City of Boulder Open Space and Mountain Parks Department

Ecological Best Management Practices

for

Trail Planning and Design, Construction, Maintenance, and Closure

City of Boulder Open Space and Mountain Parks Department
Boulder, CO

and

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Ecological Best Management Practices

The Ecological Best Management Practices (BMPs) provide City of Boulder Open Space and Mountain Parks Department (OSMP) staff with effective strategies and methods for reducing the negative effects of trails on the environment. In this report, BMPs are presented for the design, construction, maintenance, and closure of trails. The BMPs range from practices relating to the direct impact of trails on the environment to practices relating to impacts of trail users on the broader environment. The body of the report presents BMPs in four sections with supporting information for each BMP. **Appendices A – D** list the BMPs without additional text.

Project Purpose and Scope

Purpose

The purpose of the Ecological Best Management Practices is to help maintain the ecological integrity of OSMP lands by avoiding or minimizing damage to natural resources due to trail design and planning, construction, maintenance, and closure. They are intended to alert trail planners, maintenance staff, and contractors to various factors that they must consider in order to avoid adverse effects when engaging in trail-related activities.

This report supports the City's Resource Protection Initiative in the OSMP Visitor Master Plan (VMP) (OSMP 2005):

> Develop and implement trail and facility location, design, construction, and maintenance best management practices to avoid, reduce, and minimize impacts on the natural environment. These impacts include degradation of habitat qualities, trampling of vegetation, soil erosion and compaction, the spread of non-native plant species, and others.

The VMP contains four goals. They are 1) enhance the experience, 2) improve access, 3) enjoy and protect, and 4) partner with the community (OSMP 2005). The Best Management Practices in this report support these four goals, particularly goal 3, which further states "Ensure that passive recreational activities and facilities are compatible with long-term protection of natural, agricultural, and cultural resources." The BMPs in this report address "natural" resources as used above and do not address agricultural or cultural resources. As used in this report, "natural resources" includes both living organisms (plants and animals) and the non-living environment (soils, geological formations, and water) that sustains them.

Several points for improvement related to trails are identified in the VMP. These include physically unsustainable trails, the backlog of designated trail improvements, and proliferation of undesignated trails. Use of the BMPs in this report will assist in protecting the natural environment as these issues are addressed through trail construction, rerouting, maintenance, and undesignated trail designation or closure.

A list of acronyms used in this report is found in **Appendix E**.

Scope and Approach

This report focuses on principles associated with planning and designing trail projects, as well as practices associated with on-the-ground actions of construction, maintenance, and closure/restoration. OSMP has prepared guidelines for trails that address design, construction, and maintenance, criteria for evaluating trail suitability, and standards for trailhead construction and maintenance (Holland and Wheeler 1990, OSMP 2006, OSMP 2008a, OSMP 2008b, **Appendix M**). The BMPs in this report draw upon these documents, other useful references, and cumulative staff experience, and have been selected as the most relevant for the OSMP Department. Many of the BMPs have been implemented routinely by staff for years, but have not been documented in a form that could be used to communicate these practices and train new employees or inform contractors. This report is intended to provide guidance but does not generally address all of the important details of "how to" associated with certain BMPs. Readers seeking detailed information about implementing certain BMPs are directed by reference in this report to appropriate sources of information.

Most of the BMPs listed in this report are "internal" to OSMP and are advisory in nature. However, certain BMPs are motivated by "external" City of Boulder, state or federal policies. The BMPs in this report are "required" if they follow existing OSMP, City of Boulder, state or federal requirements. The BMPs that are "required" are so designated in the list of BMPs. For example, Best Management Practice Trail Design – 19 requires that appropriate City staff must be consulted if a new trail is planned to pass through a wetland. This requirement applies to all proposed OSMP actions that would entail construction in a wetland and/or buffer areas adjacent to a wetland that are protected by wetland protection regulations. It is possible that some of the BMPs that are currently not required may become "required" in the future.

BMPs that are not mandatory will be followed as closely as possible and to the degree that is feasible. Their application will often involve weighing trade-offs that emerge between constructing and maintaining sustainable trails, and preventing trail-related environmental impacts. Innate differences between recreation planning and management objectives, and ecological conservation objectives predictably lead to weighing trade-offs during trail project planning.

Many of the BMPs call for consultation with appropriate staff experts, and/or the need to reference information that is posted on the OSMP website, in the Geographic Information System (GIS), and in other forms made available to trail planning and maintenance staff (e.g., wall maps showing seasonal wildlife closures and research sites). Wetland impacts and potential impacts to federally-listed, endangered/threatened species require permits, which involve a permit application period. Trail project schedules need to account for project review (including field review) by appropriate staff members, rare plant or animal surveys, any additional information gathering that is necessary, and permit application processes, if required. To facilitate timely collaboration, time for project review and consultation also needs to be built into annual work plans for natural resource management staff.

The trail planning, design, construction and maintenance practices in this report are based on the best information that is currently available. However, the assumption is that what is considered a

"best management practice" is likely to change over time. Furthermore, OSMP's needs for BMPs are likely to change as the department undertakes new types of projects. Therefore this should be regarded as a working document that will evolve as new or improved information becomes available.

The BMPs in this report are presented with background information, and additional recommendations for minimizing impact. **Appendices A – D** provide lists of the BMPs without additional documentation. In addition, a quick reference guide, **Appendix F**,"Watch Out Situations for Minimizing Environmental Impacts During Trail Projects", summarizes the major topics of concern and recommended practices included in the BMPs.

Target Audience

The report is targeted toward OSMP staff and contractors who are directly involved in trail planning and design, construction, maintenance, and closure. It is designed to serve as a reference to ensure that BMPs are considered at appropriate times during the trail planning and design, construction, maintenance, and closure processes. Several of the BMP topics are repeated in most of the sections so that each section can be used separately.

Background

Overview of OSMP Ecological Systems, Habitats, and Species of Concern

Boulder's Open Space and Mountain Parks land is home to an unusual diversity of living things, and affords opportunities to conserve ecosystems that are becoming less common along the Front Range foothills due to urbanization. Diverse topography created by the meeting of the Great Plains and the foothills of the Rocky Mountains, combines with soils, geology and climate to support a rich flora and fauna. One quarter (over 800 species) of the vascular plants found in Colorado occur on OSMP lands, reflecting the presence of both prairie and mountain habitats. Wildlife biologists estimate approximately 500 vertebrate species use habitat on OSMP for some portion of their lives. This represents a little less than half the number of vertebrate species in Colorado. The Colorado Breeding Bird Atlas has breeding bird data for lands in the priority block (the southeastern corner of the map) in each of the 1,745 US Geological Survey 7.5-minute topographic maps in Colorado. The Boulder priority block has the highest number of breeding bird species (101) and habitat types (15) of any of the priority blocks in the state (Kingery 1998). OSMP lands also harbor 55 plant species that are considered rare or imperiled by the Colorado Natural Heritage Program or are species of local special interest. Two plant species, one documented historically and one currently, have federal "threatened" status. Numerous wildlife species occurring on OSMP are listed as species of special concern at the state level, and a few are protected under the Endangered Species Act.

Conservation of the biological and ecological richness within the forested foothills, grasslands, shrublands, wetlands, and riparian areas on OSMP is guided by the Forest Ecosystem

Management Plan (OSMP 1999) and the Grassland Ecosystem Management Plan (OSMP 2010). OSMP conservation targets are presented in **Appendix G and H**, including updated forest conservation targets (OSMP 2008b, 2009c). Conservation targets have been selected to be representative of the biodiversity occurring on OSMP lands, and include numerous nested targets. Examples of conservation targets include xeric and mesic tallgrass prairie, plains and foothills transitional riparian [areas], wetlands, cliff and talus, mixed conifer forests and woodlands, and ponderosa pine woodlands and savannas. Nested targets are typically plant species and communities and animals of conservation concern in the Boulder Valley.

Preservation of the exceptional biological diversity occurring on OSMP, involves a relatively conservative approach to recreation management. The VMP identifies four management area designations: Passive Recreation Areas, Natural Areas, Agricultural Areas, and Habitat Conservation Areas (HCAs). The management areas are designed to accommodate recreation to a greater degree in areas that experience higher numbers of visitors and have higher trail densities, and to emphasize conservation to a greater extent in areas with larger, untrailed habitat blocks and other areas that provide the best opportunities to manage habitat for species that are sensitive to human presence. Several of the BMPs in this report refer explicitly to HCAs, a map of which is found in **Appendix I**.

Trails on OSMP Lands

The Open Space and Mountain Parks system is an important community asset, supporting diverse, nationally recognized outdoor recreational opportunities (OSMP 2005). As of 2009, there are approximately 144 miles of designated trails (excluding undesignated trails) on OSMP lands (OSMP GIS data). Given the spectacular and varied natural setting of Boulder, and its reputation as a destination for outdoor-oriented people, it is not surprising that millions of visits occur on OSMP lands annually. Many of the trails on OSMP lands are heavily used by the public, and there is considerable demand for additional trails. There are also about 175 miles of undesignated trails (OSMP GIS data), which are evaluated through trail planning processes and considered for retention or closure and restoration.

