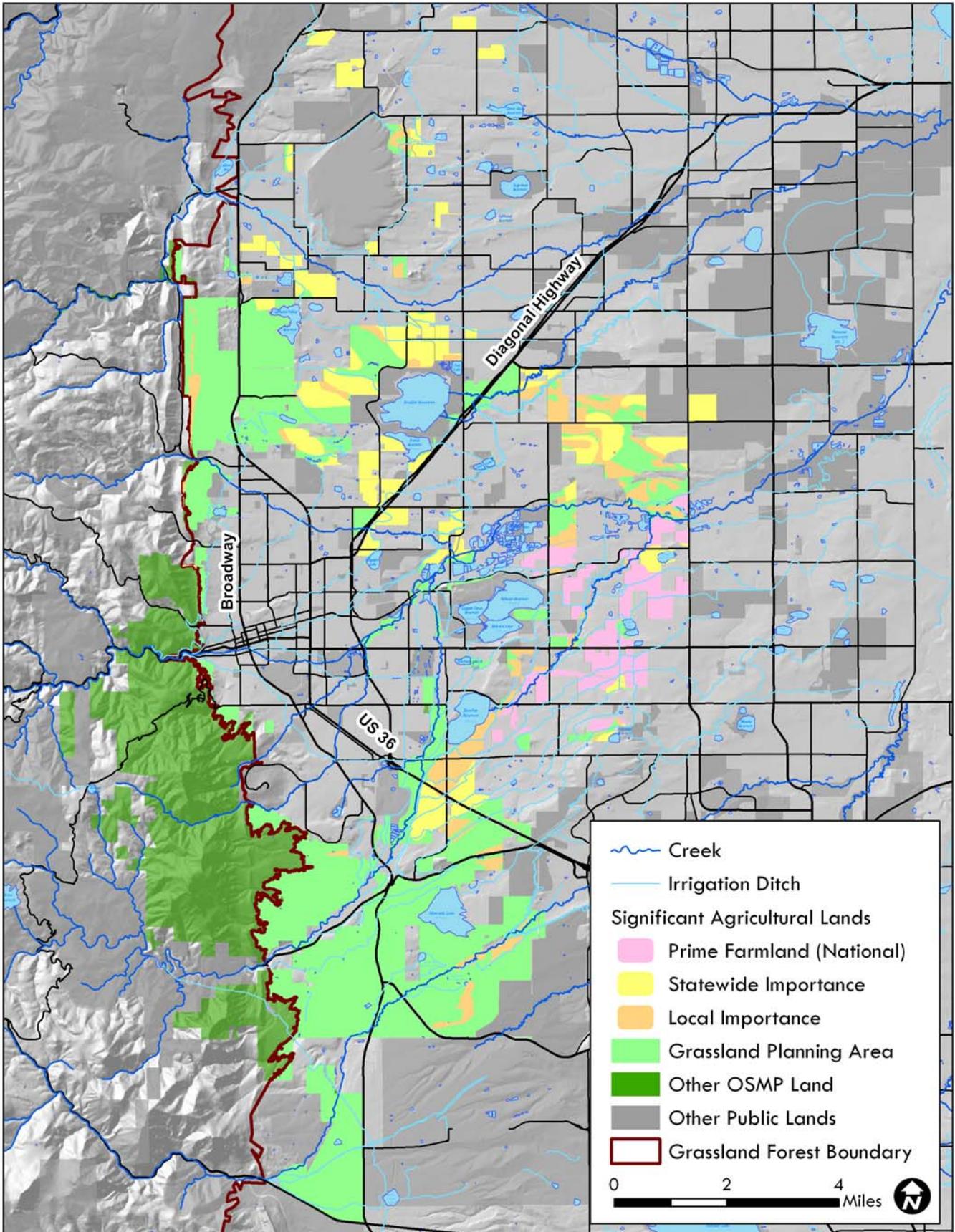


Figure 21: Significant agricultural lands in the Grassland Planning Area

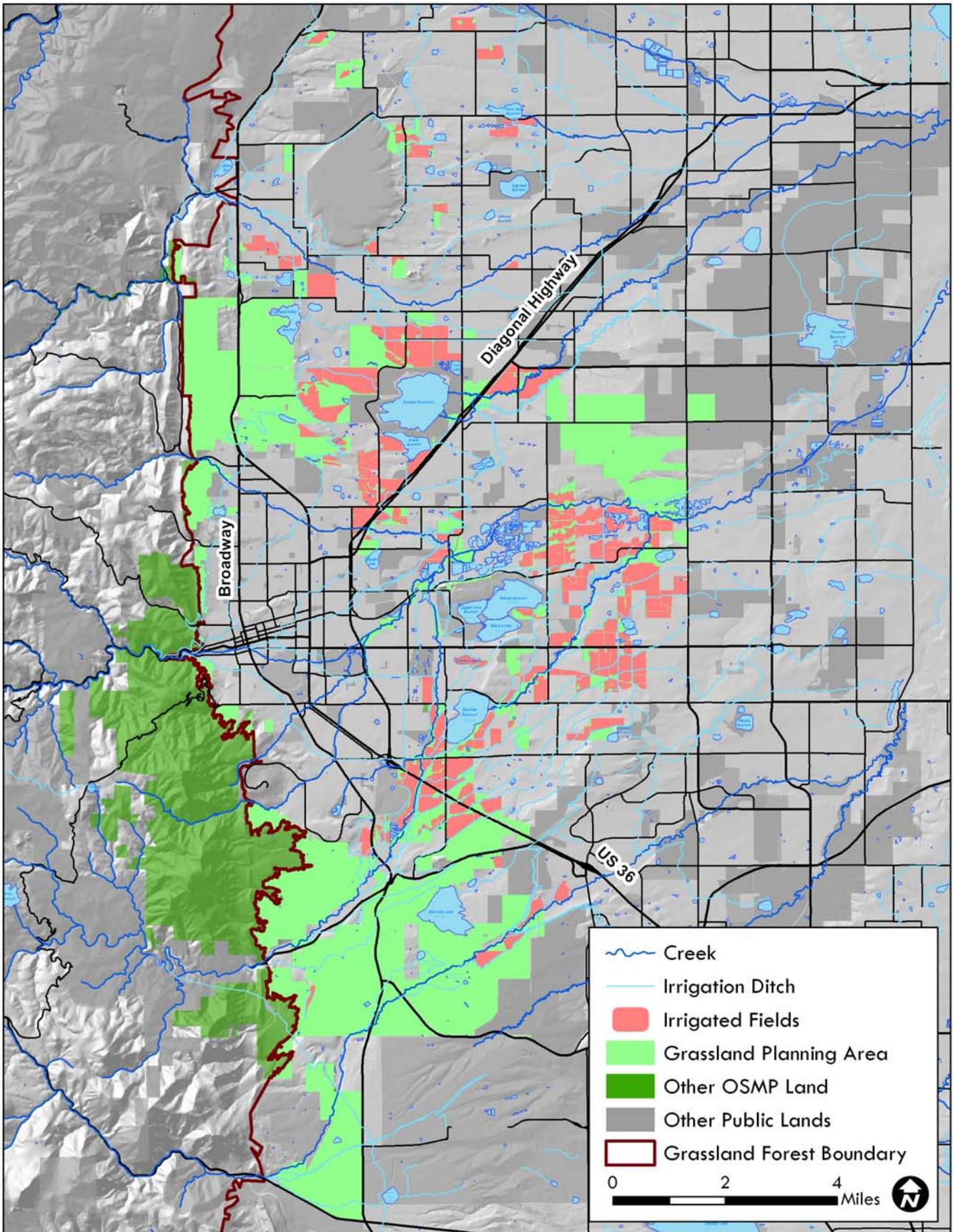


Figure 22: Irrigated fields/Best Opportunity Areas for agriculture in the GPA

Conservation Objective 3.5

By 2019, reduce the undesignated trail density in northern leopard frog habitat blocks to at most 13.4 ft/ac (10m/ha).

Strategy #	Strategy	Rating
2	Enhance prescribed grazing program through improvements to fencing, livestock watering facilities, stocking rate and seasonal use adjustments, and the establishment of one or more grass banks	Very High
24	Consider closing, restoring and discouraging the (re) establishment of undesignated trails in areas of special conservation value or sensitivity as part of the TSA planning process, and if necessary, prior to TSA planning	High
26	Consider providing additional no-dog opportunities to protect areas of conservation value and sensitivity as a part of TSA planning	High

Initiative 4: Agro-Ecosystems

This initiative focuses on sustaining agricultural uses while integrating agricultural and ecological conservation objectives.

Agriculture has played an important and dynamic role in shaping the Grassland Planning Area and providing services for people in the Boulder Valley. OSMP staff has adjusted and will continue to adjust agricultural management in response to changing markets and interests of local agricultural producers.

When and where biodiversity conservation objectives and agricultural management goals conflict, OSMP has worked to develop compatible management strategies. The Grassland Plan identifies specific opportunities to continue balancing and blending agricultural and ecological management.

Conservation Objective 4.1

Continue agricultural operations on OSMP lands to address the Charter Purposes of OSMP.

Strategy #	Strategy	Rating
2	Enhance prescribed grazing program through improvements to fencing, livestock watering facilities, stocking rate and seasonal use adjustments, and the establishment of one or more grass banks	Very High
3	Manage agricultural activities to minimize soil erosion and protect soil fertility	Very High
10	Refrain from mowing the “Class A Bobolink Management Areas” until after bobolink fledging (July 15 unless otherwise determined)	Very High
15	Construct, repair, enhance and maintain irrigation delivery system	High

Strategy #	Strategy	Rating
17	Collaborate with neighboring land management agencies to establish compatible land management practices	High
19	Promote conservation of the Grassland Plan targets by increasing awareness of grassland values and conservation issues	High
28	Identify and obtain water rights needed to support irrigated agriculture	Medium
33	Evaluate the suitability of alternative agricultural practices for OSMP lands	Medium
34	Establish ten Class B Bobolink Management Areas and refrain from mowing each area until after bobolink fledging (July 15 unless otherwise determined) one year out of three	Medium

Conservation Objective 4.2

Establish or continue agricultural management practices that support habitat for Ute ladies-tresses orchid, bobolinks and other species of conservation concern.

Strategy #	Strategy	Rating
1	Develop a safe and effective prescribed fire program for the Grassland Planning Area	Very High
2	Enhance prescribed grazing program through improvements to fencing, livestock watering facilities, stocking rate and seasonal use adjustments, and the establishment of one or more grass banks	Very High
9	Manage Ute ladies-tresses orchid habitat with compatible grazing, haying and irrigation practices	Very High
13	Treat non-native plant species in the grassland planning area using appropriate integrated pest management techniques	High
15	Construct, repair, enhance and maintain irrigation delivery system	High
19	Promote conservation of the Grassland Plan targets by increasing awareness of grassland values and conservation issues	High
28	Identify and obtain water rights needed to support irrigated agriculture	Medium
34	Establish ten Class B Bobolink Management Areas and refrain from mowing each area until after bobolink fledging (July 15 unless otherwise determined) one year out of three	Medium

APPENDIX L: Strategy Descriptions

Strategies Rated “Very High”	L-1
Strategies Rated “High”	L-11
Strategies Rated “Medium”	L-26

Strategies are numbered to correspond with their appearance in the body of the Grassland Plan.

Strategies Rated “Very High”

1. Develop a safe and effective prescribed fire program for the Grassland Planning Area

OSMP’s grasslands are fire dependent systems. Because of its important ecological role, the use of prescribed fire has been identified repeatedly by OSMP as a priority strategy to manage grasslands. Fire management is a component of the Colorado Tallgrass Prairie Management Plan and both the North Boulder Valley and South Boulder Creek area management plans identified a variety of prescribed fire strategies as “Tier I” actions.

Fire plays several roles in the management of agricultural operations. It can be used as an effective tool for managing the distribution of livestock and improving forage quality. Ditch burns occur annually to maintain the irrigation water delivery system.

Any consideration of the use of fire to improve the ecological condition or agricultural productivity of OSMP must also consider appropriate fire suppression and fire prevention practices to address the negative impacts fire can have on the community—especially on adjacent lands and dwellings. Fire planning should identify existing and potential fire hazard mitigation projects in the Grassland Planning Area.

Implementation of a prescribed fire program will need to be integrated with other grassland plan strategies, especially grazing management and IPM to develop specific treatments for specific areas.

Benefit: Very High

Fire and grazing are the ecological processes that control grassland structure, composition and function. OSMP can use fire to help manage many of the key attributes of OSMP grasslands such as vegetation composition, vegetation structure, native plant cover and agricultural production. By favoring native species, fire can also be used to reduce the dominance and prevalence of weeds in the GPA.

Fire management is likely to be one of the few tools that OSMP can use to favor specific plant species and communities as climate and atmospheric chemistry changes affect the Grassland Planning Area.

Feasibility: High

Either OSMP will need to add staffing or use partnerships, consultants or contractors to develop and implement the grassland burn plans. In the past, OSMP has relied upon its partnerships with the Boulder Fire Department and other local fire protection districts to conduct grassland prescribed fires. Although grassland burns require technical understanding of weather, fuels and fire behavior and authorizations from a variety of jurisdictions, they are routinely implemented by experienced personnel. The use of prescribed fire as a management tool will need to involve collaboration with neighboring property owners and residents to address concerns over the

negative effects of fire and to build an appreciation for its ecological and wildfire mitigation benefits.

Cost: High

Training of existing staff, contracting with consultants and hiring seasonal crews represent significant costs for this strategy. OSMP will explore grant and partnership opportunities to reduce discretionary costs for this strategy.

2. Enhance prescribed grazing program through improvements to fencing, livestock watering facilities, stocking rate and seasonal use adjustments, and the establishment of one or more grass banks

Grazing is an important process structuring Grassland Plan targets. Increasing flexibility of livestock grazing gives OSMP greater ability to manage grasslands toward acceptable conditions of vegetative structure and composition. This strategy includes:

- Evaluating fencing alignments to allow OSMP to use rotational, deferred (rest rotation) and seasonal stocking systems in response to management needs
- Developing water sources to improve OSMP's flexibility in distributing livestock
- Evaluating the potential to manage selected OSMP lands as grass banks (grazing reserves)
- Adjusting stocking rates, timing and duration to achieve acceptable conditions

Implementation of changes to grazing management will be integrated with other grassland plan strategies, especially fire management and IPM to develop specific treatments for specific areas.

Benefit: Very High

By creating more targeted livestock grazing practices, OSMP is more likely to meet the current objectives of the Grassland Plan and will be better positioned to respond to changes resulting from prairie dog grazing and drought.

Feasibility: Very High

The staff is in place to support this strategy. The techniques for developing stocking systems, developing water sources and establishing grass banks are straightforward. There is general support for OSMP's agricultural operations, and there have only been supportive comments for this strategy during the development of the Grassland Plan.

Cost: Very High

The specific features of this strategy have not been developed, and consequently costs have not been calculated. Full implementation is likely to exceed available funding. It will be necessary to prioritize projects for implementation over the ten-year planning horizon. The specific projects implemented will be determined by reviewing the viability ratings in each Grassland Plan Implementation Area.

3. Manage agricultural activities to minimize soil erosion and protect soil fertility

Fertile soil is the foundation of sustainable agricultural production. Soil loss through wind or water erosion or depletion through overgrazing undermines the sustainability of agricultural operations as well as ecological systems. OSMP's best management practices for soil conservation are centered on practices that reduce soil surface disturbances, stimulate native plant growth, maintain or increase cover, maintain or increase organic matter in soils and cycle soil nutrients. Grazing plans allocate forage to livestock to achieve acceptable production while maintaining cover and litter levels necessary to protect soils. Stocking is timed so that grazing defoliation and removal of plant material encourages re-growth and to ensure sufficient residual vegetation is left to allow plants to prepare for winter dormancy. Staff use rotational, deferred (rest rotation) and seasonal stocking in response to the needs of the particular type of vegetation, as well as changing conditions caused by drought or prairie dog grazing. Disturbances to soil surfaces are minimized by the rotation of salt, mineral and supplemental feeding areas as well as careful management of stocking rates and duration.

In addition to balancing grazing/haying with plant production, OSMP staff uses other practices to manage soil stability and fertility in non-native pastures and hayfields. These include:

- Irrigation which stimulates plant growth and can help reduce the impact of soil compaction
- Pasture renovation (reseeding a pasture with or without plowing or tilling, often with alfalfa or other nitrogen-fixing legume)
- Fertilizer use (on OSMP, grazed pastures and hayfields are typically harrowed to break up and distribute manure; in some areas manure is spread onto the fields, and in other areas commercial fertilizers are applied)

OSMP agricultural practices are informed by informal periodic assessments of integrated measures of rangeland health. Staff is evaluating the value of formalizing OSMP's assessment of rangeland soil stability, hydrologic function, as well as structural and functional resilience to disturbance with multi-metric techniques (Gerrish 2004 and Pellant et al. 2000).

Benefits: Very High

Agricultural practices affect the majority of the planning area. Soil loss and decreases in soil fertility resulting from agricultural use could have far-reaching detrimental implications for agricultural and natural systems management. The use of these best management practices therefore provides considerable benefit across the Grassland Planning Area.

Feasibility: High

OSMP staff and lessees have been using these practices consistently for 40 years. Soil conservation practices are the subject of considerable on-going research and best practices are being developed, revised and disseminated by government agencies. There is strong public support for soil conservation.

Cost: Medium

The major cost is staff time for assessing conditions and working with lessees to make changes. In most cases, the non-personnel costs are borne by the lessee as part of their operating costs.

4. Minimize the adverse effects of trail development in areas of special conservation value or sensitivity within the Grassland Planning Area, as part of TSA planning

This strategy provides guidance to the TSA planning process, identifying sensitive habitats and areas with high conservation value. These areas include:

- Northern leopard frog habitat blocks

- Rare plant populations
- Prairie dog colonies within Grassland Preserves
- Prairie dog Multiple Objective Areas
- Wetlands and Riparian Areas (especially Best Opportunity Areas)
- Areas with low weed density
- Areas of high grassland bird nesting value¹ (in situations where seasonal protection measures are not feasible)

Benefit: Very High

If TSA planning is able to either avoid new trail development in these areas or mitigate the impacts of trails, the result will be to reduce the conservation issues facing several of the targets and avoid degradation of target viability.

Feasibility: Medium

While it is straightforward to make recommendations about avoiding impacts to certain areas, the outcomes of the TSA process are unpredictable. In some areas, it may not be possible to provide the community's desired recreational services without adverse impact to sensitive habitats. Decisions about how to reconcile OSMP's recreational management and ecological management objectives will be made through the TSA planning process.

Cost: Low

The costs associated with bringing direction from the Grassland Plan to TSA planning discussions are low.

5. Construct and maintain fish passage structures along South Boulder Creek and Boulder Creek

Fish passage structures provide habitat connectivity for fish, increasing the available habitat and reducing the impacts associated with diminished in-stream flows. Fish passage structures have been completed on South Boulder Creek (McGinn Ditch, South Boulder Canyon diversion and Shearer Ditch). These projects have opened fish migration range 3-4 miles from the Goodhue diversion downstream to Baseline and Valmont Reservoirs. The previous projects have also attracted an externally funded project to evaluate the success of fish passage structures at improving connectivity, particularly for native fish. Future projects include fish passage structures along South Boulder Creek at the Goodhue Ditch, and along Boulder Creek at the Green Ditch and at the culverted creek crossing on the Short-Milne property. Other localized modifications at drop structures and elsewhere will also be implemented when identified to improve fish passage. The Shearer Ditch fish passage structure has been identified for modification and repair.

Benefit: Very High

Riparian and aquatic habitats in South Boulder Creek are impaired because of the diversion structures that impede fish migration and spawning runs. Over 20 game and non-game warm and coldwater species have been surveyed in South Boulder Creek. These species and other riparian inhabitants would benefit immediately from diversion modifications for fish passage. Future work on South Boulder Creek would open approximately 6 miles for uninterrupted fish movement.

Feasibility: Very High

Open Space and Mountain Parks' past success in managing fish passage projects reflects the internal capacity, the "do-ability" of these projects, and their appeal to community interests. South Boulder Creek has excellent potential for fish to pass from Baseline and Valmont reservoirs upstream for wild spawning. South Boulder Creek is one of the few (if not only) transitional streams

¹ Locations to be determined based upon the results of inventory and monitoring.

on the Colorado Front Range with the potential for watershed-scale restoration projects. Because the creek lies almost entirely within existing public land, improvement efforts are not likely threatened by future changes in land use on adjoining properties.

Cost: Very High

OSMP staff has been very successful in attracting external funding to support the design and construction of past fish passage projects, typically reducing the City's cost by half. However, even with dedicated grant and partnership funding, OSMP's share has typically been significant.

6. Improve aquatic habitat in South Boulder Creek

This strategy is intended to improve in-stream aquatic habitat for native and sport fish that have better access to sections of the creek with recently completed fish passage projects. Existing habitat is in poor condition and does not provide adequate cover, especially during winter when creek flows are very low. Aquatic habitat improvement will include:

- Establishment of stream channel geometry in balance with the current flow regime by narrowing over-wide stream segments
- Construction of natural-appearing in-stream habitat features (boulder clusters, random boulder refuge habitat, woody debris, boulder deflectors) that support habitat needs of native and sport fish and protect riparian vegetation from further erosion
- Stabilization of eroding banks
- Planting of native riparian vegetation to provide shade, overhead cover and additional creek bank stabilization.

Benefit: Very High

If implemented, the restoration project will increase local populations of native and sport fish in the project area by improving the quality and quantity of aquatic habitat. Completion of this project will also significantly increase the over-winter habitat for all fish species leading to better reproduction, retention and growth. The project will also benefit the public by increasing recreational fishing opportunities for anglers in Boulder County and the greater Denver metropolitan area. Aesthetically speaking, the appearance of the creek will also improve significantly (natural sinuosity, pools, use of local rock materials, etc.).

Feasibility: Very High

OSMP has an experienced project manager committed to the project, as well as assistance from other experienced biologists, engineers and equipment operators. Although projects of this sort have not been conducted on OSMP before, they have been completed successfully elsewhere by the team members. Community members, granting agencies, other city programs and the Open Space Board of Trustees have indicated strong support for the project, indicating that it appeals to the motivations of the community.

Cost: Medium

While costly, external funding sources have been identified for aquatic habitat improvement projects in South Boulder Creek. Partners include the Colorado Division of Wildlife, Colorado Department of Transportation, the Denver Water Board, and Boulder Flycasters². OSMP's share of the project will be between ten and fifty thousand dollars, mostly as in-kind participation of staff, materials and permit preparation.

² A chapter of Trout Unlimited involved in watershed restoration

7. Identify high-value grassland bird nesting areas and consider enacting seasonal protection measures through the TSA planning process, and, when necessary, prior to TSA planning

The TSA planning process has recognized the value of important grassland nesting bird habitat. Both the Eldorado Mountain/Doudy Draw and the Marshall Mesa/Southern Grassland TSA plans included the establishment of seasonal protections for grassland nesting bird habitat. One way OSMP currently protects the ecological function of high value grassland nesting bird habitat is by restricting human access. These seasonal restrictions do not prohibit visitors but require visitors to remain on designated trails and dogs to be leashed. Access by staff, lessees and contractors is also restricted. Approximately 1,100 acres (445 ha) are currently affected by these protection measures.

OSMP is conducting grassland bird monitoring in anticipation of future TSA planning to provide locations of important grassland nesting bird habitat. This information will be used to determine if and how seasonal protection measures can be used to achieve the Grassland Plan objectives, given the recreational and cultural resource objectives also being considered during TSA planning.

OSMP prefers to use the TSA planning process to integrate resource protection and visitor access and enjoyment. However, since TSA planning for portions of the GPA will not occur for several years, OSMP may institute seasonal protection measures when necessary to protect sensitive grassland nesting bird habitat prior to the TSA planning process.

The department will also continue its practice of establishing seasonal grassland raptor nesting protection measures, including restrictions on visitor access. This includes protections for nests of burrowing owl, northern harrier, ferruginous hawk and bald eagle. As part of this strategy, OSMP will work with airplane/glider pilots to reduce fly-by impacts to bald eagle nests.

Benefit: Very High

This strategy benefits several of the grassland plan targets by reducing the effects of people and dogs upon birds that nest on the ground or in low shrubs.

Feasibility: Medium

Merely developing recommendations is highly feasible. Actually instituting seasonal protection measures may be more difficult. Experience demonstrates that there is public acceptance for this strategy because it limits access restrictions to a critical time rather than establishing them year-round. However, acceptance is closely related to establishing protection measures in the most significant habitat and maintaining a reasonable balance between areas that are accessible and areas that are not. Currently, three percent of the grassland planning area is affected by grassland nesting bird protection measures (an additional 10 percent of the GPA is affected by seasonal raptor protections—mostly for bald eagle and osprey). There are OSMP staff members available to provide leadership for this project. Protection measures are relatively easy to implement, although there have been past difficulties successfully communicating seasonal access restrictions to visitors.

Cost: Medium

The costs associated with inventory fall within the medium range. Additional costs of providing this information to TSA planning discussions are negligible. However if it is determined that on-going monitoring is needed to inform the process, costs would be significantly higher. Should seasonal protection measures be established, there would be additional costs as well associated with rangers patrol and signing.

8. Manage selected ponds as northern leopard frog breeding habitat

OSMP has assessed the ponds in the GPA for their suitability as northern leopard frog breeding habitat. Factors considered in the suitability assessment were:

- Presence of northern leopard frogs
- Presence of non-native predators of northern leopard frogs (bullfrogs, crayfish, predatory fish)
- Presence of *Batrachochytrium dendrobatidis* (Bd). Bd is a fungus responsible for a disease thought to be partly responsible for northern leopard frog population declines
- Water level control structures and their condition
- Pond size
- Proximity to trails/nature of visitor use
- Nature of livestock access
- Use as native fish refugia
- Level of recreational fishing
- Condition of habitat (vegetation) surrounding the pond and between the pond and the next nearest wetland/riparian area
- Proximity of nearest wetland/riparian area

Based on the assessment, OSMP has identified several sites as priorities for management to establish breeding areas for the northern leopard frog. Specific actions to be implemented at priority sites are:

- Excluding bullfrogs from ponds where they are absent
- Managing water levels in ponds with functioning water control devices to remove exotic predators while favoring leopard frogs and other native aquatic species
- Directly controlling of exotic predators
- Educating visitors who fish on OSMP about ways of avoiding the spread of Bd and the impacts of using bullfrogs as bait
- Evaluating restrictions on the use of bullfrogs as bait on OSMP
- Considering fishing restrictions in northern leopard frog breeding habitat (any restrictions on fishing would be vetted through a collaborative process with the fishing community)
- Establishing alternate or modified water sources for livestock
- Fencing ponds from livestock, dogs, visitors
- Restoring native vegetation around ponds
- Creating new wetlands as part of broader floodplain restoration strategies

Benefit: Very High

This strategy would provide long-term conservation of a species of concern facing significant threats in the Grassland Planning Area. The strategy reduces conservation issues and enhances viability of animal species composition for the Wetland and Riparian Areas targets.