Trails on OSMP lands are for "passive" recreation. The City charter does not define "passive recreation"; however, the charter mentions several passive recreation activities, including hiking, nature study, and photography. The charter also mentions bicycling, fishing, and horseback riding as passive recreational activities that are appropriate under certain conditions and where specifically authorized (OSMP 2005). Motorized recreation is prohibited on all OSMP land. Therefore, BMPs that address motorized recreation are not considered in this report.

The VMP guides recreational planning and management (OSMP 2005). Trail Study Areas (TSA) were formulated in the VMP to provide for area-specific trail and other recreation planning. During a TSA planning process, potential trail additions, reroutes, social trail designation or closure and other recreational opportunities and improvements are considered. In addition, natural resource values (e.g., conservation targets and nested targets) are identified so that recreational planning can avoid or minimize ecological impacts. Once new trails, trail reroutes, or visitor activities are proposed, the Trail Suitability Criteria are employed to address factors related to the quality of the visitor experience, physical sustainability, environmental

sustainability, and protection of cultural / paleontological resources. In addition to the trail suitability factors, other factors related to project feasibility, cost, and practicality are used to evaluate the pros and cons of trail alternatives and to weigh trade-offs. These combined analyses become the basis for selecting the preferred alternative(s) that best balance goals related to visitor experience and resource protection. The Ecological BMPs provide on-the-ground guidance for trail planning related to minimizing environmental impacts. The BMPs specifically inform trail construction, maintenance, and closure/restoration.

Issues of Concern

This section is adapted from "Best Management Practices for Recreational Activities on Grasslands in the Thompson and Okanagan Basins", a document prepared by the British Columbia Ministry of Water, Land and Air Protection and the Grasslands Conservation Council of British Columbia (British Columbia Ministry of Water, Land and Air Protection 2004). Each topic will be addressed with a brief description of the issues involved and the types of impacts that are known.

Soil erosion

Soil plays a vital ecological role, and proper trail design and regular maintenance can minimize soil erosion. Soil is the medium for infiltration of precipitation and movement of groundwater to streams and ponds. Soil supplies nutrients and water to plants, and stores and recycles mineral nutrients and carbon. Soil provides habitat for a vast number of micro-organisms that support higher-order life forms (e.g., soil organisms mediate numerous ecological processes such as nutrient cycling).

Trails create several types of disturbances, particularly removal of plants and plant litter, compaction, and displacement. Compaction occurs on trails as the force of the feet of trail users, hooves of horses, and tires of bikes compress soil particles, eliminating voids between soil particles, and reducing soil volume. This condition degrades the habitat of soil organisms that recycle nutrients and support plant growth. Bare or compacted soils tend to shed precipitation, reducing the amount of precipitation that infiltrates into the soil. Riparian areas and wetlands are generally dependant on supplies of ground water as opposed to direct precipitation, and can be impacted by increased surface runoff leading to changes in ground water recharge and availability. When compaction causes a trail to become a conduit for runoff water, susceptibility to erosion increases. On the other hand, compaction can stabilize soil within the tread of a properly designed trail and, thereby, minimize erosion (Marion and Wimpey 2007).

Bare soils are susceptible to erosion by wind and water. The eroded soil can end up in streams and ponds thereby creating sediment pollution and degrading habitat for fish and other aquatic organisms. Bare soils provide excellent opportunities for the establishment of invasive non-native plant species, including noxious weeds. Trails erode and become muddy, which creates difficult conditions for walking or biking and may cause users to create a parallel or braided trail, further impacting trailside soils and vegetation.

Introduction and spread of invasive species

As used in this context, invasive non-native plants (e.g., weeds) are species that are not native to the Boulder area and which readily colonize disturbed and sometimes undisturbed habitats. There are many invasive non-native plant species on OSMP lands. A subset of invasive non-native plants includes noxious weeds, which are species whose management is mandated by State law and/or local ordinance. Approximately 71 non-native plant species are designated by the State of Colorado as "noxious". OSMP maintains a list of invasive non-native species that are priorities for management (**Appendix J**).

Disturbed soils on and along trails provide good conditions for invasive plant colonization. In addition, people walking along trails can carry seeds of invasive plants in their socks and other clothing, or in mud caked on the bottoms of their boots. Horses and dogs walking on trails can carry weed seeds on their fur, and horses can spread weed seeds in their droppings. Several researchers have found that invasive plant species spread both along trails and outward from trails and transportation corridors (Hansen and Clevenger 2005, Tyser and Worley 1992). It is important to ensure that new trails do not become significant avenues for the spread of invasive plant species into areas with low weed abundance. Careful trail planning and maintenance should incorporate methods that minimize the risk of spreading weeds.

Invasive non-native plants can cause numerous impacts to plant communities, including reducing the diversity of native plant and animal species (Knopf and Olson 1984); enrichment of the soil thereby creating habitat for other weeds (Vitousek 1986); reduction or loss of rare plant species (Duncan 1997); increasing soil erosion (Lacey at al. 1989, 1989a); promoting more frequent wildfires (Anable at al. 1992), and reducing water yields from catchments (Le Maitre et al. 1996).

Invasive animal species are a serious problem, particularly in some local aquatic habitats. The New Zealand mudsnail now inhabits Boulder Creek and an area on Dry Creek east of Baseline Reservoir, and will likely spread to other streams in the Boulder area unless access to the infested sites is restricted. The zebra mussel has caused wide-scale ecologic and economic disruption in the Great Lakes and has recently been discovered in several reservoirs in Colorado. It is imperative to take appropriate measures to minimize the likelihood of accidentally spreading these and other invasive species. The appendices contain a list of recommended actions for preventing the spread of New Zealand mudsnails and a map of known mudsnail occurrences of OSMP lands (Appendices K and L). While these animals do not occur on trails, they have implications for trail projects that are adjacent to and/or cross streams.

Effects upon native wildlife and plants

The direct loss of habitat due to trail construction has an impact on native plants. However, impacts that emanate from travel corridors can be much more important. The number of non-native plant species was greater closer to trails in Glacier National Park compared to farther away from trails (Tyser and Worley 1992). Non-native plant species were found to be more abundant up to 150 meters into adjacent grassland areas from the edges of transport corridors as

compared to control areas (Hansen and Clevenger 2005). Dog excrement and urine likely increase nutrient loadings to areas along trails, thereby promoting the colonization of invasive plant species. Higher nitrogen concentration in soils can shift species composition in plant communities to more opportunistic (i.e., weedy) species (McLendon and Redente 1991). Hikers walking off trail can trample sensitive plant species. For example, a rare plant, the Bell's twinpod (*Physaria bellii*), grows close to several OSMP trails. Visitors in Shenandoah National Park have trampled populations of rare plants that grow on rock outcrops (Wood et al. 2006).

As noted above for native plants and communities, there is a direct impact of trail construction on native wildlife. However, the impact of people and dogs using trails is much more significant. Research on grasslands and forests within OSMP found that generalist bird species were more abundant and specialist bird species were less abundant near trails (Miller et al. 1998). This same study found that nest predation was greater near trails. A study in Utah found that mule deer had a 70% chance of flushing in response to on-trail recreationists (Taylor and Knight 2003). People and dogs may cause animals to change their spatial and temporal patterns of use. George and Crooks (2006) found that bobcats tended to avoid more heavily traveled trails and became more nocturnal in high human use areas in a large urban nature reserve in southern California.

The impact of hikers and mountain bikers on wildlife can extend a considerable distance from trails. In one study, the average perching distance of raptors from an adjacent riparian area was nearly four times greater (156 versus 42 meters) for riparian areas with trails compared to riparian areas without trails (Fletcher et al. 1999). A local study focusing on hikers on trails, found that flushing distances for two grassland bird species, vesper sparrow and western meadowlark, ranged from 9 - 17 meters and 19 - 37 meters, respectively. Flushing distances for mule deer in forests varied from 46 – 101 meters (Miller at al. 2001).

Urban development in the Boulder Valley negatively impacts certain wildlife species on OSMP lands. Jones and Bock (2002) stated that the conservation of many prairie birds in Boulder County may be possible only on large, uninterrupted grassland expanses. Schmidt and Bock (2005) found that rough-legged hawks declined by about 75% while red-tailed hawks, a species that is better adapted to urban settings, had tripled in Boulder County. They also noted that a number of grassland bird species, including mountain plover, long-billed curlew, burrowing owl, common nighthawk, loggerhead shrike, and lark bunting, have declined markedly in Boulder County over the past century. These authors speculated that municipal open space would be insufficient to sustain bird species of open grassland unless large contiguous blocks of habitat were retained. These studies suggest that new trails on OSMP lands should not be routed through in the middle of large expanses of grassland.

Presumably the impacts of trails and their use would depend to some extent on the value of the wildlife habitat through which a trail runs. A trail running through an area of low quality habitat would likely have much less impact on wildlife than a trail running through exceptional habitat. Trail impacts are also species-specific.

Effects upon aquatic areas

In this context, aquatic areas include streams, lakes, ponds, wetlands, and riparian areas. There are a number of streams, lakes and ponds on OSMP lands. Erosion from trails that run along streams or lake shores can degrade water quality, primarily from sediment deposition. Construction of trails in riparian areas destroys the portion of the riparian area under the tread of the trail. Pathogens in dog excrement can contaminate bodies of water (Anonymous 2008).

Although they comprise less than two percent of the land cover, riparian areas supply habitat for approximately 80 percent of birds, mammals, reptiles, amphibians and fish native to Colorado (Knopf 1985). Trails are built through riparian areas (e.g., the Bobolink Trail along South Boulder Creek and the Boulder Creek trail), because riparian areas are visually attractive to people, offer shade on hot days, and are excellent areas to observe wildlife. However, human use of trails in riparian areas can have detrimental impacts on wildlife.

The impact of OSMP visitors walking along trails may be especially significant in riparian areas because of the exceptional habitat they provide in semi-arid places like Boulder. A study on OSMP riparian areas found that raptor species richness and abundance was lower along riparian areas with trails compared to riparian areas that lacked trails (Fletcher at al. 1999). Trails that run through riparian areas and wetlands could impede the movement of the northern leopard frog, a species that is considered "sensitive" by the Colorado Division of Parks and Wildlife and the US Forest Service, and is a high-priority nested conservation target for OSMP (OSMP 2010).

Generally, wetlands are too wet to support trails. However, trails can be constructed in wetlands if they are built using bridges, boardwalks or on fill materials. Unless such trails are carefully constructed, they can impede the flow of surface water across a wetland.

Ecological BMPs for Trail Planning and Design

A well designed trail is economical to maintain and minimizes impacts to the environment. An improperly designed trail might be relatively inexpensive to build, but can require more in long-term maintenance costs than the initial capital investment in the trail (Anonymous 2007, Basch et al. 2007, Parker 2004). Thus, it is imperative that trails are properly designed from the beginning to avoid potentially severe environmental and maintenance problems (Volunteers for Outdoor Colorado 2007). Additionally, when designing a trail, it is important to be proactive in identifying potential significant natural resources that need to be taken into account and considered in trail planning. Trail planning and design that considers how visitors will experience and use the trail to get to desired destinations improves the likelihood that visitors will stay on the trail and minimizes off-trail travel. The Resource Protection Initiative in the VMP specifically stated this objective as to, "locate and design trails to provide a travel route and travel experience that encourage users to stay on-trail and avoid off-trail travel" (OSMP 2005).

Trail design should be considered at both a macro and micro scale. Design at the larger macro scale considers placement of a trail at the landscape level, and deals with questions such as "should a trail run through this drainage?" At the smaller micro scale, design considers factors such as the grade of a trail, need for water management features, and avoiding small-scale sensitive areas. **Appendix M** presents a summary of OSMP guidelines for some physical aspects of trail design and maintenance.

Emphasis in this section is on gathering information about the trail project area, and identifying sensitive soils, plant and animal species, and environments of concern (i.e., first determining the key natural resources that exist within or close to the project area, which are important to protect, and which might be harmed by a new trail). Based on this information, decisions can then be made about how natural resource protection objectives affect trail design, construction and maintenance, and direct strategies to avoid impacting significant natural features to the extent feasible.

OSMP has developed a process for evaluating the suitability of alternative trail alignments with respect to quality of visitor experience, and physical and environmental suitability (OSMP 2006). Trail planners and resource management staff use a checklist of evaluation criteria to select a trail alignment that, insofar as feasible, has the highest recreational and ecological suitability.

A list of the BMPs for Trail Planning and Design is found in **Appendix A**.

General considerations (BMPs 1 – 3)

Best Management Practice Trail Planning and Design - 1

> *Specify the minimum width of trail tread that is needed to accommodate the designed uses of the trail, as defined by the OSMP Trail Design and Management Guidelines (Appendix M).*

Background: From a resource protection standpoint, a narrower trail tread is better than a wider trail tread, providing that the activities intended for the trail are accommodated. A narrower trail limits the lateral extent of damage to native plant communities, and may represent less of a barrier to movement for small mammals, reptiles and amphibians and other wildlife.

Best Management Practice Trail Planning and Design - 2

Specify the minimum necessary construction access adjacent to the trail or within the tread of the trail under construction.

Background: The intent of this BMP is to limit the lateral impact of construction activities, including the operation of heavy equipment, to as narrow a corridor as feasible along the trail during construction. If possible, construction access should be contained within the trail tread as it is constructed.

Best Management Practice Trail Planning and Design - 3

Identify and avoid existing research and monitoring sites when designing new trails and rerouted sections of existing trails.

Background: Building a trail in proximity to active research or monitoring sites could compromise study results. Direct impacts would likely destroy the value of a site for research or monitoring. The locations of most current and long term research and monitoring sites are documented in the OSMP GIS. Consultation with OSMP research and monitoring program leaders during trail planning is advised.

Soil erosion (BMPs 4 - 8)

Best Management Practice Trail Planning and Design - 4

Specify trail design features to minimize the time water flows on the trail.

Background: Trails are susceptible to surface water flowing down the trail and causing erosion. There are a number of design features that can be employed to remediate this surface flow and, therefore mitigate erosion damage. A 5-10% outslope on the tread surface can convey water across the trail and back onto the native slope. Periodic grade dips incorporated into the original design will shed water that is running down the trail. Grade dips or grade reversals are especially critical to design where the trail intersects natural drainages even if the surface flow is only seasonal or intermittent.

Best Management Practice Trail Planning and Design - 5

Avoid planning trails in wet areas and/or flat areas.

Background: Wet and flat areas are undesirable because they do not allow for proper drainage. Raised trail or structures such as bridges, turnpikes, and boardwalks can be used when trails can't be routed away from flat, wet areas. Several techniques for elevating the trail tread and creating drainage channels are explained and illustrated in Hesselbarth et al. (2007).

Improper drainage leading to muddy conditions often results in the widening of the trail tread, and the formation of parallel trails along the constructed trail. A braided or widened trail degrades the native plant and animal communities adjacent to the constructed trail, and invites colonization by invasive plant species.

Best Management Practice Trail Planning and Design - 6

Use OSMP Trail Design and Management Guidelines (Appendix M) for planning and design.

Background: These guidelines are a result of OSMP's commitment to creating more "sustainable" trails. They are not a comprehensive list of trail design specifications, but they do reflect some critical elements that OSMP intends to incorporate into trails wherever possible. Soil type, visitation levels, and types of visitor activities inform the optimum grade design for a trail.

Best Management Practice Trail Planning and Design - 7

Identify areas of highly erosive soils and areas of soil with high clay content and avoid routing trails across such soils. If not possible, specify appropriate measures to minimize the effects of these conditions.

Background: Soil type should be considered as a design criteria, especially if an alignment includes a substantial number of feet through an undesirable soil. The soil survey for Boulder County (Moreland and Moreland 1975) can help with determining the erodibility of soils.

If mitigation is necessary, retention walls, cribbing, planting, jute netting, and imported surface materials are among the strategies that may be considered. BMPs that address preventing the introduction and spread of invasive non-native species must be followed, if surfacing or other materials are brought in from off-site to mitigate erosive soils.

Best Management Practice Trail Planning and Design - 8

Prepare a plan for erosion control during construction.

Background: Construction inevitably disturbs soil and renders it susceptible to erosion. The intent of this BMP is to ensure that trail designers consider potential sources of soil erosion and specify (e.g., in contracts and/or project descriptions) measures to minimize soil erosion during construction. The *City of Boulder Wetland Protection Program Best Management Practices* (City of Boulder 1995a) contains detailed information on erosion control plans for upland and wetland habitat.

Invasive species (BMPs 9 – 10)

This section identifies practices that, collectively, would ensure that colonization by and dispersal of invasive plant species are not facilitated by trail construction and use. These BMPs guide trail planners to avoid locating a trail through infestations of key invasive non-native plant species and to minimize the potential for invasive plant species entering a trail project area during construction.

Best Management Practice Trail Planning and Design - 9

Survey the proposed trail alignment, identify significant invasive plant occurrences, and suggest alternate alignment(s) to avoid these occurrences or control invasive plant species prior to construction. In cases where infestations are likely to be disturbed by trail construction, plan for post-construction, follow-up weed treatments.

Background: This BMP does not apply to invasive plant species that are naturalized and/or which are not actively managed by OSMP. Rather, the goal is to determine if any invasive plant species that are a management priority are present in the project area. Consultation with an OSMP Integrated Pest Management coordinator should occur during trail planning. A list of priority invasive plant species is found in **Appendix J**.

Weed surveys are used to prioritize the eradication of high-priority invasive species, e.g., myrtle spurge (*Tithymalus myrsinites = Euphorbia myrsinites*) prior to trail construction. Surveys are conducted when it is possible to identify invasive plant species expected in the project area, and should be done the year before trail construction is slated to begin. Rapid Assessment Mapping data for priority invasive species are stored in the OSMP GIS files, and can be used to determine the most important species and areas to survey within the vicinity of a planned trail.

Post-construction weed surveys and treatments may be necessary for 2 or more years after the project is completed, while revegetation by native plants is progressing. This work should be incorporated into OSMP staff work plans as the trail project is designed.

Best Management Practice Trail Planning and Design - 10

Specify imported trail tread fill material (e.g., soil, aggregates, and crusher fines) only from known sources confirmed to be free of weed seeds.