Feasibility: Very High

OSMP has staff with the skills necessary to complete this strategy. Although the specific tasks associated with the strategy have not been done before on OSMP, they are straightforward. There is general support for the conservation of species facing local and regional extirpation. Community members may be concerned about non-target impacts resulting from temporarily draining ponds. OSMP will work to mitigate any such effects.

Cost: Medium

This project is likely to require significant staff and seasonal time and infrastructure improvements (which may be possible to integrate with improvements to the irrigation water delivery

infrastructure). OSMP will explore opportunities to work with volunteers and partner agencies such as the CDOW to reduce costs.

9. Manage Ute ladies-tresses orchid habitat with compatible grazing, haying and irrigation practices

OSMP staff coordinates agricultural management practices (irrigation, winter grazing, as well as the timing and distribution of hay cutting) with lessees in the South Boulder Creek floodplain. Coordinated management for Ute ladies-tresses orchid is focused on three fields where large populations are found but also includes other areas.

General management for the orchid was summarized in the South Boulder Creek Area Management Plan (City of Boulder 1998):

- Haying should occur prior to July 1 (or as soon after as possible) to avoid cutting of flowering stalks.
- In areas that are not hayed annually, prescribed fire or mowing should be conducted on a periodic basis (3 to 5 years). Fire or mowing should occur in tallgrass areas in March, April or October.
- Graze livestock after October 15 and before May 15 to avoid the most sensitive portion of the growing period (mid-May to mid-October). If orchid habitat is burned in the fall, grazing may need to be deferred until *after* the next growing season.
- Use moderate intensity or high intensity and short duration stocking during the late fall, winter and early spring.
- In irrigated meadows, water needs to be applied in the spring (April to June) before haying and again after haying (August, September) to maintain orchid and ground nesting bird habitat.
- Wetlands and orchid habitat are often created by leaky irrigation structures and ditches. Sensitive resources should be considered when construction or maintenance is proposed.

Benefit: Very High

Compatible agricultural management maintains habitat for this federally threatened plant species. This management also provides habitat for other associated, uncommon species and wetland plant communities. Although recently influenced by a better understanding of the orchid's biology, the basic agricultural management responsible for creating habitat for this species predates OSMP management (and description of the species) and is likely to persist into the future.

Feasibility: Very High

OSMP collaborates with lessees to develop grazing and haying plan. Lessees are responsible for irrigation, livestock management and haying operations. The practices are well established and supported by the community.

Cost: Low

Costs to OSMP are limited to time spent with the lessees in consultation. This strategy is largely implemented by lessees as part of their on-going agricultural operations.

10. Refrain from mowing the "Class A Bobolink Management Areas" until after bobolink fledging (July 15 unless otherwise determined)

In 2007, OSMP staff and volunteers detected bobolinks at 42% (70) of the hayfields sampled (165). Using abundance and density information from the hayfield bird monitoring program, staff chose four top-tier fields to be designated Class A Bobolink Management Areas where mowing would only occur after 15 July. The four top-tier fields are Church field 355, Burke II field 263,

and two fields on the Van Vleet property (315 and 331). Waiting until after July 15 gives the bobolinks an opportunity to fledge before mowing operations destroy the nest and its contents.

Monitoring may indicate that it is preferable to delay mowing longer or acceptable to begin mowing earlier. Changes to the mowing date, as informed by monitoring results, will be developed by OSMP wildlife and agricultural staff.

Benefit: Medium

This strategy provides long-term reduction of the key conservation issue to a sensitive and uncommon nested target within the Agricultural Operations target.

Feasibility: Very High

OSMP wildlife and agricultural managers worked together with lessees to implement this strategy.

Cost: Low

There is no out of pocket cost to OSMP associated with the mowing of these fields. Lessees continue to provide lease payments to the department in exchange for the use of OSMP land, water and other facilities.

11. Develop a protocol to coordinate relocation of prairie dogs onto OSMP lands that is compatible with both the Urban Wildlife Management Plan and the Grassland Plan

Two of the prairie dog management designations in the Grassland Plan can serve as receiving sites for relocated prairie dogs. These are:

1. Areas within a Prairie Dog Conservation Area (PCAs) with an existing burrow structure and
2. Areas within a Grassland Preserve with an existing burrow structure, if the Grassland Preserve is below 10% total occupancy, vegetation within the receiving site meets the minimum standards established in the Grassland Plan, and the majority of the receiving site has been rated as exhibiting “Good” or “Very Good” habitat suitability.

Consequently, the extent of grassland available as receiving sites depends upon patterns of prairie dog occupancy and vegetative condition—both of which change seasonally. OSMP samples prairie dog occupancy during the fall and by late winter or early spring is able to map the location of active prairie dog colonies.

In an attempt to integrate the conservation objectives of the Grassland Plan with Council’s direction on prairie dog management found in the Urban Wildlife Management Plan, OSMP and the Office of Environmental Affairs/Urban Wildlife Coordinator will develop an annual consultation process that will identify to what extent city-owned lands can reasonably accommodate the prairie dog removal needs of public agencies and private property owners affected by the Urban Wildlife Protection Ordinance and the Urban Wildlife Management Plan. Implementation of this strategy may require modifications to internal policies and rules affecting prairie dog relocation.

Benefit: High

Developing a shared understanding about the availability and use of relocation sites on OSMP lands will facilitate implementation of both the Urban Wildlife Management Plan and the Grassland Plan. Successful conservation of the Mixedgrass Prairie Mosaic, Xeric Tallgrass Prairie, and Agricultural Operations on OSMP relies upon the ability to remove prairie dogs from areas of incompatibility. The City’s preference for prairie dog removal is relocation.

Feasibility: High

OSMP has the staff with the appropriate expertise assigned the responsibility of prairie dog management to implement this strategy. Developing a protocol to guide relocation onto OSMP is not a technically challenging task and can be completed relatively easily. Community support for coordination between the two plans is expected to be high; there is likely to be public interest in the details of how the priority of receiving site needs is determined.

Cost: Low

The costs for developing a protocol are estimated to be low and comprised primarily of staff time. There may also be costs associated with public process.

12. Establish specific indicators and acceptable ranges of variation to fill information gaps

OSMP staff identified the need to develop additional indicators that were not included in the Grassland Plan.

- Vegetation Height and Density (grassland bird habitat)
An indicator of vegetation density measured as visual obstruction (Robel et al. 1970). This indicator is needed to describe the vegetation structure associated with diverse or abundant grassland bird populations. This indicator would be used as a tool to inform grazing and fire management, allowing managers to ensure adequate cover is available for grassland birds.
- Preble's Meadow Jumping Mouse
An indicator of the viability of Preble's meadow jumping mouse (Preble's). Preble's was listed as a threatened species under the Endangered Species Act in 1998 and occurs in wetlands, riparian areas and other habitats near streams and ditches along Colorado's Front Range and in southeastern Wyoming. Preble's has been found in the Grassland Planning Area mostly around South Boulder Creek and OSMP lands are likely to be integral to the conservation of this species in Colorado.
- Range Site Condition
This (or these) indicator would be developed as part of a rapid assessment protocol for use by agricultural managers to provide a preliminary evaluation of soil/site stability, hydrologic function and integrity of the biotic community. Such an indicator will help OSMP track areas that are potentially at risk of degradation and provide early warnings of potential problems and opportunities to alter management practices. Some examples of such indicators include the presence of erosion features (water flow patterns, gullies, wind scour, blowouts and litter movement), bare ground, dominance of various functional or structural groups of plants and annual production.
- Wetland and Riparian Hydrology
OSMP has identified the altered hydrologic regime of the Wetland and Riparian Areas targets as a fundamental issue. However, the Grassland Plan proposes no way of describing current conditions or setting an acceptable future condition so that strategies can be developed to improve the situation. Determining the acceptable range of variation for hydrology is complicated by the highly developed and regulated use of water in Colorado and the flood issues affecting the developed areas that surround the Grassland Planning Area. Developing an indicator and an understanding of current and historic conditions will help OSMP work toward defining acceptable conditions for this highly modified ecosystem that are consistent with the purposes of OSMP and the objectives of the Grassland Plan.

Benefit: High

These indicators will provide OSMP with actionable information about significant viability concerns and important conservation issues. Establishing these indicators is likely to leverage more effective conservation action.

Feasibility: Very High

OSMP has staff with sufficient time and expertise identified to development these indicators and ranges of acceptable variation. None of these indicators is especially complex to develop, as there is considerable information available to inform each of them. The indicators are non-controversial and logical parts of the Grassland Plan framework.

Cost: Low

The costs associated with the development of these indicators are limited to staff time and should fall within the “Medium” range. The costs of implementing monitoring these indicators are not included in the cost assessment for this strategy.

Strategies Rated “High”

13. Treat non-native invasive species in the grassland planning area using appropriate integrated pest management techniques

In 2006 and 2007, OSMP mapped selected weed species in the Grassland Planning Area using methods developed by Utah State University and referred to as Rapid Assessment Mapping (RAM). The information from this inventory and recommendations of the authors of the first year’s work (Dewey and Anderson 2006) has been used to formulate the approach used by OSMP to address invasive plant species.

Since the abundance of weeds in the Grassland Planning Area exceeds the resources available for control, OSMP prioritizes weed management. OSMP’s prioritization centers on the invasiveness of the weeds as well as their abundance and distribution. OSMP gives special priority to weeds species for which the state requires control. OSMP’s approach has been to devote some of its resources to each of the following objectives (Dewey and Anderson 2006):

- **Eradication of small infestations of highly invasive species** is a high priority for OSMP. These will grow if left unmanaged and become more costly and difficult to control in the future.
- The **containment and reduction of moderately sized infestations** is employed for somewhat larger weed populations that can be managed, but where eradication is unlikely.
- **Protecting non-infested areas from the spread of pervasive weeds** that are beyond the scope of containment and reduction.

Specific actions nested within this broad strategy include:

- Establishing “weed prevention areas” in areas with low weed diversity or the absence of certain weed species
- Working with conservation easement owners on treating invasive species on easements that border and contribute to the spread of weeds onto OSMP managed areas
- Forming a Cooperative Weed Management Areas for the Best Opportunity Areas in the northern and eastern portions of the planning area
- Supporting the biocontrol work done by universities and Boulder County to reduce diffuse knapweed
- Reclaiming or restoring localized disturbance areas that act as seed and propagule sources for surrounding areas

- Paying special attention to “hot spots” where new weeds are likely to become established due to on-going disturbances and numerous vectors (e.g., parking lots and trails)
- Analyzing hydrology data and irrigation use to promote desirable vegetation and discourage noxious weeds
- Using grazing goats in areas with high density of invasive species and low potential for impact on desirable species
- Reviewing and revising grazing management plans to ensuring that cattle are not moved from areas with Mediterranean sage to un-infested areas

Implementation of the IPM program will be integrated with other grassland plan strategies, especially grazing and fire management to develop specific treatments for specific areas.

Benefit: Very High

Successful IPM efforts will help abate one of the sources of stress most degrading the Grassland Plan targets.

Feasibility: High

OSMP has invested significantly in IPM, providing staffing and leadership. There is also strong community support for the program. While the mechanics of weed management are well understood and OSMP has effective means of implementing cultural, mechanical, biological and chemical controls, the department is unable to spread the available resources across the system to implement the necessary treatments. It is also unclear whether, in the presence of global environmental changes, IPM treatments will be effective in enhancing viability of the Grassland Plan targets.

Cost: Very High

OSMP's direct costs for system-wide IPM are approximately \$250,000 per year. Costs associated with the GPA have not been calculated, but the majority of IPM treatments occur in the Grassland Planning Area. OSMP's IPM efforts are also supported by the activities of agricultural lessees and volunteers.

14. Establish, maintain, remove and exclude prairie dog colonies in accordance with prairie dog management designations

The Grassland Plan describes prairie dog management designations for the Grassland Planning Area. These designations were developed to provide opportunities for the conservation of prairie dog mediated grasslands, grasslands unaffected by prairie dogs and agricultural operations. The City of Boulder seeks to conserve prairie dogs and associated species, but because prairie dogs' digging and grazing activities are incompatible with the conservation of other targets, the management of prairie dogs colonies is an important strategy. This strategy includes:

- Tracking the extent of prairie dog activity on OSMP on at least an annual basis
- Assessing conditions of Grassland Preserves to determine suitability as sending or receiving sites for prairie dog relocation
 - Prairie dog removal from Grassland Preserves will be considered when occupation exceeds 26% and vegetation conditions are rated “Poor”
 - Relocation of prairie dogs to Grassland Preserves will be considered in accordance with the receiving site relocation criteria found in Appendix I
- Identifying and prioritizing removal and receiving sites
- Relocating prairie dogs as appropriate after obtaining the appropriate authorization from the City and the Colorado Division of Wildlife
- Obtaining necessary permits and removing prairie dogs via lethal control when necessary
- Sending site reclamation

- Coordinating with Boulder County Health on plague and other animal-borne disease
- Using tillage, irrigation and other practices to discourage prairie dogs from establishing colonies in removal and transition areas
- Working with community members, researchers and other land managers to develop innovative solutions prairie dog management

Prairie dog relocation criteria (Appendix I) were developed to provide for recovery of native plant communities and prairie dog habitat in Grassland Preserves after the death or removal of prairie dog colonies and to protect habitat for rare and sensitive plant species and communities.

This strategy requires that vacant colonies within Grassland Preserves be monitored to determine suitability for relocation. Because relocation needs may not be timed to coincide with ideal monitoring times, OSMP will need to identify potential relocation sites and decide how much monitoring is appropriate in a given year based upon the anticipated need for receiving sites by OSMP and others. OSMP will work with the Urban Wildlife Coordinator to integrate implementation of the Grassland Plan and the Urban Wildlife Management Plan.

Benefit: Very High

This strategy is crucial to allow OSMP to meet viability standards for the Black-Tailed Prairie Dog and Associates target. Implementation will ensure that sufficient acreage of prairie dog occupation is maintained on the OSMP land system to provide for long-term conservation of the black-tailed prairie dog and its associates.

Implementation of this strategy will also directly support the sustainability of OSMP's Agricultural Operations and viability of both the Mixedgrass Prairie Mosaic and Xeric Tallgrass Prairie targets. Demonstration of prairie dog management compatible with the conservation of other grassland types and agriculture may also leverage greater community support for the conservation of the Black-tailed Prairie Dog and Associates target.

Long-term occupation of prairie dog colonies affects vegetation composition and structure. Measurements of native plant species richness, native plant cover and cover by bare ground fall outside the range of acceptable variation in plots located within the Mixedgrass Prairie Mosaic on prairie dog colonies. Allowing vegetation to recover prior to reintroducing prairie dogs, as detailed in the prairie dog relocation criteria (Appendix I), is an essential component of managing for both prairie dogs and native communities in the relatively small and fragmented grasslands of the GPA.

Feasibility: Medium

Experienced staff members are available to conduct annual prairie dog mapping and assess the vegetation in Grassland Preserves (a prerequisite to relocation). There is currently no staff capacity identified to conduct relocation or other removal activities. While prairie dog relocation requires an understanding of prairie dog behavior, experience handling wild animals, and appropriate permits from the Colorado Division of Wildlife, it is routinely implemented by trained professionals. This strategy is consistent with the City Council-approved the Wildlife Protection Ordinance describing how prairie dogs should be managed in the city and on city-owned lands such as open space. OSMP has heard from community members who would like to have prairie dogs conserved in selected areas as well as those who would like to see more areas of native grassland and agricultural activity without prairie dogs. While staff has made adjustments to address a variety of perspectives while trying to maintain a workable approach, it is likely that some community members will feel that the strategy does not go far enough to meet their concerns. There are likely to be concerns from some members of the community that prairie dogs should be relocated to areas before the vegetation meets the relocation criteria or into areas not previously occupied by prairie dogs.

Cost: Very High

Annual prairie dog mapping is typically conducted by seasonal wildlife technicians and processed by GIS analysts. Vegetation readiness evaluations in Grassland Preserves can be conducted by either staff or contractors and are likely to take several days each for data collection and analysis. Prairie dog trapping success rates vary significantly from year to year and location to location making it difficult to predict the costs reliably. However, removing prairie dogs from the ground either by trapping or “flushing”³ burrows is expensive whether conducted by staff or contractors. Once captured, there are additional costs associated with both relocating prairie dogs elsewhere or using lethal methods of control. If the number of prairie dogs that are retained at receiving site are figured into relocation costs the per-animal costs can be quite high (hundreds of dollars per animal).

Site restoration costs for sending sites are also highly variable. Some areas may be left untreated allowing the suppressed native vegetation to grow. Other areas may need to be treated for varying levels of invasive or non-native species. Agricultural areas such as irrigated pastures may need to be leveled and replanted.

The greatest efficiencies for OSMP are afforded when population levels in removal and transition areas are lowest.

15. Construct, repair, enhance and maintain irrigation delivery system

OSMP manages several miles of ditch laterals and approximately five hundred water supply structures (headgates, gauges, dams, developed springs, stock tanks etc.). Information about the water delivery system is managed using a proprietary water resources management database integrated with GIS. Combined, this information system allows staff to manage, store, query, retrieve and analyze tabular or geographic data for various water resources, including the water delivery infrastructure. This database has enabled OSMP to conduct an inventory and assessment of the function and condition of OSMP’s irrigation facilities. The assessment produced several findings:

- A significant amount of the maintenance to the water delivery systems in the Grassland Planning Area has been deferred. While many irrigation structures on OSMP lands were old and in need of repair or replacement when the properties they serve were purchased by the department, others have deteriorated because of insufficient funding and staffing to maintain acceptable conditions. Staff used the inventory and assessment to identify, prioritize and estimate the costs and staffing needs for facility maintenance and capital improvements.
- OSMP needs a greater ability to measure water availability and use to manage its water resources effectively. Some measuring devices are available to quantify water use on OSMP properties. However, they are not sufficient in number or distribution, and there is insufficient staff time to visit these devices, which under current conditions cannot be monitored remotely.
- Some types of structures, such as junction boxes, and information (such as OSMP’s operation, maintenance and replacement responsibility) are not yet part of the facility inventory.
- OSMP has a responsibility to avoid or minimize impacts from the maintenance and operation of the irrigation water delivery system to other OSMP resources.

Specific tasks under this strategy include:

³ Burrows are actually filled with foam, however prairie dogs typical response it to leave the burrow, presumably because they believe it is flooding.

- Inventorying the location of existing measuring devices that can support water management and quantify water use on Open Space properties.
- Monitoring water use at key locations.
- Identifying and prioritizing locations where water use information would be useful for management
- Installing measuring devices at priority unmeasured locations
- Installing measuring devices when headgates are replaced or repaired on both ditches and laterals, if the location will provide useful water use information
- Inventorying the locations of junction boxes that support OSMP's irrigation delivery system both on and off OSMP lands.
- Assessing the condition of the junction boxes and estimating the scope and timing of repairs or replacement
- Developing an ditch burning schedule to be integrated with the prescribed fire program
- Working with ditch companies that have written easements and prescriptive uses on OSMP land to encourage maintenance practices that minimize damage to other resources
- Working to ensure practices that minimize resource damage are followed according to program maintenance policies within constraints imposed by the by-laws of the ditch company in situations where OSMP is the primary or sole shareholder in a ditch company

Benefit: Very High

Addressing deferred maintenance issues will improve OSMP's ability manage the water the department owns supporting agricultural operations and the attendant biodiversity (e.g., Ute-ladies tresses orchid, bobolinks, and Preble's meadow jumping mouse as well as some wetlands and portions of the Mesic Bluestem Prairie). Improvements to the irrigation infrastructure will also help the department ensure long-term protection of those rights. The ability to track water more thoroughly will also provide OSMP greater flexibility and may bring understanding of how other targets might benefit from innovative applications of OSMP's water rights.

Feasibility: Medium

While OSMP has a staff knowledgeable and experienced in water resource management, the work to be done exceeds the available capacity. While requiring significant technical knowledge and expertise, the maintenance and repair projects are straightforward and many similar projects have been completed before by staff and contractors. There is strong public support for the maintenance of OSMP's infrastructure and water rights.

Cost: Very High

A significant amount of maintenance on the water delivery systems that serve OSMP lands has been deferred. These repair expenses will require a long-term commitment. Alternative funding sources, including participation by other water users, ditch companies and others, may be required where legally or financially appropriate and feasible.

16. Establish instream flows in South Boulder Creek and Coal Creek

Instream flow programs can improve the hydrologic variability and improve the ecological characteristics of the Riparian Areas target by establishing the minimum flows necessary to sustain aquatic life and prevent further deterioration of aquatic ecosystems.

Colorado law allows the Colorado Water Conservation Board (CWCB) to appropriate water without the requirement of diverting it from the natural watercourse—a so-called “instream” appropriation. Except for these instream appropriations, all other water decrees require that the water be diverted from the creek. New instream flow appropriations typically provide little benefit in most years because the rights are so junior and all the reliable water was fully

appropriated long ago (MacDonnell 1991). The Colorado legislature has expanded the CWCB’s ability to improve environmental conditions by allowing the acquisition of existing, decreed senior water rights for instream flow. Because water rights can now be “transferred” to instream appropriations without losing their seniority, instream appropriations can result in reliable flows in the creek.

The minimum instream flow needs for South Boulder Creek to sustain an adult trout population have been estimated (Hydrosphere 1994) (Table L-1). This estimate was selected because it addressed the interest of key stakeholders and provided flows that would also support native fish and other aquatic life. With the exception of flows between Gross Reservoir and the town of Eldorado Springs during the irrigation season, minimum instream flows in South Boulder Creek are completely unaddressed by existing flow patterns.

Table L-1: Instream flow goals and instream flow deficits for South Boulder Creek (from Hydrosphere 1994)

Stream Reach	Irrigation Season (April 15-October 31)		Storage Season (November 1-April 14)	
	<u>Instream Flow Goal</u>	<u>Instream Flow Deficit</u>	<u>Instream Flow Goal</u>	<u>Instream Flow Deficit</u>
Gross Reservoir Outlet to Eldorado Springs (Community Ditch)	22.0 cubic feet/second	minor amounts	8.0 cubic feet/second	8.0 cubic feet/second
Eldorado Springs (Community Ditch) to Confluence w/Boulder Creek	6.0 cubic feet/second	6.0 cubic feet/second	2.5 cubic feet/second	2.5 cubic feet/second

Hydrosphere (1994) identifies management options to meet the minimum instream flow goals. The Denver Water Board’s proposal to enlarge the capacity of Gross Reservoir and its need to mitigate for the environmental impacts of this expansion may provide an opportunity to progress towards providing instream flows for South Boulder Creek.

OSMP commissioned an instream flow planning study for Coal Creek to identify instream flow objectives and develop preliminary strategies to meet those objectives (Hydrosphere 2000). Rather than focus on conditions needed for a single species, the consultants proposed a model intended to provide conservation of the entire riparian and aquatic systems by incorporating more of the hydrologic variability inherent in natural creek systems (Richter et al. 1997). Although the Range of Variability (RVA) approach was not used by Hydrosphere, they did estimate monthly instream flow goals deficits based upon almost 40 years of flow data for Coal Creek (Table L-2). With the exception of the month of July, Coal Creek has an instream flow deficit throughout the year.

Table L-2: Preliminary model results instream flow goals and instream flow deficits for Coal Creek from Plainview to Superior (from Hydrosphere 2000)

	March	April	May	June	July	Aug-Feb
Instream Flow Goal	1.5	8	12	5	0.7	0.4
Instream Flow Deficit	0	3	5.5	3.9	0.7	0.3

Hydrosphere (2000) proposed and evaluated the general feasibility of several specific actions that would protect the existing flow regime and increase flows to meet the instream flow goals. These fall into the following categories:

- Establishing an instream flow right to protect the creek from the impact of appropriations that would divert additional flows from the creek
- Reducing diversions
- Increasing flows

While the city has proposed instream flow appropriations on Coal Creek to the CWCB, no instream flows have yet been appropriated. The City has not yet refined its management objectives or developed an RVA analysis of instream flow goals for Coal Creek. Those steps are needed before the OSMP can follow through on strategies to reduce diversions or increase flows.

Benefit: Very High

This strategy would make a significant contribution to the restoration of a fundamental process controlling one of the Grassland Plan targets.

Feasibility: High

City staff (OSMP and Utilities) has the experience and skills necessary to undertake this strategy and have been making progress for several years. Although establishing instream flows involves many complexities and uncertainties, this type of strategy has been accomplished before. The strategy is likely to find strong community support.

Cost: Very High

The water rights necessary to implement this strategy are extremely valuable. The CWCB would rely upon a donation from the City to establish an instream appropriation for South Boulder Creek. If that were to happen, the City would exchange the environmental benefit of the instream appropriation for the economic value of the water. Other options exist whereby the City could manipulate the location and timing of water storage and release in the upper and lower watershed to maintain minimum instream flows in the creek. The cost of implementing the strategy also includes considerable time of city staff, water resources consultants and water attorneys.

17. Collaborate with neighboring land management agencies to establish compatible land management practices

Regional coordination is a practical response to several management issues affecting all natural land managers in the area. These management issues include weed management, restoring habitat connectivity and agricultural management. There are four public agencies managing natural lands adjacent to the Grassland Planning Area, three of which are engaged in or committed to the development of management plans.

The US Fish and Wildlife Service manages the 6,200-acre (2,500-ha) Rocky Flats National Wildlife Refuge. The Comprehensive Conservation Plan (the Plan) for the refuge was approved in 2005. The Plan identifies the following strategies:

- Meet annually (at a minimum) with local governments and other adjacent landowners to coordinate habitat management and resource conservation strategies
- Work closely with surrounding open space and natural resource entities such as . . . City and County of Boulder . . . to develop resource management approaches for issues that cross refuge boundaries
- Within two years develop a vegetation management plan (this plan has not yet been developed due to funding limitation)
- Participate in regional Xeric Tallgrass Prairie conservation efforts

- Develop comprehensive integrated pest management plan
- Work with others to protect movement corridors [for deer and elk]

Boulder County Parks and Open Space (BCPOS) is currently in the process of developing a Grassland Management Policy and a management plan for 1,600 acres (650 ha) of grasslands adjacent to the southeast corner of the Grassland Planning Area. The BCPOS staff have made significant contributions to the development of the Grassland Plan and indicated that the Grassland Plan may provide useful information for their management planning efforts.