Background: Seeds of invasive plants can be found in soil, gravel, and other materials that are commonly used as fill for trail projects. OSMP staff should visit sources of fill materials to gauge the likelihood of the fill material containing seeds of invasive plants. For example, stored crusher fines infested with diffuse knapweed (*Acosta diffusa*) would be unacceptable as a source of trail tread material for a project on OSMP. It would be advantageous for OSMP to find one to two reliable sources of fill materials and purchase all fill materials for trail projects solely from these sources.

Native wildlife and plants (BMPs 11 – 16)

Best Management Practice Trail Planning and Design - 11 **(Required for federally protected species)**

Identify conservation targets and nested conservation targets, that may occur near the proposed trail alignment, survey the proposed trail alignment, and consider alternate trail alignment(s) that avoid occurrences of the conservation targets.

Background: One of the largest known populations of a federally listed plant species, the Ute ladies'-tresses orchid, occurs on OSMP land. Critical habitat for Preble's meadow jumping mouse, a federally and state-listed species that lives in riparian areas is also found on OSMP. Many other rare and/or sensitive plant and animal species occur on OSMP land and are considered conservation targets or nested targets (**Appendices G and H**). OSMP staff members have first-hand knowledge of local occurrences of rare plant communities and plant and animal species. The most up to date spatial data and other information regarding rare and sensitive species on OSMP is housed in the OSMP GIS and other OSMP files. The Colorado Natural Heritage Program (CNHP) also maintains computer databases for rare and sensitive plant species and communities, and wildlife in Colorado. This BMP should be accomplished through consultation with OSMP plant and wildlife ecologists and use of the GIS rare and sensitive species data layers. A data sharing agreement is required by OSMP for the release of rare and sensitive species data to individuals who are not OSMP staff members.

If plant and/or animal surveys are necessary, they need to be conducted at the appropriate time of year when it is possible to identify target plant and animal species, which is from late spring through early fall for most species. The survey work would be done the year before detailed trail planning and design is slated to begin in order to allow enough time to make adjustments to the trail alignment.

Best Management Practice Trail Planning and Design - 12

Minimize trails in Habitat Conservation Areas (as defined in the VMP) and other areas of significant vegetation or significant wildlife habitat.

Background: The VMP identifies Habitat Conservation Areas (HCAs) as areas that "typically represent the largest blocks of an ecosystem type with few, if any, trails" and have "naturally functioning ecosystems." HCAs may contain areas with evidence of human use and impacts. In general, HCAs contain the most significant natural features on OSMP lands, and carry the most restrictions of the VMP management area types for new infrastructure development, including trails. Thus, new trails should be avoided in HCAs unless a new trail will channel visitor use in a mannerr that will prevent social trailing and thereby minimize recreational impacts in nearby areas of high conservation value. See **Appendix I** for a map of HCAs areas on OSMP lands.

Areas of significant vegetation or sensitive wildlife habitats also occur outside of HCAs in management areas defined as Natural Areas and Passive Recreational Areas. "Significant vegetation" includes areas of vegetation with few invasive plant species or with a high diversity of native plant species or with high wildlife value. Avoiding trail alignments in areas of high conservation value reduces the threat of new or expanded invasive, non-native plant occurrences in these areas. Thus, to the extent possible, route new trails out of these areas utilizing tools such as the Trail Study Area planning process and the Trail Suitability Criteria. (OSMP 2005, OSMP 2006)

Best Management Practice Trail Planning and Design -13 **(Required)**

Specify that only native plant species are to be used for revegetation of areas disturbed by trail construction. Work with OSMP plant ecologists to determine suitable native plant species to use in post-construction revegetation.

Background: The majority of OSMP lands support communities of native plants. The required use of native plant species is consistent with the *OSMP Long Range Management Policies* (City of Boulder 1995b).

Best Management Practice Trail Planning and Design -14 **(Required if species is federally protected and included in USFWS permit)**

Specify that construction should avoid critical times in the life cycles (e.g., bird nesting) of key wildlife species.

Background: Surveys should be conducted to identify sensitive wildlife species and/or habitat for sensitive species in a trail planning area at least a year before fine-scale trail planning occurs. If a trail alignment ultimately falls within or near habitat for species that are sensitive to human disturbance, the best possible timing for construction should be selected to avoid impacting the sensitive periods in the life cycles of those species.

Wildlife species are generally most sensitive to disturbance from human activities during the reproductive period, particularly those disturbances to which they are not accustomed. Examples of seasonal protection of sensitive life cycle periods for birds include the existing visitor use closures to protect grassland nesting birds that run from May through July, and the closures for nesting raptors from November, February or March through July or October

OSMP wildlife ecologists can identify which target wildlife species occur along or have habitat near a proposed trail, and determine periods during the year when construction should be avoided. An annual timeline for standard seasonal wildlife protection closures is presented in **Appendix N**. Please be aware that for Federally Listed species, permitting may be required prior to any construction commencing.

Best Management Practice Trail Planning and Design - 15 **(Required)**

Incorporate City requirements for wildlife protection that are relevant to trail construction into trail planning. Provide OSMP trail construction staff and contractors with relevant wildlife protection information.

Background: OSMP trail construction contracts specify that contractors must follow all City ordinances. Trail project managers should consult with OSMP wildlife ecologists and review City wildlife protection requirements during the planning and design phase of a trail project. Project managers should provide OSMP trail construction staff and contractors with the City requirements for wildlife protection (e.g., damaging or destroying black-tailed prairie dog burrows is prohibited) and the location(s) of pertinent seasonal wildlife protection closures will increase the likelihood of compliance with these requirements Information about the City wildlife protection ordinance and information about OSMP seasonal wildlife closure areas may be provided to contractors by referencing the City of Boulder website, www.bouldercolorado.gov, and the OSMP website, www.osmp.org, in the contract. Consultation with the OSMP wildlife ecologist is required prior to planning a trail through a prairie dog colony.

Best Management Practice Trail Planning and Design - 16

Consult with OSMP Ecological Systems staff prior to specifying the use of local native rock for building retaining walls and other structures.

Background: Removal of rock from areas near a trail construction site may impact wildlife or plant habitat. Some reptile and amphibian species and invertebrate species use rocks as shelter and for part of their reproductive cycle. Rock removal could impact plant species that grow in the shaded, moist micro-habitat created by rocks. Small scale rock removal would not be likely to have a significant effect on wildlife or plants. Consultation with OSMP Ecological Systems staff during project planning is advised, if use of on-site native rock is proposed. Ecological Systems staff can delineate areas where rock gathering should and should not take place.

Aquatic areas (BMPs 17 – 21)

The City of Boulder regulates certain activities in wetlands and wetland buffers within the City limits (excluding federal property and the University of Colorado) and on City-owned property outside the City limits. A new trail that would run through riparian areas or along the edge of a lake would probably be subject to regulation. Therefore, the OSMP Wetland and Riparian Ecologist and the City's wetland protection staff in Planning and Development Services must be consulted whenever a new trail is slated to enter a riparian area or wetland. The *City of Boulder Wetland Protection Program Best Management Practices* Manual (City of Boulder 1995a) contains detailed explanations of numerous techniques for reducing impacts of construction and maintenance activities on wetlands.

Best Management Practice Trail Planning and Design - 17

Minimize the length of trail and the number of trail crossings in aquatic areas.

Background: Trails that run along stream banks or along lake shores may directly diminish the stability of the vegetation that holds the stream banks or lake shore in place. In addition, trail users will likely want to walk to the stream or lake in multiple locations, thereby increasing undesignated trail development and the area that is subject to trampling. Trampling of stream banks or lake shores can lead to destruction of the vegetation that holds the banks and shores in place, resulting in bank or shoreline erosion, which can lead to sedimentation in the water body.

Riparian areas provide critical habitat for numerous wildlife species. Routing new trails away from riparian areas and wetlands would likely benefit many species of wildlife. The Center for Watershed Protection and United States Environmental Protection Agency (2005) estimated that the distance between a trail and a nearby riparian area or wetland that would be needed to minimize the effects of the trail on wildlife ranged between 50 and 300 feet depending on the particular wildlife species.

Given the ecological importance of riparian and aquatic habitat, the best practice is to avoid these areas in trail planning to the maximum extent possible.

Best Management Practice Trail Planning and Design - 18

Specify construction techniques and trail design to minimize impacts to hydrology, water quality or aquatic biota where trails cross aquatic areas.

Background: When a decision has been made to route a trail near lakes, creeks, wetlands or riparian areas, measures to minimize adverse impacts should include prohibiting the use of heavy equipment in certain areas, elevating the trail so it will stay dry and thereby encourage visitors will stay on the trail, and minimizing the width of a trail in wetland and riparian areas consistent with achieving the trail's purpose.

When trails are planned near natural aquatic features or irrigation ditches and laterals, alignments should be designed with knowledge of seasonal fluctuations in surface or

groundwater levels and the potential for occasional flooding. Trails will be constructed to allow uninterrupted flow of groundwater.

Best Management Practice Trail Planning and Design – 19 **(Required)**

Consult with the OSMP Wetland and Riparian Ecologist to determine if a proposed trail falls within a wetland or a wetland buffer area.