City of Boulder Parks and Recreation manages the approximately 300 acres (121 ha) around Boulder Reservoir and are currently engaged in the development of a management plan that will include resource management direction for the reservoir's natural areas. Open Space and Mountain Parks staff is participating in that planning effort.

United States Department of Commerce (DOC) National Oceanic and Atmospheric Administration (NOAA) owns Table Mountain in the northern portion of the Grassland Planning Area where they operate an experimental radio research site. While the DOC's focus at the 1,700-acre (690-ha) Table Mountain Field Site is not grassland conservation, the site offers considerable conservation potential. This strategy includes meeting with representatives from the DOC to understand their resource management practices and learn more about the vegetation and wildlife use of the site.

State, county and city transportation departments maintain rights-of-way adjacent to OSMP lands. Coordination of weed management, revegetation/plantings and rare plant management can help advance the individual and shared goals of OSMP and these agencies.

Benefit: High

Adjacent natural areas already confer significant habitat value to the Grassland Planning Area. However, coordinated approaches to weed management, and conservation of sensitive or uncommon species or natural systems could provide a long-term reduction of conservation issues and improve target viability. A management agreement with one agency could build support for other agreements.

Feasibility: Medium

Although OSMP staff members have the relevant experience, the department has not identified a lead individual with sufficient time to undertake this strategy. Developing management agreements with the County is very straightforward and has been done often. However, collaborative resource management with federal agencies can be complex, uncertain and require significant time devoted to process, though OSMP has occasionally entered into management agreements with federal agencies. There is likely to be strong public support for cooperation among government agencies to achieve compatible goals.

Cost: Medium

Staff time is the primary cost associated with meeting, information sharing and developing formal agreements.

18. Create a large block of conserved grassland in the northern portion of the OSMP land system through acquisitions and management agreements

OSMP's Acquisition Plan includes, among other aspects, two focal areas for acquisition on properties north of Neva Road and east of Broadway. The "Northern Tier" is centered on Table Mountain. An area surrounding this is identified as "Boulder County Partnerships". Specific actions

for this strategy would be land acquisition, developing perpetual (or very long-term) management agreements with Boulder County, establishing land management objectives for conservation easements or other types of ownership agreement consistent with selected objectives of the Grassland Plan.

Benefit: Very High

In addition to the benefits of providing more conserved grassland, providing conservation management to large blocks of grassland habitat would offer protection to area sensitive species and provide additional areas for wide-ranging grassland species. OSMP's land acquisition and conservation easements are in perpetuity, so this strategy would be long lasting. OSMP acknowledges that purchasing land in poor condition has the potential to lower the rank for some key attributes (e.g., native plant cover).

Feasibility: Medium

OSMP staff includes property agents experienced in complex land negotiations who have already been actively involved in acquiring lands and property interests in this area, including several joint purchases with Boulder County. There is typically a large degree of community support for OSMP acquisitions and partnerships to conserve land. Any acquisitions would require the approval of the OSBT and the City Council. This strategy is consistent with board and council approved acquisition plan.

Cost: Very High

It is likely that this strategy would require the purchase of land. Consequently, it is a very high-cost strategy.

19. Promote conservation of the Grassland Plan targets by increasing awareness of grassland values and conservation issues

The Grassland Plan provides a framework for heightening public understanding and interest in OSMP grassland. Telling the “essential stories” of the Grassland Planning Area can increase people’s understanding of connection with OSMP.

A better understanding of the ecological and agricultural services that OSMP provides to the community is likely to translate into greater appreciation of OSMP lands for those who visit and stronger general awareness and support for the OSMP program. Increased understanding of how the conservation targets “work” and the conservation issues they face has special relevance for many of the ways people enjoy OSMP lands. This understanding may lead to changes in behavior that will improve the viability of targets over time. Specific areas where greater understanding among community members and community groups can lead to significant impact are:

- Avoiding activities that spread weeds, the New Zealand mudsnail and zebra mussel
- Staying on trails, especially in sensitive areas or during times of sensitivity for grassland species
- Respecting seasonal protective measures
- Abiding by dog management requirements

OSMP has well-developed programs for community outreach, education and enforcement. Staff members are accustomed to and skillful at developing innovative and diverse programs to build connections by telling compelling stories and providing fun and meaningful experiences in the natural world. Programs range from trailside signs and a simple set of “Leave No Trace” principles to advanced naturalist training, long-term volunteer opportunities and a seasonal employment/educational program for teens. OSMP’s priority for developing compatible behaviors is to provide opportunities for experience and understanding first, only using restrictions and regulations as complementary or backup strategies.

Benefit: High

OSMP relies upon public understanding and awareness of basic principles and laws to ensure compatible behaviors by visitors. This requires communicating these principles and rules along with information about the value of the resources and the objectives of management, and, most importantly, compatible ways to enjoy OSMP. OSMP believes that this approach is an effective means to promote compatible visitor behavior and confers significant conservation benefit. The effectiveness of these strategies is difficult and expensive to measure. While OSMP has invested some resources in measuring the effectiveness of our public engagement strategies, it has chosen to invest a greater share of resources in actual public engagement. This strategy is thought to improve the viability of all conservation targets and reduce conservation issues to some (unknown) degree.

Feasibility: High

OSMP has a staff capable and experienced in developing educational programs, community outreach and volunteerism. (More information about levels of service within the Grassland Planning Area is available in Appendix G.) These programs are under continual development and enhancement, and while sometimes complex, they represent a task that has been done repeatedly. There is strong community support and desire for these community services.

Cost: High

Based upon current levels of effort, staff time and other expenses for programs in the Grassland Planning Area over the ten-year planning horizon represent a “High” cost.

20. Protect Boulder Creek from the spread of New Zealand mudsnails by restricting access to the creek between 55th Street and 75th Street

The existing closure, established by regulation in 2005, includes informative (“Mud Snail Alert!”) signs posted at nearby access points and periodic enforcement by rangers. It may also be necessary to conduct periodic outreach with local anglers to update them on the status of the mudsnail and the on-going need for the closure. A similar fishing access closure in the creek by the state of Colorado was rescinded in 2006.

Benefit: Medium

Because this remains one of only two known infestations in Colorado and the only one on OSMP, reducing human-borne transport of snails (attached to waders, shoes, in creels, etc.) can be an effective way to slow the spread of this species to other areas.

Feasibility: High

Anglers, the group most affected by this strategy, appear to support the closure and have demonstrated good compliance. Motivation to accept the closure was reduced somewhat by actions of the state of Colorado, creating confusion among some anglers about the different management approaches of the City and the State. Some members of the public who use the area for hiking and dog walking have expressed displeasure at the closure and anecdotal information suggests that a small number of users violate the closure.

Cost: Low

There are not significant discretionary costs associated with this strategy. Signs may need to be replaced periodically. Rangers enforce the regulation as part of their regular patrol schedule.

21. Continue Integrated Pest Management efforts to control Eurasian watermilfoil

Eurasian watermilfoil (EWM) is an aquatic invasive species that is getting a foothold in the Boulder Creek and St. Vrain Creek watersheds. In 2005, staff surveyed and managed this weed on a one-mile stretch of Boulder Creek and constructed experimental barrier fencing in Bear Creek to prevent further spread downstream. So far, OSMP has successfully managed to reduce infestations and contain this invasive species in Boulder Creek above 75th Street. If this level of containment is to be continued, OSMP will need to invest in on-going management. Under this strategy, OSMP would continue to increase public awareness of Eurasian watermilfoil and work with other city and county agencies, citizens and special interest groups to promote preventative methods such as an “Early Detection and Rapid Response” protocol. Staff will also play a role coordinating the control efforts of other city departments, the University of Colorado and County, State and private (ditch companies) interests.

Benefit: High

Control of this weed will help protect native aquatic habitat and irrigation infrastructure. Eurasian watermilfoil degrades native habitat in a variety of ways. It competes with native aquatic plants, deteriorates fish and macroinvertebrate habitat, leading to a loss of food sources for waterfowl and other wildlife, depletes dissolved oxygen, and increases water temperature, phosphorus levels, and nitrogen levels. It affects irrigation by clogging pipes and impeding the flow of water.

Feasibility: High

OSMP's management efforts to date have been effective at containing and reducing populations of EWM as well as increasing awareness of the threats posed by this species among water managers and members of the community. There is strong public support for removal efforts. Several control methods have been used effectively to contain EWM populations upstream of 75th Street.

Cost: High

Mechanical control of EWM is time consuming. Staff time for mechanical control, the installation and maintenance of physical controls, as well as materials and supplies are likely to fall in the \$50-\$100,000 range over the planning horizon. Volunteers have been willing to participate in mechanical control reducing, to some degree, personnel expenses.

22. Construct or maintain hunting perches near reservoirs and prairie dog colonies to encourage use by raptors

Benefit: Medium

If successfully implemented, this strategy will attract predators identified as prairie dog associates and improve the viability of the Black-tailed Prairie Dog and Associates target.

Feasibility: High

OSMP staff members have the expertise and availability to implement this strategy. It is also relatively straightforward and similar strategies (nesting platforms) have been implemented before. Attracting raptors typically appeals to the motivations of the community. However, some members of the community are opposed to the placement of tall structures in grasslands because of their aesthetic impacts and because they can provide locations from which cowbirds can detect nests to parasitize and could potentially increase predation on burrowing owls.

Cost: Low

Although the costs for this strategy are low even if borne by OSMP, partnerships with a public utility for perch pole placement could reduce costs further. The department has been successful in this regard in the past working to establish osprey-nesting platforms.

23. Construct and maintain alternate nesting structures for sensitive raptors in best opportunity sites

Historically, ferruginous hawks commonly nested on or near the ground. Since such locations are vulnerable to predation, nesting mortality has probably been high and ferruginous hawk populations low. Raptor biologists have experimented with artificial nest structures in an effort to compensate for habitat destruction and human disturbances from mining, agriculture and development. Research has indicated that ferruginous hawks can be attracted to nest on artificial platforms and that these platforms can attract breeding pairs to nest in areas where no nesting had previously been recorded. Artificial platforms have been used successfully to provide nesting habitat in Alberta, Washington, Montana and south-central Wyoming.

Ferruginous hawks are common winter residents in the Grassland Planning Area and are occasionally seen during the breeding season. There are no records of ferruginous hawks nesting in Boulder County. OSMP will evaluate where artificial nest structures would be most likely to attract nesting ferruginous hawks.

In 2008, ten pairs of osprey nested in Boulder County. Four pairs nested on artificial structures on city-owned lands, all near Boulder Reservoir and two on Open Space and Mountain Parks. OSMP will evaluate opportunities for constructing additional osprey nest platforms in the Grassland Planning Area.

In 2008, five pairs of bald eagles nested in Boulder County, two pairs on OSMP lands in the GPA. So far, bald eagles have found suitable natural sites in the Grassland Planning Area. Their nests have been located in mature cottonwood trees in riparian areas with low levels of human activity. It is possible that the two bald eagle nests in the Grassland Planning Area have occupied the available habitat. OSMP is not proposing at this time to construct artificial structures to attract additional nesting by bald eagles. The Department is observing natural patterns of population expansion to learn more about the carrying capacity of the Grassland Planning Area for bald eagles.

Northern harriers (or marsh hawk) are known to nest in Boulder County. While there are no records of northern harrier nesting on OSMP lands, they do nest in marshes on adjacent city-owned lands near Boulder Reservoir. The northern harrier nests on the ground and is not known to use artificial nesting structures.

Benefit: Medium

This strategy currently benefits the osprey and has the potential to establish nesting by ferruginous hawks in Boulder County. Red-tailed hawks, a widespread raptor with sufficient existing nesting habitat, could appropriate artificial structures for their own use before ferruginous hawks begin nesting. Brown-headed cowbirds may also use these structures to locate and parasitize grassland songbird nests.

Feasibility: High

Staff with the appropriate skills and relevant experience is available to implement this strategy over the planning horizon. The construction, placement and maintenance of artificial nest structures are very straightforward and have been done before. There is typically strong public support for projects that support raptor population expansion. Some members of the community may be opposed to the construction of artificial structures on open space because of the aesthetic or potential ecological impacts.

Cost: Low

Although the costs for this strategy are low even if borne by OSMP, partnerships with a public utility for perch pole placement could reduce costs further. The Department worked successfully with Xcel Energy to erect osprey-nesting platforms.

24. Consider closing, restoring and discouraging the (re) establishment of undesigned trails in areas of special conservation value or sensitivity as part of the TSA planning process, and if necessary, prior to TSA planning

There are approximately 115 miles of undesigned trails within the Grassland Planning Area. One of the essential components of TSA plans is a set of recommendations about how undesigned trails (UDTs) will be managed. The management decision about UDTs typically determines that an UDT should either be **designated** by incorporation into new or existing designated trails or **closed and restored**. This strategy recommends that the TSA process consider the Grassland Plan recommendation to close and restore UDTs in places that meet the following criteria:

- Northern leopard frog habitat blocks
- Rare plant populations
- Prairie dog colonies within Grassland Preserves
- Prairie dog Multiple Objective Areas
- Wetlands and Riparian Areas (especially Best Opportunity Areas)
- Areas with low weed density
- Areas of high grassland bird nesting value⁴ (in situations where seasonal protection measures are not feasible)

Given that undesigned trails will be closed for a variety of reasons, some unrelated to the Grassland Plan goals, this strategy also recommends that the TSA process consider prioritizing the closure of undesigned trails in these areas once undesigned trail management decisions have been made. Places that meet multiple criteria should be given a higher priority.

These recommendations are made with the understanding that they will be integrated with the recreational objectives of TSA plans.

This strategy also recommends that the TSA planning process consider closing UDTs in these areas first, once the decision has been made about which UDT's are to be closed. It is understood that several other considerations may factor into the prioritization of UDT closure.

OSMP prefers to use the TSA planning process to integrate resource protection and visitor access and enjoyment. However, since TSA planning for portions of the GPA will not occur for several years, OSMP may close undesigned trails when necessary to protect sensitive resources **prior to the TSA planning process**. TSA plans should also include a mechanism for responding to new information about sensitive resources allowing OSMP to enact protective measures after the TSA plan has been completed.

Benefit: High

The outcomes of TSA planning are unpredictable. The degree to which this strategy will successfully reduce the conservation issues associated with UDTs is unknown. Closing and restoring UDTs will benefit nested conservation targets that require large blocks of un-fragmented habitat and those that are sensitive to human and dog presence. Undesigned trails in and around

⁴ Locations to be determined based upon the results of inventory and monitoring.

prairie dog colonies in Grassland Preserves and prairie dog MOAs reduce the otherwise significant potential of these areas to attract burrowing owls, horned larks and raptors.

This strategy also identifies the need for OSMP to protect sensitive resources by taking necessary actions prior to TSA planning, especially when the TSA process is far in the future.

Feasibility: Medium

There is staff available and capable of implementing this strategy. “Considering” closure of undesignated trails in areas of environmental sensitivity is not a complicated matter and has been done before. Closing UDT’s prior to TSA planning may be more complicated, but has been done before. If adopted as part of the Grassland Plan, this strategy will provide direction and motivation for the planning team/community group to consider UDT closures in the best opportunity areas and sensitive habitats identified in the Grassland Plan. It is likely that some members of the community will not support resource protection measures that restrict visitor access prior to TSA planning.

Cost: Low

This is a low cost strategy, requiring some staff time during the TSA planning process. The closure and reclamation of many UDTs before TSA planning may increase the cost of this strategy.

25. Consider establishing on-leash requirements in areas of special conservation value or sensitivity as part of the TSA planning process, and, if necessary, prior to TSA planning

Dogs are allowed to be off leash if in sight and under voice control of their guardian throughout much of the Grassland Planning Area. TSA planning provides an opportunity for site-specific consideration of OSMP’s dog management. This strategy recognizes that certain areas are either more vulnerable to the effects of dogs or pose a greater challenge to voice and sight control or both. It calls upon the TSA planning process to consider establishing leash requirements in those areas. This strategy recommends that the TSA process consider the Grassland Plan recommendation to require that dogs be leashed in places that meet the following criteria:

- Prairie dog colonies within Grassland Preserves
- Prairie dog Multiple Objective Areas
- Areas of high grassland bird nesting value⁵ (in situations where seasonal protection measures are not feasible)

Prairie dog colonies in Grassland Preserves and prairie dog MOAs have been identified as the best opportunities to conserve prairie dogs and their associated species. Some of these species, like burrowing owls, horned larks and the prairie dogs themselves, are sensitive to disturbance by domestic dogs. The likelihood of disturbance by dogs in prairie dog colonies is elevated by the tendency of dogs to chase prairie dogs and the difficulty that many dog guardians face in gaining voice control of their dogs in this challenging situation.

While the Grassland Plan identifies seasonal on-designated trail and on-leash requirements as the preferred means to protect high-value grassland nesting bird habitat from the impacts of visitors and dogs, that approach may not be practical in all situations. A leash requirement would provide a lesser but potentially important way to reduce the negative effects of dogs traveling through these areas.

These recommendations are made with the understanding that they will be integrated with the recreational objectives of TSA plans.

⁵ Locations to be determined based upon the results of inventory and monitoring.

OSMP prefers to use the TSA planning process to integrate resource protection and visitor access and enjoyment. However, since TSA planning for portions of the GPA will not occur for several years, OSMP may institute leash requirements when necessary to protect sensitive resources **prior to the TSA planning process.** TSA plans should also include a mechanism to responding to new information about sensitive resources allowing OSMP to enact protective measures after the TSA plan has been completed.

Benefit: High

The degree to which this strategy will successfully reduce the conservation issues associated with dogs in prairie dog colonies and high-value grassland bird habitat is unknown. Establishing leash requirements in MOAs and prairie dog colonies within Grassland Preserves will reduce the conservation issues associated with dogs traveling through these colonies and chasing prairie dogs. In high-value grassland bird nesting habitat applying a leash restriction would help reduce the area covered by dogs, reducing the likelihood of direct disturbance to nests or young.

This strategy also identifies the need for OSMP to protect sensitive resources by taking necessary actions prior to TSA planning, especially when the TSA process is far in the future.

Feasibility: Medium

The outcomes of TSA planning are unpredictable. There is staff available and capable of implementing this strategy. "Considering" leash requirements in areas of environmental sensitivity is not a complicated matter and has been done before. Establishing leash requirements prior to TSA planning may be more complicated but also has been done before. The greatest feasibility issue is associated with the difficult of identifying where the regulation is in effect. Boundaries of active prairie dog colonies might have to be generalized to existing fence lines or natural landmarks to ease notification and compliance. This strategy will provide direction and motivation for the planning team/community group to consider some leash restrictions. It is likely that some members of the community will not support implementation of leash requirements either as part of the TSA process or prior to TSA planning.

Cost: Low

This is a low cost strategy, requiring some staff time during the TSA planning process. The establishment of leash requirements before TSA planning may increase the cost of this strategy.

26. Consider providing additional no-dog opportunities to protect areas of conservation value and sensitivity as a part of TSA planning

One of the strategies in the VMP calls for is the establishment of additional no-dog opportunities on some trails using a collaborative process and suitability criteria. The Grassland Plan has identified a number of habitats where historic and current stresses present conservation challenges. These habitats or areas include riparian areas, leopard frog habitat blocks, wetlands, ponds, prairie dog MOAs, prairie dog colonies within Grassland Preserves and large blocks of grassland habitat. The effects of dogs are only a part of the challenge to managing these areas. As the TSA process seeks to identify additional no-dog opportunities, these areas of special conservation value and sensitivity should be considered as the most ecologically suitable places for dog access restrictions.

Benefit: High

As a proposal, this strategy has no direct effect on conservation. However, if implemented, this strategy would reduce the effects of dogs in areas of conservation value and ecological sensitivity. This would reduce the degree of conservation issues facing the targets and improve habitat effectiveness for many species such as ground nesting birds, northern leopard frogs, sensitive raptors and prairie dogs. This strategy is also likely to lead to long-lasting results.

Feasibility: Medium

The outcomes of TSA planning are unpredictable. The degree to which this strategy will successfully reduce the conservation issues associated with poorly managed dogs is unknown. OSMP staff is available and able to integrate these suitability criteria into TSA planning. The strategy is straightforward and has been done before with other ecological concerns. The concept of identifying areas for no-dog opportunities that provide ecological benefit is likely to make sense to the community.

Cost: Low

The costs associated with bringing direction from the Grassland Plan to TSA planning discussions are low.

Strategies Rated "Medium"

27. Consider changes to the VMP management area designation in part of the Gunbarrel/Heatherwood Passive Recreation Area to "Natural Area" as part of the TSA planning process, or prior to TSA planning

The VMP placed the lands in the Gunbarrel/Heatherwood area into two management area designations. OSMP north of Lookout Road was designated as a Natural Area; the area south of the road was designated as a Passive Recreation Area (PRA). The VMP notes that the two areas share many characteristics and that the major difference is the level of recreational access and activity, which is greater south of Lookout Road.

The VMP describes the Gunbarrel Hill/Heatherwood areas as a large contiguous block undergoing native grassland restoration with the intent of restoring a sustainable native grassland ecosystem. It also recognizes that the habitat values of the area support many native bird species and prairie dog colonies. The VMP also identifies seasonal closures or dog exclusions to protect nesting birds in both the PRA and Natural Area.

The Grassland Plan identifies a prairie dog Grassland Preserve that includes the part of the Gunbarrel/Heatherwood PRA north of the East Boulder/Gunbarrel Farm Trail. After a system-wide analysis, this was one of three areas identified where prairie dogs and their associated species are found as part of a relatively large and diverse grassland habitat block. Over the past several years, burrowing owls have nested in this area, and although grassland bird monitoring has not been completed in the area, the expansive grasslands and relatively low levels of use suggest that the area could make important contributions to OSMP's upland prairie bird grassland conservation objectives. In addition, the condition of restored native plant communities has improved in many areas, providing higher quality native grassland habitat beyond what existed at the time of VMP planning.

Staff recognizes that the VMP process established management area designations through a careful and deliberate public process and that it may be difficult to make changes because of interrelationship between the many components of the Visitor Master Plan. However, given the new information resulting from a system-wide analysis about the potential significance of the area for grassland conservation, staff recommends that OSMP propose re-designating the area north of the East Boulder/Gunbarrel Farm Trail to "Natural Area". Such a designation would not preclude the development of trails or use but would provide a context for access, use and grassland conservation strategies for the East TSA more in keeping with the ecological value of the area. The process for considering such a change should include involvement of relevant stakeholders, and could be integrated with the East TSA planning process. This would require a different approach

from that used in the West TSA process where one of requirements was that VMP designations would not be changed. Because the East TSA planning process is probably several years away, staff could choose to engage in a process to consider this change prior to the development of the North TSA plan.

Benefit: Medium

While the outcomes of this strategy are uncertain, if successful this strategy would improve the likelihood that visitor access and activity development in the area are consistent with conservation strategies. Efforts to manage for prairie dog predators and commensals, species requiring large blocks of grassland habitat, are more consistent with the emphasis of the Natural Area designation.

Feasibility: Medium

OSMP is appropriately staffed to undertake this strategy. Although no management area designations have been considered for changes since the acceptance of the VMP, developing a process is straightforward. Given the need for all plans to be flexible to changing understanding and conditions, it will be useful to have a way to make changes to the VMP designations. However, there is likely to be concern among stakeholders about altering the delicate balance of management designations in the VMP.

Cost: Low

This strategy would require staff time and some costs for public meetings. If integrated into the East TSA plan, it would not represent any additional costs.

28. Identify and obtain water rights needed to support irrigated agriculture

OSMP has identified irrigated pastures and hayfields as the best opportunities for agricultural production. Without sufficient or sufficiently reliable water rights, the agricultural value of these properties is diminished. OSMP staff has developed a water rights database and associated GIS that allow an analysis of irrigation water requirements and availability. Related analyses of site conditions and water availability may also identify lands where irrigation is not cost effective because of soil quality, perennial maintenance issues or other factors that contribute to making on-going irrigation impractical and uneconomical. Water rights associated with these properties may be useful for supplementing irrigation on higher quality sites, establishing instream flow programs or supporting ecological conservation objectives.

This strategy includes continuing to refine irrigation water models and acquiring the water rights needed to support irrigated agriculture on OSMP lands.

Benefit: Medium

This strategy supports the viability of agricultural operations. It provides a framework to ensure sufficient reliable water for the long-term support of irrigated agriculture. This in turn establishes conditions that are likely to attract to potential lessees—thereby maintaining OSMP lands in agricultural use. There would be greater benefit of to this strategy if the focus were upon securing senior rights that would support additional conservation targets.

Feasibility: Very High

OSMP staff has contracted the development a water rights database that supports the analyses and has developed other tools in-house to use GIS and other tools to identify locations where irrigation water requirements and availability are imbalanced. Staff members with considerable experience in water rights acquisitions are also available to participate in this strategy. The analysis needed to identify the appropriate water rights for acquisition requires an understanding of how to both calculate irrigation water requirements and determine the availability and

reliability of water for a large number of sites. Staff has developed the tools necessary to undertake this analysis. The community, Open Space Board of Trustees and City Council have been supportive of OSMP's water rights acquisition. It is likely that targeted water rights acquisitions to improve agricultural sustainability will also be approved.

Cost: Very High

Water rights are expensive and their value tends to increase over time. While some irrigation water currently in use on other properties may be available to be redirected to higher quality sites in need of more water, it is likely that water will need to be purchased.

29. Establish and support the survival of plains cottonwoods and diverse and abundant shrub communities in riparian areas

Historic mining and agricultural uses of riparian areas compounded by water diversion and impoundment have altered riparian vegetation in the Grassland Planning Area. In order to improve understanding of riparian vegetation dynamics, OSMP hosted research projects that examined pathways of cottonwood and native willow establishment. Based upon the results of these studies staff has experimented with a variety of revegetation methods. A cottonwood regeneration project along Boulder Creek provided a successful example of artificially creating cottonwood forests in the absence of natural disturbances. This strategy applies this technique to increase the size and ecologic functioning of riparian areas on other OSMP properties. Other actions related to this strategy are:

- Controlling of exotic tree species (Russian olive, crack willow)
- Fencing riparian areas to control access by livestock, promote the growth of shrubs and protect young cottonwoods from grazing
- Planting trees and shrubs using traditional methods

Riparian planting is a component of integrated restoration projects identified along Boulder, South Boulder, Dry Creek (Carrier No. 2) and Coal creeks.

Benefit: High

This strategy makes fundamental improvements to the structure of one of the most highly degraded targets in the planning area. It directly addresses two key attributes (vegetation structure and composition) and will have cascading effects on animal species composition, habitat structure and water quality.