Background: The City's Stream, Wetland, and Water Body Protection Ordinance protects wetlands and their associated buffers from certain development activities. Currently, a 25-or 50-foot wide buffer runs along the landward boundary of each mapped wetland in the City. An interactive map of the City's wetlands is available on-line at www.bouldercolorado.gov. If a trail project is planned where wetland mapping outside of city limits is incomplete, the OSMP Wetland and Riparian Ecologist will assess whether wetland mapping must be done in order to analyze potential impacts and/or to comply with the City Stream, Wetland, and Water Body Protection Ordinance.

Best Management Practice Trail Planning and Design - 20

Specify equipment and timing of its use to minimize environmental damage while accomplishing trail construction in wetlands and riparian areas.

Background: Using the equipment that can do the job with the least environmental impact should minimize damage to aquatic environments associated with trail activities. For example, metal mats spread the weight of a piece of heavy equipment over a relatively wide area, thereby reducing the damage to the underlying wetland or riparian area. Use of heavy equipment that is specially designed to exert minimal force per unit area of its wheels or treads may also minimize impacts in some situations.

When soils are frozen, rutting and compaction may be reduced in wetlands or other habitat types.

Best Management Practice Trail Planning and Design – 21 **(Required)**

Specify the use of non-toxic building materials (e.g., boardwalk pilings) in wetlands.

Background: Some timbers that could be used to build boardwalks in wetlands are treated with highly toxic materials that could leach into wetlands. Non-toxic alternatives are available. This BMP is a requirement specified in a wetland permit, when applicable to a project.

Ecological BMPs for Trail Construction

The following BMPs focus on activities that occur during construction. See **Appendix B** for a list of the BMPs for Trail Construction.

General considerations (BMPs 22– 25)

Best Management Practice Trail Construction - 22

Install barriers and/or signs during and after construction to keep visitors on designated trails and to discourage off-trail use.

Background: Signs can be used to inform visitors about the project, temporary closures, or alternative routes during trail construction. Clear delineation of travel routes during construction will reduce the creation of new undesignated trails and their associated impacts to wildlife, vegetation, wetlands and soils.

After construction, strategically located barriers and signs can provide ongoing cues for visitors to stay on trails. In principle, trails are designed to minimize the tendency of trail users to deviate from a designated trail, and reduce the formation of undesignated trails. Signs and/or barriers can be used to guide visitors to stay on trail in places where trail design may not accomplish that objective. Community Outreach and/or Ranger staff should be scheduled to assist visitors on site during the first several days after a new trail is opened.

Best Management Practice Trail Construction - 23

Stage materials and equipment in sites which are not sensitive to disturbance. Demarcate the boundaries of staging areas.

Background: The use of staging areas is important in order to limit the extent of impact of heavy equipment and construction materials. From a soils perspective, an ideal staging area would be flat, well vegetated with grasses, and with a well-drained loam soil. This would reduce soil disturbance and erosion. From a plant and wildlife perspective, equipment should be staged in areas that lack invasive plants, and significant vegetation or wildlife value. Materials and equipment should not be staged in wetlands or wetland buffer areas.

Clearly marking the boundaries of a staging area will increase the likelihood of staff's or contractors' compliance.

Best Management Practice Trail Construction – 24

Specify construction access on or along the trail alignment in which construction equipment must stay. Minimize the number of vehicles and frequency of vehicle travel along the access corridor.

Background: This BMP will help contractors and/or OSMP trail crews understand the limits of the construction use. This should help prevent accidental incursions into areas that are not be disturbed during construction.

Soil compaction and erosion, and direct impacts to vegetation will be reduced by limiting the amount of vehicle and equipment travel within construction corridors.

Best Management Practice Trail Construction – 25

Avoid research and monitoring sites during construction, in accessing construction sites, and when gathering native rock or other surface materials for use in trail building.

Background: Building a trail in proximity to active research or monitoring sites can compromise study results. Direct impacts would likely destroy the value of a site for research or monitoring. The locations of most current and long term research and monitoring sites are documented in the OSMP GIS, and this information should be used during trail planning. Consultation with OSMP research and monitoring program leaders is required prior to trail construction.

Soil erosion (BMPs 26 – 29)

Objective: Minimize the extent, intensity, and duration of soil disturbance during trail construction.

Best Management Practice Trail Construction – 26

Avoid construction activities when soils are wet or muddy.

Background: Running heavy equipment over wet or muddy soils causes much greater soil compaction than it does under normal soil moisture conditions. This is particularly important in areas of heavy clay soil which include much of the OSMP land on the plains.

Best Management Practice Trail Construction - 27

Install erosion control materials to prevent soil disturbed by construction from moving off of the construction site.

Background: Soil movement and deposition off the construction site can cover and suppress the growth of existing vegetation, create habitat for weeds, and degrade aquatic habitat quality. Suitable erosion control materials include properly installed silt fences and coir logs (Anonymous 1994). In some situations, erosion control materials may not be needed. For example, narrow trails that involve minimal amounts of cutting and filling and which run across level, well-vegetated upland areas may not need erosion control materials.

Best Management Practice Trail Construction - 28

Dispersed spoils should be spread along the trail corridor within 50 feet of the location of the cut to allow continued growth of the underlying vegetation. No trail construction spoils may be placed in streams, wetlands, or waterbodies or their adjacent buffer areas. Scattered soil should be no more than 2 inches in depth, and added cobbles and larger rocks should cover 20% or less of the ground surface. At least 50% vegetation cover should remain after dispersion of spoils. In forested settings where there is limited space for disposing of spoils, soil and small rock may be piled in an unvegetated upland area. The locations for spoils piles should be selected in collaboration with the forest ecologist.

Background: The scattered soil will be protected from erosion by the canopies of the overtopping plants. Keeping the scattered soil in a thin layer will allow the plants to quickly recover from being partly covered with soil. Scattered soil should be no more than 2 inches deep with an average of at least 50% cover by vegetation visible at the time that soil distribution is completed. Soil can be raked to achieve the desired depth. Excess soil should be used in areas of the project where additional soil is needed, or removed from the project site. In forested settings where there is limited space and the terrain may be steep and dissected by numerous small drainages, the excess soil and small rock from trail construction may be piled in an unvegetated area.

Placing construction spoils in streams, wetlands or waterbodies or their adjacent buffer areas violates the City of Boulder Stream, Wetland, and Water Body Protection Ordinance. Consult with OSMP Wetland and Riparian Ecologist during the project planning phase to identify all streams, wetlands, and waterbodies and their adjacent buffer areas in the vicinity of a project.

Consult with OSMP IPM coordinator before moving soil or rock material to another part of the project area or another OSMP area. Soil from some sites may contain seed or propagules from invasive non-native species.

Best Management Practice Trail Construction - 29

Complete timely post-construction revegetation by seeding at the appropriate time of year with a mixture of hand-collected native plant species or commercially purchased seed, and/or native plantings suitable for the site.

Background: This BMP has several related components.

Revegetation should be incorporated into trail construction plans and completed as quickly as possible once the construction has been completed. This will limit the time that bare soil is exposed to erosion caused by precipitation and wind. Timely also refers to the point in the growing season when seeding or planting occurs. It is important to spread seeds or plant container-grown stock when the likelihood of success is high. Seeding should be done between October 15 and May 15 and when the soil is not wet or frozen. Container-grown stock is usually best planted in the spring or fall, but can

establish successfully when planted in the summer, if reliable, supplemental watering is available. In any case, plantings of woody species should be watered regularly during the first two growing seasons. The watering frequency depends on the timing and amount of precipitation.

OSMP Ecological Systems staff will be able to prepare a list of suitable native plant species for revegetation. OSMP requires contactors to seed only with native species. The particular plant species (and possibly the source of the seeds), the number of pure live seeds per square foot, the number of container-grown stock per unit area, and the locations to be re-seeded or planted must all be specified by OSMP. It is important to note that **commercially available seed may contain weed seeds**.

Reseed or replant if revegetation standards are not met. The OSMP restoration program will develop revegetation standards and monitor seeding and planting success, as appropriate.

Invasive species (BMPs 30 – 35)

Objective: Minimize the introduction and spread of invasive plant species during trail construction.

Best Management Practice Trail Construction – 30

Include in trail construction specifications the requirement for construction equipment to be washed before coming to the construction site and inspected for plant seeds, propagules, and soil prior to entry onto OSMP land. Recommend the washing and cleaning of equipment after finishing OSMP projects to prevent the spread of weed species and aquatic nuisance species (ANS) to other work sites.

Background: Seeds, fruits, and other live fragments of invasive plants can lodge in construction equipment. Unless vehicles and other equipment are thoroughly washed, seeds and propagules can be carried to OSMP lands where they can dislodge and start a new occurrence of an invasive plant species. Caked mud that might harbor weed seeds and plant fragments should be removed from the equipment, placed in bags, and deposited in a dumpster. The condition of equipment used on OSMP trail projects should be monitored by OSMP staff.

See **Appendix K** for recommended practices to prevent the spread of New Zealand Mudsnails and **Appendix L** for a map of New Zealand Mudsnail locations on OSMP.

Best Management Practice Trail Construction - 31

Encourage contractors or OSMP staff to leave all pieces of heavy construction equipment at the job site for the duration of the project, or if equipment leaves the site and returns, require that equipment be washed and then inspected by OSMP staff before returning.