Feasibility: Medium

While OSMP staff includes individuals with expertise to implement this strategy, there is currently insufficient availability for staff to design and implement a project of this scale while managing on-going responsibilities and other project work. This project involves a fair number of complexities and uncertainties. Although it has been completed at a small scale, it has not been done over a large area before. There is likely to be a very high level of community support for the restoration of native riparian vegetation.

Cost: Very High

This strategy would require significant staff time, earth moving, the purchase or collection of shrubs and new fencing.

30. Remove trees from grasslands at 75% of best opportunity sites

Although prescribed fire will be an effective means to reduce woody plant invasions of Open Space and Mountain Parks, mechanical removal and herbicide treatments will be needed in areas where fire cannot be safely used or where mature or otherwise fire resistant trees persist after a

grassland fire. This strategy would focus tree removal on best opportunity sites for the Xeric Tallgrass Prairie, Mixedgrass Prairie Mosaic, and Mesic Bluestem Prairie targets. A seasonal crew modeled on OSMP's forestry program may be the most effective way to implement this strategy.

Benefit: High

Woody plant invasion is a significant conservation issue for grassland birds. Reducing the scope of this stress would improve conditions in several of the dominant targets in the Grassland Planning Area.

Feasibility: Medium

People with expertise and experience are part of the OSMP staff and already committed to implementing a large proportion of this strategy. The forest ecologist and seasonal forestry crew, working under the guidance of the Forest Ecosystem Management Plan (FEMP), will reduce the tree density in ponderosa pine savannas at the margin of grasslands and forests. The IPM crew is committed to the removal of other trees in the Grassland Planning Area. OSMP has not yet assigned responsibility for the removal of ponderosa pine outside the stand boundaries of the FEMP. Tree cutting is straightforward although there may be some complexities associated with site access and wood removal and disposal. This strategy appears to be consistent with the motivations of the community. Some progress has been made on this strategy in the past as part of the FEMP and through IPM efforts to remove Russian olive and crack willow.

Cost: Very High

Trees are abundant and widespread across OSMP grasslands. It is likely to require a great deal of staff time to accomplish this strategy.

31. Treat wetlands dominated by non-native or invasive species using appropriate integrated pest management techniques.

The invasive plant species most affecting wetlands and wetland weed infestations were not as well identified by the RAM process as weeds elsewhere. Consequently, OSMP proposes a separate strategy for addressing wetland weeds.

Wetlands and wetland habitat for nested targets have been degraded or are threatened by several invasive species such as purple loosestrife, reed canarygrass and cattails. The dominance of these species can reduce the suitability of these areas as breeding habitat for waterfowl, shorebirds and northern leopard frogs. Russian olive degrades wetland habitats by replacing the native cottonwood and willow species. Russian olive is slower growing, has denser wood and is less susceptible to insect feeding compared to native trees. The result of Russian olive dominance is a reduction in the number and size of tree holes available for cavity nesters and the amount of food available for insectivores.

IPM techniques for treating non-native or invasive species include but are not limited to the use of fire, cattle or goat grazing, hand pulling, weed whipping, mowing, tree cutting and the use of herbicides. This strategy addresses several species that are not tracked through the RAM methodology. It is likely that OSMP would prioritize weed-dominated wetlands and riparian areas that have been identified as best opportunities for restoration.

Benefit: High

This strategy contributes to the abatement of one of the most significant sources of stress affecting wetland plant communities and wildlife habitat in wetlands. IPM efforts also help ensure compliance with state laws requiring control of certain weeds. Absent IPM efforts, the impact of invasive species on OSMP would increase over time.

Feasibility: Medium

Staff members experienced with weed management techniques are available to implement this strategy and have been doing so for several years. Though integrated management of numerous species involves a fair amount of complexity, OSMP has effectively reduced some populations of wetland and riparian weeds. Staff will rely upon their experience, the weed control literature and consultation with other weed management professionals to develop integrated approaches for the control of invasive species. There is typically strong public support for OSMP's integrated pest management activities and minimal use of herbicides. As with the general IPM strategy, OSMP capacity limits its ability to implement this strategy fully.

Cost: Very High

The costs associated with this strategy are very high. IPM requires significant amounts of manual labor to detect and treat weeds. Given the sensitivity of wetland and riparian areas, OSMP seeks to minimize the impact upon non-target vegetation by careful, selective application of herbicide. The costs of weed control can be reduced to some degree by enlisting volunteer assistance.

32. Participate in native fish recovery efforts with the Colorado Division of Wildlife

OSMP is interested in working with the CDOW and USFWS to assist in species recovery efforts. OSMP and fishery biologists from the CDOW have identified several opportunities to use ponds on OSMP as natural fish hatcheries. Native fish are released into predator-free ponds where they reproduce naturally. Once populations reach an acceptable level, fish are collected from the ponds and reintroduced into creeks and streams with low populations or from which the species has been extirpated. Starting in 2001, OSMP and CDOW have introduced creek chub, redbelly dace, common shiner, lake chub and greenback cutthroat trout in four OSMP ponds. OSMP has identified eight ponds (on the Papini, Bennett and Stratton properties) that could be reclaimed to support native fish refugia as needed.

Benefit: Low

OSMP anticipates that this strategy may improve the viability of the Riparian Areas target by improving the native fishery.

Feasibility: High

OSMP and CDOW staff have already collaborated to establish populations of four species in fish refugia on OSMP (creek chub did not survive). The project has been straightforward to implement and has been successfully implemented. The reintroduction of native fish is generally consistent with the motivations of the community and does not adversely affect any known community interest.

Cost: Low

Most of the non-personnel and some of the personnel costs are borne by the CDOW.

33. Evaluate the suitability of alternative agricultural practices for OSMP lands

Traditional agricultural activities (cow-calf operations, horse-hay production) continue to be attractive for those interested in leasing OSMP lands and water. OSMP agricultural staff members receive frequent requests about the availability of leases for these purposes. It is likely that traditional practices will continue to dominate agricultural operations during the ten-year planning period.

However, OSMP also has an interest in looking further into the future and assessing the benefit, feasibility and costs of other agricultural practices. Organic gardening and community-supported agriculture are currently expanding in the Boulder Valley. Boulder has historically been a center for organic and natural products industry and is working to enhance and publicize this community identity. If feasible and beneficial for the long-term sustainability of agriculture on OSMP, establishing or expanding natural and organic agricultural practices could also contribute to the city's efforts to enlarge and promote its reputation as a leader in organic and natural products.

A study on the feasibility of converting open space agricultural properties to organic and natural production operations was commissioned by the department fifteen years ago (Lelewi 1994). A review of the study report would provide a good starting point for examining alternative agricultural operations.

An evaluation of alternatives may point in other directions or suggest that current agricultural practices are likely to be economically and ecologically sustainable into the future. Other ideas that have been identified in past planning efforts include:

- Increasing the use of native grass and forbs for hay production
- Establishing a native seed production operation
- Establishing a native plant nursery operation

Benefit: Low

This strategy does little to directly enhance viability or reduce the effect of identified conservation issues affecting agricultural operations, but it may leverage future opportunities. However this strategy may leverage continued community support for OSMP's agricultural program.

Feasibility: Very High

There are staff members available who are capable of completing this project or overseeing its completion by a consultant. Completion of this strategy requires an understanding of how to evaluate the OSMP land system, agricultural economics and trends in agricultural production. Consultants knowledgeable in these areas are likely to be available. Alternatively, a staff member could develop the necessary understanding while implementing this strategy.

Cost: Medium

This project could be scaled to the available funding. However, if a consultant were to be hired to complete the project, the project would probably require at least \$10,000 and staff time to develop and oversee the consulting agreement.

34. Establish ten Class B Bobolink Management Areas and mow each area after bobolink fledging (July 15 unless otherwise determined) one year out of three

In 2007, OSMP staff and volunteers detected bobolinks at 42% (70) of the hayfields sampled (165). Using abundance and density information from the hayfield bird-monitoring program, staff identified 14 second-tier fields as candidates for consideration as "Class B Bobolink Management Areas". In each of these areas, mowing would be delayed (after July 15) in at least one of three years.

OSMP staff determined that 75% of the 14 fields identified as candidate Class B Bobolink Management Areas should be designated as such. So far, the five Class B Bobolink Management Areas that have been designated are: Gallagher field 133, Spicer field 260, Teller Farm North field 186 and two fields on the Bell II property (194 and 199). Agricultural production was identified as the appropriate priority management activity at four of the candidate sites. No determination has yet been made for the remaining five sites.

OSMP will attempt to create bobolink habitat outside of hayfields. Agricultural and wildlife staff will work with lessees to adjust stocking to achieve appropriate vegetation height and density conditions in irrigated pastures. Staff will also examine bobolink use of un-mowed habitats (i.e., wet meadows and wetlands) and may study fledging dates. Changes the preferred mowing date will be developed by OSMP wildlife and agricultural staff.

Benefit: Medium

This strategy provides long-term reduction of the key threat to a sensitive and uncommon nested target within the Agricultural Operations target.

Feasibility: Medium

OSMP staff with the skills and experience is available to implement this strategy. This strategy is operationally uncomplicated, and there is support for this approach in some sites. In three of the Class B areas, OSMP lessees already mow after July 15 as part of their agricultural practices. This management has been in effect for several years in these areas. It may be difficult to agree upon five additional Class B sites from among the candidates because of complexities in water availability, historic practices, lease agreements and other factors.

Cost: Low

There is no out of pocket cost to OSMP associated with the mowing of these fields. Lessees continue to provide lease payments to the department in exchange for the use of OSMP land, water and other facilities. It may be necessary to reduce lease payments to compensate lessees for decreased yields resulting from delayed mowing.

35. Assess changes to agricultural and water management in the Northern Grassland Preserve to achieve sustainability of numerous Grassland Plan targets.

Irrigated lands have been identified as OSMP's best opportunity to sustain agricultural operations. In an attempt to develop compatible strategies, prairie dogs may be excluded from irrigated areas within Grassland Preserves. An incompatibility emerges because Grassland Preserves were identified as areas that offer the best opportunity for conservation of prairie dogs and their associates in the context of lands unaffected by prairie dogs. Few opportunities are available on OSMP lands for this purpose. The northern Grassland Preserve is effectively bisected by and directly adjacent to irrigated agriculture, reducing the effective block size of area and continuing a longstanding incompatibility between wildlife management and agricultural operations in the area. Although the current situation is workable, it is not ideal. OSMP is interested in understanding the feasibility and desirability of modifying existing irrigation practices to allow for a more effective design for the northern Grassland Preserve.

Benefit: Medium

This strategy will have limited direct benefit on any of the conservation targets but could leverage an improved situation for the conservation of the Black-tailed Prairie Dog and Associates target. The further implementation of this strategy would only be considered a success if effects upon OSMP's Agricultural Operations were mitigated.

Feasibility: Medium

OSMP staff has the expertise and availability to implement this strategy. Integrating competing management objectives has many complexities and uncertainties. This sort of strategy has not been successfully implemented before.

Cost: Low

The assessment costs should be low, consisting primarily of staff time. The costs associated with actually changing irrigation practices could be very high when considering expenditures for legal services and reclamation, as well as the loss of lease revenue associated with the change in agricultural land use.

APPENDIX M: Monitoring Summary

Indicators	Priority	Methods	Frequency and Timing	Location	Lead	Who monitors	Status
Absolute cover bare ground	Very High	Point intercept method along 50 m transects plus complete species list from 100 m ²	Sampling season: July 15-August 31 Frequency: Annually for two years then three to five years break repeating pattern	System-wide	Grassland Ecologist	Plant Ecology staff, Monitoring staff, contractors	Planned
Native frog presence in suitable habitat	Very High	Visual encounter surveys augmented with aural breeding surveys	Aural sampling season: depends on species but generally late March through July Visual encounter sampling season: July through mid-September Frequency: Annual for both	System-wide	Wildlife Ecologist	Wildlife Ecology staff, Monitoring staff, Resource Information staff, volunteers	On-going
Native species relative cover	Very High	Point intercept method along 50 m transects plus complete species list from 100 m ²	Sampling season: July 15-August 31 Frequency: Annually for two years then three to five years break repeating pattern	System-wide	Grassland Ecologist	Plant Ecology staff, Monitoring staff, contractors	Planned
Native species richness	Very High	Point intercept method along 50 m transects plus complete species list from 100 m ²	Sampling season: July 15-August 31 Frequency: Annually for two years then three to five years break repeating pattern	System-wide	Grassland Ecologist	Plant Ecology staff, Monitoring staff, contractors	Planned

City of Boulder Open Space and Mountain Parks
 Grassland Ecosystem Management Plan
 APPENDIX M: Monitoring Summary

Indicators	Priority	Methods	Frequency and Timing	Location	Lead	Who monitors	Status
Percent of occupied land in Grassland Preserves, Multiple Objective Areas or Prairie Dog Conservation Areas.	Very High	GPS mapping of prairie dog colonies	Sampling season: August-November Frequency: Annual	System-wide	Wildlife Ecologist	Wildlife Ecology staff, Monitoring staff, Information Resource staff, volunteers	On-going
Percent of target with acceptable bird conservation score	Very High	Distance sampling of line transects	Sampling season: May 15-July 15 Frequency: TBD	System-wide	Wildlife Ecologist	Wildlife Ecology staff	Enhance
Proportion of habitat blocks over 100 ha with singing male grasshopper sparrows	Very High	Distance sampling line transects	Sampling season: May 15-July 15 Frequency: TBD	System-wide in blocks over 100 ha	Wildlife Ecologist	Wildlife Ecology staff	Enhance
Relative cover of host plants for skipper/butterfly species of concern (big bluestem and little bluestem)	Very High	Point intercept method along 50 m transects plus complete species list from 100 m ²	Sampling season: July 15-August 31 Frequency: Annually for two years then three to five years break repeating pattern	System-wide	Grassland Ecologist	Plant Ecology staff, Monitoring staff, contractors	Planned
Richness of selected conservative plant species	Very High	Point intercept method along 50 m transects plus complete species list from 100 m ²	Sampling season: July 15-August 31 Frequency: Annually for two years then three to five years break repeating pattern	System-wide	Grassland Ecologist	Plant Ecology staff, Monitoring staff, contractors	Planned
Abundance of black spleenwort	High	Population census	Sampling season: August Frequency: Once every five years	White Rocks	Grassland Ecologist	Plant Ecology staff, Monitoring staff, contractors	Planned

City of Boulder Open Space and Mountain Parks
 Grassland Ecosystem Management Plan
 APPENDIX M: Monitoring Summary

Indicators	Priority	Methods	Frequency and Timing	Location	Lead	Who monitors	Status
Acres in agricultural production	High	Database analysis	Annual report	System-wide	Agricultural Specialist	Agricultural Specialists, Resource Information staff	On-going
Average derived PIF score of sampled sites within selected drainages	High	Fixed distance point counts	Sampling season: May-July Frequency: Every other year or every third year	System-wide	Wildlife Ecologist	Wildlife Ecology staff, Resource Information staff, volunteers	Enhance
Grassland preserves with occupancy of prairie dogs between 10 and 26%	High	GPS mapping of prairie dog colonies	Sampling: August-November Frequency: Annual	Grassland Preserves	Wildlife Ecologist	Wildlife Ecology staff, Resource Information staff, volunteers	On-going
Fish index of biotic integrity (IBI)	High	Methods developed during recent EMAP project	Sampling: TBD Frequency: Once every five years	System-wide	Wetland/Riparian Ecologist	Wetland/Riparian Ecology staff, Wildlife Ecology staff, Monitoring staff, CDOW	Planned
Impediments to fish passage	High	GIS analysis	Annual report	System-wide	Wetland/Riparian Ecologist	Wetland/Riparian Ecology staff, Resource Information staff	On-going
Macroinvertebrate index of biotic integrity (IBI)	High	Methods developed during recent EMAP project	Sampling: Mid-summer Frequency: Once every five years	System-wide	Wetland/Riparian Ecologist	Wetland/Riparian Ecology staff, Wildlife Ecology staff, Monitoring staff, CDOW, contractors	Planned

City of Boulder Open Space and Mountain Parks
 Grassland Ecosystem Management Plan
 APPENDIX M: Monitoring Summary

Indicators	Priority	Methods	Frequency and Timing	Location	Lead	Who monitors	Status
Management of Ute ladies-tresses orchid habitat	High	GIS and database analysis	Annual report	Two VanVleet parcels and Yunker	Monitoring Coordinator	Agricultural Specialists, Grassland Ecologist, Water Resources Administrator	Planned
Number of active bald eagle nest sites in the Grassland Planning Area	High	Visual observation	Sampling season: Nov. 1 through July 31 Frequency: Annual	System-wide	Wildlife Ecologist	Wildlife Ecology staff, Rangers, volunteers	On-going
Number of prairie dog colonies with successful nesting attempts by burrowing owls	High	Visual observation	Sampling season: March - October Frequency: Annual	System-wide at prairie dog colonies	Wildlife Ecologist	Wildlife Ecology staff, possibly volunteers	On-going
Percent of grazed areas in good condition according to an integrated measure of range quality	High	TBD	Season: When livestock leave a pasture Frequency: Annual	Leased lands	Agricultural Specialist	Agricultural Specialists	Planned
Percent of target area experiencing a 5-30 year fire return	High	GPS mapping and GIS analysis	Mapping will occur after fires. Analysis will occur on an annual basis.	System-wide	Resource Information coordinator	Resource Information staff, Monitoring staff, Grassland Ecology staff	On-going
Percent of target area experiencing a 5-10 year fire return	High	GPS mapping and GIS analysis	Mapping will occur after fires. Analysis will occur on an annual basis.	System-wide	Resource Information coordinator	Resource Information staff, Monitoring staff, Grassland Ecology staff	On-going

City of Boulder Open Space and Mountain Parks
 Grassland Ecosystem Management Plan
 APPENDIX M: Monitoring Summary

Indicators	Priority	Methods	Frequency and Timing	Location	Lead	Who monitors	Status
Percent of target dominated by exotic species (Rapid Assessment Mapping)	High	RAM	Sampling season: late June-early August Frequency: Once every five-ten years	System-wide	IPM Specialist	IPM staff	On-going
Percent of target with prevalence of exotic species (Rapid Assessment Mapping)	High	RAM	Sampling season: late June-early August Frequency: Once every five-ten years	System-wide	IPM Specialist	IPM staff	On-going
Physical instream and riparian habitat metric	High	Methods outlined in Barbour et al. 1999	Sampling season: June-October (growing season) Frequency: Once every five years.	System-wide	Wetland/Riparian Ecologist	Wetland/Riparian Ecology staff, Monitoring staff	Planned
Predator community composition/abundance	High	Visual observation	Sampling season: TBD Frequency: Annual	System-wide at prairie dog colonies	Wildlife Ecologist	Wildlife Ecology staff, volunteers	Desired
Presence of populations of Ute ladies-tresses orchid	High	Botanical inventory for presence	Season: second or third week of August Frequency: Annual	Two VanVleet parcels and Yunker	Grassland Ecologist	Plant Ecology staff, volunteers	Planned
Undesignated trail density within 200meters of northern leopard frog habitat blocks	High	GIS analysis	Sampling season: NA Frequency: Once every five years - on the same cycle as undesignated trail mapping	System-wide	Monitoring Coordinator	Resource information staff, Wetland/Riparian Ecologist, Monitoring staff	On-going
Size distribution of large blocks	High	GIS analysis	Sampling season: NA Frequency: Once every five years	System-wide	Monitoring Coordinator	Resource information staff, Monitoring staff	On-going

City of Boulder Open Space and Mountain Parks
 Grassland Ecosystem Management Plan
 APPENDIX M: Monitoring Summary

Indicators	Priority	Methods	Frequency and Timing	Location	Lead	Who monitors	Status
Size of Bell's twinpod populations	High	CNHP/OSMP rare plant census methods	Season: May (late April possibly) Frequency: once every five years (minimum)	Shale barrens	Grassland Ecologist	Plant Ecology staff, volunteers	On-going
Size of dwarf leadplant populations	High	CNHP/OSMP rare plant census methods	Season: late May - mid June (ideal) through September (possible) Frequency: once every five years (minimum)	System-wide (concentrated at forest/grassland interface)	Grassland Ecologist	Plant Ecology staff, volunteers	On-going
Size of grassyslope sedge populations	High	CNHP/OSMP rare plant census methods	Season: June Frequency: once every five years (minimum)	Two known populations on pediments in southern part of the planning area	Grassland Ecologist	Plant Ecology staff, volunteers	On-going
Size of prairie violet/bird's foot violet populations	High	CNHP/OSMP rare plant census methods	Season: May (or late April) Frequency: once every five years (minimum)	System-wide (concentrated at forest/grassland interface)	Grassland Ecologist	Plant Ecology staff, volunteers	On-going
Visual obstruction vegetation height-density (Robel pole measure)	High	Modified Robel pole or similar methodology	TBD	System-wide	Grassland Ecologist	Plant Ecology staff, contractors	Planned
Bobolink indicator	High	Aural surveys along transects	Sampling season: May-July Frequency: Annual	System-wide within hay fields or similar habitat	Wildlife Ecologist	Wildlife Ecology staff, volunteers	Enhance

City of Boulder Open Space and Mountain Parks
 Grassland Ecosystem Management Plan
 APPENDIX M: Monitoring Summary

Indicators	Priority	Methods	Frequency and Timing	Location	Lead	Who monitors	Status
Buffer width (vegetated area within 100 m of a creek)	Medium	Visual estimation or measurement	TBD	System-wide	Wetland/ Riparian Ecologist	Wetland/ Riparian Ecology staff, Monitoring staff	Planned
Buffer width (vegetated area within 100 m of the wetland)	Medium	Visual estimation or measurement	TBD	System-wide	Wetland/ Riparian Ecologist	Wetland/ Riparian Ecology staff, Monitoring staff	Planned
Cottonwood regeneration	Medium	Plots	TBD	System-wide	Wetland/ Riparian Ecologist	Wetland/ Riparian Ecology staff, Monitoring staff	Planned
Distance to nearest wetland or riparian area	Medium	GIS analysis	TBD	System-wide	Wetland/ Riparian Ecologist	Wetland/ Riparian Ecology staff, Monitoring staff, Resource Information staff	Planned
Irrigable land leased for agriculture	Medium	GIS and database analysis	Every other year	System-wide	Agricultural Specialist	Agricultural Specialist, Water Resources Administrator, Resource Information staff	Planned
Percent occurrence of CNHP-tracked grassland dependent butterflies and skipper species	Medium	TBD	Sampling season: May-August based on flight times which differ by species Frequency: Two consecutive years followed by three-seven years off repeating pattern	System-wide	Wildlife Ecologist	Wildlife Ecology staff, contractors	Desired

City of Boulder Open Space and Mountain Parks
 Grassland Ecosystem Management Plan
 APPENDIX M: Monitoring Summary

Indicators	Priority	Methods	Frequency and Timing	Location	Lead	Who monitors	Status
Percent occurrence of grassland dependent butterflies and skipper species	Medium	TBD	Sampling season: May-August based on flight times which differ by species Frequency: Two consecutive years followed by three-seven years off repeating pattern	System-wide	Wildlife Ecologist	Wildlife Ecology staff, contractors	Desired
Percent of colonies with territorial horned larks	Medium	Visual observation	Sampling season: May-July Frequency: Annual	System-wide at prairie dog colonies	Wildlife Ecologist	Wildlife Ecology staff, possibly volunteers	Desired
Percent soil organic matter	Medium	TBD	Sampling season: Growing season Frequency: Once every four years	Leased lands	Agricultural Specialist	Agricultural Specialists, lessees	Desired
Presence of full suite of rare species	Medium	Varies by species	Varies by species	White Rocks	Monitoring Coordinator	Wildlife Ecology staff, Plant Ecology staff, volunteers	Planned
Species richness of sensitive breeding birds	Medium	Point counts	Sampling season: May-July Frequency: TBD	System-wide in wetlands	Wildlife Ecologist	Wildlife Ecology staff, volunteers	Planned
Submerged aquatic nuisance species richness	Medium	Visual surveys	Sampling season: July-August Frequency: TBD	System-wide	IPM Specialist	IPM staff, Wetland/Riparian Ecology staff, Wildlife Ecology staff	On-going
Dissolved oxygen (lotic-flowing water habitats)	Low	Dissolved oxygen meter	TBD	System-wide in flowing water	Wetland/Riparian Ecologist	Wetland/Riparian Ecology staff, Monitoring staff	Desired

City of Boulder Open Space and Mountain Parks
 Grassland Ecosystem Management Plan
 APPENDIX M: Monitoring Summary

Indicators	Priority	Methods	Frequency and Timing	Location	Lead	Who monitors	Status
Instream flows	Low	TBD	TBD	System-wide	Wetland/ Riparian Ecologist	Wetland/ Riparian Ecology staff, Monitoring staff	Desired
Number of over-bank flooding events during late May through June measured every 5-10 years	Low	TBD	When it occurs	System-wide	Wetland/ Riparian Ecologist	Wetland/ Riparian Ecology staff, Monitoring staff	Desired
Percent of area in conservation ownership	Low	GIS analysis	Annual report	White Rocks	Monitoring Coordinator	Resource Information staff, Monitoring staff	On-going
Percent of wetlands in each class with idealized/prescribed/pr oper hydrologic regime.	Low	TBD	TBD	System-wide	Wetland/ Riparian Ecologist	Wetland/ Riparian Ecology staff, Monitoring staff	Desired
Secchi disk depth (for ponds)	Low	Secchi disk sampling	TBD	System-wide in ponds	Wetland/ Riparian Ecologist	Wildlife Ecology staff, Wetland/ Riparian Ecology staff, Monitoring staff	Desired
Total phosphorus (for ponds)	Low	Grab and/or composite samples	TBD	System-wide in ponds	Wetland/ Riparian Ecologist	Wildlife Ecology staff, Wetland/ Riparian Ecology staff, Monitoring staff	Desired

City of Boulder Open Space and Mountain Parks
 Grassland Ecosystem Management Plan
 APPENDIX M: Monitoring Summary

Indicators	Priority	Methods	Frequency and Timing	Location	Lead	Who monitors	Status
Presence of breeding barn owls	Low	Nighttime broadcast call playbacks	Sampling season: May-June Frequency: Annual	White Rocks	Wildlife Ecologist	Wildlife Ecology staff, volunteers	Desired
Presence of six-lined racerunner	Low	Visual observation	Sampling season: May-August Frequency: Annual or every other year	White Rocks	Wildlife Ecologist	Wildlife Ecology staff, volunteers	Desired
Total phosphorus (lotic--flowing water habitats)	Low	Grab and/or composite samples	TBD	System-wide in flowing water	Wetland/Riparian Ecologist	Wetland/Riparian Ecology staff, Monitoring staff	Desired