Background: Bringing a piece of heavy equipment to the job site, redeploying it elsewhere, then bring it back to the job site increases the risk of transporting seeds of invasive plant to the job site. If a contractor or staff must remove and return with equipment, washing will help mitigate for the increased risk of transporting invasive species. Washing equipment before going to another job site from OSMP or between OSMP sites should be strongly encouraged.

Best Management Practice Trail Construction - 32

Inspect off-road transportation corridors leading to staging and work sites for noxious weeds. Pretreat noxious weeds before access routes and staging areas are used.

Background: Seeds and propagules from non-native species can be inadvertently picked up on site by vehicles and foot traffic, and moved from one place within a project area to another. It is particularly important to proactively manage weeds within the staging area(s) and travel corridors used during construction.

In cases where a state A-listed (mandatory control), non-native plant species (e.g., Mediterranean sage (*Salvia aethiops*)) is present in one part of a project area, and not in other sections, leave construction in the infested area until last. Washing all equipment before moving from infested to uninfested areas is an important strategy for preventing weed spread.

Best Management Practice Trail Construction - 33

If native plants are salvaged from the trail construction, install them adjacent to or as close as possible to locations where they were obtained to reduce the risk of spreading invasive plant seeds and plant fragments present in the soil.

Background: Transplanting salvaged native plants to new locations provides local genetic material for revegetation, which helps to mitigate the loss of native plants resulting from trail construction. However, soil that supports salvaged plant species may harbor seeds or viable fragments of invasive plant species that can become established elsewhere. Thus, moving salvaged plants to a new location may introduce invasive plant species that are not already present, much like disposing of soil far from its point of cutting. If salvaged plants cannot be transplanted adjacent to the location where they were removed, consider transplanting to easily accessible areas that are practical to monitor and weed on a regular basis (e.g., trailheads). *OSMP resource management staff may make the decision to transfer salvaged plant material to a holding nursery facility before deciding where to use that material.*

Best Management Practice Trail Construction – 34

Where seeding is used in revegetation, evaluate whether it is necessary to cover the soil surface with an appropriate mulch or jute netting to prevent erosion, facilitate seedling

establishment, and prevent the introduction of invasive, non-native plant species. Hay, straw, and plastic netting are not used for post-construction revegetation.

Background: Steep slopes are prone to erosion, even after they have been graded and/or ripped. Erosion control measures are recommended on slopes over about 30%, and may be useful in areas with a lower percent slope. Jute netting is the preferred erosion control material, though various other weed-free materials such as coconut fiber and aspen excelsior blankets are available. Jute is bio-degradable, does not contain weed seeds, and does not inadvertently trap snakes or other wildlife. Plastic netting can trap snakes and other wildlife species. In addition to controlling soil erosion, jute netting ameliorates environmental conditions, especially on dry, south-facing slopes or windy areas, to facilitate seedling establishment. On dry, south-facing slopes, the benefit of improved seeding establishment may be more significant than the benefit of reduced soil erosion. The use of hydromulch may be appropriate in accessible areas. If an area will be seeded and hydromulched, the hydromulch must be applied after seeding.

Do not use straw or hay for any purpose. There is serious risk of introducing non-native plant seeds that may be contaminants in straw, even if the straw is advertised as being "weed-free". Current regional "weed free" certification standards permit several non-native species that are considered invasive by OSMP (e.g., jointed goatgrass (*Cylindropyrum cylindricum*) and smooth brome (*Bromopsis inermis*). Bark mulch, or needle litter may be appropriate for holding moisture and reducing erosion, particularly on projects in the foothills. Bark mulch is often available as a by-product of OSMP forest thinning.

Best Management Practice Trail Construction – 35

If slash from trees and shrubs is used in revegetation or to encourage visitors to stay on-trail, use only material from native species.

Background: Cut branches from non-native woody species may sprout and establish, if partially buried in soil. Seeds from invasive, non-native species could be inadvertently brought to a site on cut branches. *Consult with IPM coordinators or plant ecology staff, if assistance is needed in identifying non-native woody species along the trail corridor.*

Native wildlife and plants (BMPs 36 – 38)

Objective: Minimize the damage to native wildlife, native plant communities and sensitive native plant species during trail construction.

Best Management Practice Trail Construction – 36 **(Required if species are federally protected)**

Identify the locations of rare plant occurrences and minimize impacts during trail construction.

Background: During trail planning, rare plant occurrences in the vicinity of a new trail alignment will be noted so that trail construction activities can avoid disturbance to rare plants. Rare plant surveys may need to be conducted before construction begins. This BMP should be accomplished through consultation between trail construction project managers and OSMP plant ecologists, and by using the GIS rare and sensitive plant species data layers.

Best Management Practice Trail Construction - 37 **(Required)**

Schedule construction to avoid critical times in life cycles (e.g., nesting) of key wildlife species.

Background: Initial surveys conducted during or prior to trail planning will have identified key wildlife species and habitat in the trail project area. An OSMP wildlife ecologist can provide guidance with regard to wildlife species and sensitive time periods that should be considered during a project. During reproductive periods, many wildlife species are generally most sensitive to disturbance from human activities, particularly those disturbances to which they are not accustomed. In order to protect wildlife during sensitive species, seasonal closures are enacted on OSMP for ground-nesting grassland birds from May through July, raptors from November, March or February through July or October. Additional timing requirements may exist if Federally Listed species habitat is present within the area of trail construction. Wildlife Ecologists must be consulted on the presence of these species and permit requirements resulting prior to any construction occurring. **Appendix N** provides closure periods, and additional periods to avoid wildlife disturbance.

Best Management Practice Trail Construction - 38 **(Required)**

Comply with City requirements for wildlife protection that are relevant to trail construction. Provide OSMP trail construction staff and contractors with relevant wildlife protection information.

Background: OSMP trail construction contracts specify that contractors must follow all City ordinances. Trail project managers should provide OSMP trail construction staff and contractors with the City requirements for wildlife protection (e.g., damaging or destroying black-tailed prairie dog burrows is prohibited) and the location(s) of pertinent seasonal wildlife protection closures will increase the likelihood of compliance with these requirements Information about the City wildlife protection ordinance and information about OSMP seasonal wildlife closure areas may be provided to contractors by referencing the City of Boulder website, www.bouldercolorado.gov, and the OSMP website, www.osmp.org, in the contract. However, consultation with OSMP wildlife ecologist is required prior to construction within a prairie dog colony.

Aquatic areas (BMP 39)

Objective: Minimize the disturbance to aquatic areas during trail construction. Some aspects of aquatic area protection are covered elsewhere in this document.

Best Management Practice Trail Construction - 39

> *As specified by wetland permitting, use appropriate erosion control materials during trail construction within 50 feet of a body of open water (stream, lake or pond) or wetland as needed to prevent soil disturbed by trail construction from entering a water body.*

Background: During trail planning, the need for a wetland permit or permits will be assessed. If a permit is required and obtained, the terms of the permit must be strictly followed. A permit may require specific best management practices to minimize erosion. The *City of Boulder Wetlands Protection Program Best Management Practices* (City of Boulder 1995a) includes a detailed discussion of various methods to control erosion that is applicable to trail construction.

Ecological BMPs for Trail Maintenance

Appendix C contains a list of BMPs for Trail Maintenance.

General considerations (BMPs 40 – 41)

Best Management Practice Trail Maintenance - 40

Monitor trail condition regularly throughout the system such that priority maintenance needs are addressed in a timely manner, and natural resource protection and management issues are considered in advance.

Background: Quick on-the-ground inspection of trail segments can identify needed maintenance activities, especially those that are urgently needed to prevent significant erosion of the trail tread. Typically, OSMP trails are scouted on an annual basis to identify maintenance needs. A schedule for trail work is developed, identifying labor, equipment and material needs. In addition, trail maintenance planning should incorporate information about periods during the year that are especially disruptive for wildlife, and the best timing of maintenance to avoid spreading priority non-native plants.

Best Management Practice Trail Maintenance - 41

When it is necessary to prune or remove encroaching vegetation from trails, dispose of pruned material in a responsible manner.

Background: Branches of shrubs and trees or herbaceous vegetation that has encroached on the trail tread encourage trail users to walk off of the trail. This is undesirable because it can create a braided trail, with associated erosion and damage to native vegetation. Pruned material should be cut into short lengths (2 - 4 feet long) and scattered on the ground to create a natural appearance near the point where it was cut. Pruned material from native species can be spread close to where it was cut. If non-native woody species are encroaching upon the trail, consult with OSMP IPM coordinators to arrange removal or for guidance on disposal of pruned material. Do not spread cuttings from non-native species, due to the risk of spreading seed and the potential for some species to reproduce from cuttings (e.g., crack willow).

Soil erosion (BMPs 42 – 44)

Best Management Practice Trail Maintenance - 42

Minimize soil disturbance by walking into sites and performing maintenance activities on foot when feasible; otherwise use motorized equipment that will cause the least amount of impact.

Background: Foot access for trail maintenance is preferable to motorized access unless overriding factors indicate otherwise. Access on foot will usually result in less damage to soil and vegetation along a trail compared to vehicular access. Use of motorized

equipment may be preferable, if the frequency of trips to a site is minimized due to vehicle use, or impacts are reduced in other ways compared with foot-travel.

Best Management Practice Trail Maintenance - 43

Install or renovate water bars, as needed, to minimize erosion of the trail surface.

Background: The function of a water bar is to move water off of a trail to prevent erosion of the trail surface. Water bars need to be cleaned and/or renovated periodically, and may not always be a successful erosion control method (Hesselbarth 2007). Accumulated sediment should be scattered close by to prevent the spread of non-native plant species, but not in stream channels or ponds.

Best Management Practice Trail Maintenance - 44

Ensure proper trail outslope drainage by removing trail edge berms.

Background: A tread of a well-built trail will be outsloped so water runs off the trail to the downhill side. Over time, a small berm may develop on the downhill side of a trail. This berm will cause water to collect on the trail surface, which will then become muddy, often leading visitors to create a parallel trail.

In areas of high priority invasive species, this necessary maintenance should occur seasonally before species like jointed goatgrass produce viable seed. Soil removed during maintenance should be used on the tread or scattered nearby (within 2 to 3 feet).

Invasive species (BMPs 45 - 47)

Objectives: Minimize the introduction and spread of invasive plant species resulting from trail maintenance.

Best Management Practice Trail Maintenance - 45

Avoid spreading invasive non-native plant species through planning and collaboration between trail maintenance staff and IPM coordinators.

Background: Priority non-native plant species that are commonly found along trails, and require specific strategies to prevent their spread by trail maintenance activities, should be highlighted by IPM coordinators. Collaboration between trail maintenance staff and IPM coordinators in planning trail maintenance projects will lead to strategies to prevent weed spread. For example, trail maintenance should be conducted prior to seed set in priority non-native plants (e.g., before late May for jointed goatgrass) to reduce the potential for spreading weeds. In addition, more aggressive pre-treatment of jointed goatgrass and other weeds that readily infest trail sides may be warranted to reduce the likelihood of spreading weed seeds during trail maintenance. In cases involving highly invasive species that spread along trails, routine maintenance could be deferred for

several years along sections of trails while intensive weed management treatments are carried out.

Some trails on OSMP lands are effectively light-duty gravel roads, functioning as fire breaks, fire access and/or utility access. Like other trail maintenance, routine maintenance of roads should occur only as necessary, working with the OSMP IPM coordinator to ensure these activities occur when the likelihood of spreading invasive species is lowest.

Best Management Practice Trail Maintenance - 46

Spread soil cleaned from waterbars and drains thinly on the trail tread no more than 15 feet from the cleaned feature.

Background: Spreading soil cleaned from water bars and drainage channels close to the trail will limit the spread of seeds or other fragments of invasive plant species that may occur in the drainage features. Since the amount of soil cleaned from waterbars and drains during trail maintenance will almost always be small, it should be possible to dispose of all soil cleared from trail drainage features very close to the point of cleaning. Spreading the cleaned material on the trail may also help maintain the trail tread and further reduce weed spread.

Best Management Practice Trail Maintenance – 47

Wash mowing and other maintenance equipment or use other cleaning methods before moving from one project area to another. Equipment cleaning should be done off-site.

Background: Seeds, fruits, and other live fragments of invasive plants can lodge in vehicles and other equipment used to maintain trails. In this way, weeds can be spread between work sites.

Native wildlife and plants (BMPs 48 – 51)

Best Management Practice Trail Maintenance – 48 **(Required if species are federally protected)**

Identify the locations of rare plant occurrences and avoid impacting them insofar as possible during trail maintenance.

Background: Many of the rare plant species occurring on OSMP have habitat along or near trails. Timely communication between trail maintenance and plant ecology staff regarding upcoming maintenance projects will help protect rare plants near trails. OSMP ecologists and/or GIS staff can assist maintenance staff in obtaining current information on the locations of rare plants that have been documented along trail corridors where maintenance is planned. Rare plant occurrences may be easily avoided during routine maintenance if locations are known and ground disturbance is minimal. If

trail maintenance will create widespread ground disturbance, strategies for avoiding rare plants should be developed. If a rare plant survey has not been conducted within the last 5 years in an area where major trail maintenance work is planned (e.g., grading and surface replacement on larger trails that serve as vehicle access), a rare plant survey should be conducted one year in advance of the maintenance project.

Best Management Practice Trail Maintenance - 49 **(Required if species is federally protected)**

Identify any potential conflicts of maintenance activities with sensitive animal species or habitat or with key times of the year (e.g., nesting). Schedule maintenance activities to avoid sensitive wildlife and sensitive periods for wildlife.

Background: Generally speaking, disturbance is most disruptive to wildlife during the reproductive season, especially during incubation for birds or when the young are born. For most wildlife species this occurs from spring into summer (**Appendix N**). OSMP has identified conservation targets for grassland and forest areas (**Appendices G and H**), and OSMP wildlife ecologists can identify which wildlife species have habitat along a trail where maintenance will be occurring, and determine periods during the year when disturbance should be avoided.

Best Management Practice Trail Maintenance - 50 **(Required if species is federally protected or is within a wildlife closure area)**

If emergency trail maintenance is needed due to hazardous conditions, wildlife and vegetation protection should be addressed and trail closures should be considered.

Background: Emergency trail maintenance may be required due to hazardous conditions created by fallen trees, rock slides and other conditions that impede travel on trails. In these cases, maintenance can include the use of chainsaws or heavy equipment. If emergency maintenance will involve loud noise and other disturbances, and maintenance must occur during sensitive periods for wildlife, consult with OSMP wildlife ecologists to devise an approach to addressing the emergency while minimizing wildlife disturbance. In addition, check with plant ecologists to determine whether maintenance may impact rare plants. If conditions are unsafe for visitors, temporarily close damaged trail to allow time for consultation and maintenance.

Best Management Practice Trail Maintenance - 51

Leave trail sides unmowed unless there is a human safety concern or trail sustainability is compromised by vegetation encroachment. If mowing is warranted, blade height should be 6 to8 inches or higher.

Background: Mowing reduces the value of wildlife habitat along trails. The area of mowed vegetation may discourage some animals from traversing a trail.

In addition, mowing during summer months with a low blade setting generally dries out soils, contributes to trail widening and compaction, decreases the vigor of native

vegetation, and increases light availability. The resulting conditions increase the risk of invasion by noxious weeds. Mowing at a higher blade height reduces stress on native vegetation, and leaves vegetation high enough so that trailside trampling associated with mowing is less likely.

Aquatic areas (BMP 52)

Best Management Practice Trail Maintenance – 52 **(Required)**

Do not cast soil and rocks removed from trails outside of wetland and riparian areas into wetlands, riparian areas, streams, and ponds.

Background: Riparian and aquatic areas typically have high ecological and biological value, and can be negatively impacted by the addition of debris from trail maintenance. City ordinance prohibits casting sediment cleaned from water bars, culverts, or drains into wetlands. Therefore, sediment should be placed in upland areas adjacent to where it was collected and where the sediment will not run into adjacent riparian and aquatic habitat.

Ecological BMPs for Trail Closure and Restoration

There are an estimated 175 miles of undesignated (social) trails on OSMP lands (OSMP GIS data, 2010). These trails were not designed, but were formed by visitors, livestock, wildlife, or a combination. Thus, undesignated trails typically have serious grade and drainage problems that contribute to soil erosion and other problems. Closing undesignated trails and unsustainable segments of designated trails is a way to prevent further significant resource damage. See **Appendix D** for a list of BMPs for Trail Closure and Restoration.

General considerations (BMP 53)

Best Management Practice Trail Closure - 53

Identify priority undesignated trails for closure.

Background: OSMP periodically documents undesignated trails throughout the system, and, through the Trail Study Area process, identifies undesignated trails that warrant closing. Typical criteria for trail closure include the degree of on-going resource damage (e.g., amount of erosion, impacts of eroded soil on aquatic areas), newly developing undesignated trails, undesignated trails in HCAs, and the feasibility of a successful closure (e.g., accessibility, technical difficulty, availability of staff or volunteers to do the work, materials and labor cost).

Soil erosion and revegetation (BMPs 54 – 61)

The primary purpose of the following set of BMPs is to establish native plant cover as quickly as possible. This will stabilize the closed trail, thereby preventing significant soil erosion and colonization by invasive plants. Successful revegetation will discourage continued visitor use.

Best Management Practice Trail Closure - 54

Prepare a plan for trail closure.

Background: Trail closures are typically sufficiently complicated that a plan is essential for a successful outcome. A plan should be prepared for each trail closure through collaboration between staff involved with trail planning, plant (including wetlands) and wildlife ecology, IPM, and agriculture, as is appropriate for each project. A trail closure plan would address grading, soil preparation (including scarification, amendments, etc.), plant species to seed or transplant, erosion control, a schedule, and follow-up inspection. BMPs 53 – 60 are elements of a typical trail closure plan. If a trail construction project is occurring in the same area as a trail closure project, noxious weed-free soil from the trail construction could be used to cover the surface of the trail being closed. This would provide a source of seeds of native plants and microorganisms. Some trails to be closed likely will be relatively narrow and lack significant erosion features. Closure of such trails may be accomplished with temporary signage, fencing, scattering of branches and

strategically-placed rocks, and may not require ground-disturbing activities. This is desirable because ground-disturbing actions have the potential to spread invasive plants.

Best Management Practice Trail Closure - 55

Grade areas along the trail as needed to create surfaces that will likely revegetate.

Background: Erosion of the undesignated trail may have been so severe that deep gulleys or other steep slopes have formed. If so, it may be necessary to use heavy equipment or hand tools to move soil and/or rocks from adjacent areas into the gulleys to achieve slopes that are capable of being revegetated. If soil from adjacent trail construction is used; it should be graded to mimic the contours of any hill slope.

Best Management Practice Trail Closure - 56

Scarify the trail tread to loosen compacted soil and create a rough surface capable of absorbing and holding precipitation and providing suitable conditions for seeds to germinate.

Background: Soil compaction can negatively affect the long-term success of a closure and restoration project. Compacted soil is difficult to revegetate because the small roots of seedlings may not be able to penetrate the soil. Ripping compacted soil to a depth of at least six – ten inches loosens and roughens the soil, thereby creating a suitable medium for seedling establishment (State of Colorado 1998). Rocky soils may limit scarification to depths less than six inches. For narrow trail treads, scarification should be accomplished using hand tools to minimize disturbance of adjacent ground. Unless compaction is severe, minimal or no scarification may be appropriate where a weedy seed bank is likely to exist or if native vegetation is likely to recover without additional disturbance.

Best Management Practice Trail Closure - 57

Amend the graded / scarified soil with organic matter and/or other amendments if top soil is absent.

Background: It is not uncommon for top soil to be completely absent on severely degraded trails. If so, particularly on steep, south-facing slopes where growing conditions are severe, it can be helpful to amend the prepared soil with microflora and organic matter. Many species of native perennial plants (which will likely be used for re-seeding or planting) depend on associations with soil microbes that help the plants acquire water and/or nutrients from the soil. Severely degraded soils may also lack organic matter which is vital for retaining water, particularly for seedlings. A product called Biosol provides microflora and organic matter without excessive nutrient inputs. Typically, Biosol is hand-broadcast on the soil at the time of seeding. We do not recommend amending the soil with standard NPK fertilizer. Fertilization was found to promote weed growth far more than it promoted establishment of native plant species in a

study in northwestern Colorado (McLendon and Redente 1991). Native plant species usually have modest nutrient requirements and do not generally need fertilizer.

Best Management Practice Trail Closure - 58

If seeding is part of the closure plan, seed the prepared soil at the appropriate time of year with a mixture of hand-collected native plant species or commercially purchased seed, and/or plantings of native species that are suitable for the site.

Background: An OSMP ecologist or restoration specialist will be able to prepare a list of suitable native plant species for revegetation. For larger areas, a rangeland seed drill that accommodates seeds of native plant species is recommended. On small areas, seeds can be hand-broadcast and raked lightly into the soil to enhance soil-seed contact which improves seed germination and establishment. Seeding should be done between October 15 and May 15 and when the soil is not wet. Fall seedings are conducted sufficiently late in the season to avoid germination before freezing temperatures occur. Seedings can be accomplished during the winter, if the soil is not frozen or wet. Spring seedings are conducted during the early part of the season when precipitation is most likely. Seeding should be done prior to covering the soil surface.

OSMP currently contracts with USDA plant material centers to produce seed in quantities for restoration. This project uses local genotypes of selected native plant species. In the future, seeds from this source may be available for OSMP revegetation projects. Commercially available seed may not include local genotypes and can contain small amounts of weed seeds.

Best Management Practice Trail Closure - 59

After seeding, evaluate whether it is necessary to cover the soil surface with an appropriate mulch to prevent erosion and facilitate seedling establishment. Hay, straw, and plastic netting are not used for post-construction revegetation.

Background: Steep slopes are prone to erosion, even after they have been graded and/or ripped. Erosion control measures are recommended on slopes over about 30%, and may be useful on less steep slopes. Jute netting is the preferred erosion control material, though various other weed-free materials such as coconut fiber and aspen excelsior blankets are available. Jute is bio-degradable, does not contain weed seeds, and does not inadvertently trap snakes or other wildlife. In addition to controlling soil erosion, jute netting ameliorates environmental conditions, especially on dry, south-facing slopes or windy areas, such that seedling establishment is best facilitated. Locally acquired needle duff, grass thatch and other raked plant material from adjacent, weed-free sites may also be used on gentle to moderate slopes. On dry, south-facing slopes, the benefit of improved seeding establishment may be more significant than the benefit of reduced soil erosion. The use of hydromulch may be appropriate in accessible areas. If an area will be seeded and hydromulched, the hydromulch must be applied after seeding.

Do not use commercial hay or straw for erosion control, to mitigate for moisture loss, or any other purpose. There is serious risk of introducing non-native plant seeds that may be contaminants in straw, even if the straw is advertised as being "weed-free". Current regional "weed free" certification standards permit several non-native species that are considered invasive by OSMP (e.g., jointed goatgrass, *Cylindropyrum cylindricum*, and smooth brome, *Bromopsis inermis*). Bark mulch, or needle litter may be appropriate for holding moisture and reducing erosion, particularly on projects in the foothills. Bark mulch is often available as a by-product of OSMP forest thinning.

Best Management Practice Trail Closure - 60

Discourage use of the closed trail by placing rocks, branches, shrub plantings, jute netting, and/or temporary fencing at the edges of the re-seeded areas to create a visual barrier. Post signs, as needed.

Background: Scattered rocks and branches can disguise the closed trail and give a more natural appearance. Branches should be placed on top of jute netting, or a seeded area without erosion control materials. Remove branches when restoration is complete in order to address the tendency for invasive plant species to establish in brush piles. Rocks can be placed strategically to block off the closed trail, but should not impede revegetation. Planting plants that create a barrier may be an effective addition or alternative to rocks or branches. Temporary wooden fencing can discourage visitor use while revegetation progresses. These measures will give trail visitors visual cues to stay off the closed trail, or when installed in as natural a pattern as possible may obscure the trial altogether. In addition, signs can be used to direct visitors away from restoration areas.

Best Management Practice Trail Closure - 61

Inspect annually for the first 3 years to gauge planting success. Re-seed and/or re-plant as needed. Water tree and shrub plantings during the first 2 growing seasons on a regular basis.

Background: Sometimes a seeding is not successful due to lack of precipitation, competition from non-native species, flaws in the restoration methods used, or other reasons. In this case, a plan for reseeding should be developed. An annual inspection may reveal flaws in the design and operation of the trail closure project that can be avoided in future trail closure projects. Regular inspection will provide an opportunity to learn from successes and failures. We recommend focusing the inspection on the recruitment of native plant species, especially those that were planted.

Plantings of woody species should be watered on a regular basis during the first two growing seasons after planting to promote survival. If supplemental watering is impractical, mulch any planted woody species well with bark mulch and minimize the number of plantings.

Invasive species (BMPs 62 – 64)

Best Management Practice Trail Closure - 62

Survey the length of the trail to be closed for significant invasive plant species prior to starting closure activities; control invasive species as needed to prevent spread to new locations.

Background: This will reduce the chance that seeds of invasive plant species will be inadvertently spread during trail closure activities. Appropriate control treatments vary by species, location, and the extent of the invasive species occurrence. Consult with an OSMP IPM coordinator to arrange for a survey and obtain advice on appropriate weed management.

Best Management Practice Trail Closure - 63

Survey the closed trail during the first growing season following closure to locate new occurrences of significant invasive plant species.

Background: There is potential for seeds from non-native plant species to be inadvertently introduced by restoration activities. Thus, it is important to visit the closed trail during the growing season following closure to search for new invasive plant species that may have become established. Consult with an OSMP IPM coordinator to arrange for a survey and obtain advice on appropriate weed management.

Best Management Practice Trail Closure – 64

Clean tools and equipment before and after maintenance work (mowers, graders, hand tools, etc.) to remove plant materials.

Background: Cleaning tools and equipment will minimize the likelihood of spreading seeds and other living fragments of weeds to new locations. This applies to waders and boots that are used in streams and ponds that could carry invasive invertebrates to new locations. Soil and mud should be cleaned from hand tools using a screwdriver or a putty knife at the job site. Equipment such as a Bobcat or a mower should be inspected carefully and any plant fragments that are lodged in the equipment removed and bagged. Crawling under the equipment may be required to inspect the undercarriage adequately. Employ appropriate safety practices when working around or inspecting machinery.

Native wildlife and plants (BMPs 65 – 66)

Best Management Practice Trail Closure – 65 **(Required if species is federally protected)**

Identify the locations of any rare plant occurrences adjacent to the trail closure, and avoid impacting them.

Background: Knowing the location of any rare plant occurrences will help avoid inadvertently damaging them during trail closure operations. This is especially important in situations where heavy equipment will be used for grading along the trail or ripping the trail surface. This BMP should be accomplished through consultation with OSMP plant ecologists, and by using the GIS rare and sensitive plant species data layers.

Best Management Practice Trail Closure - 66 **(Required if species is federally protected or project is within a closure area)**

Identify any potential conflicts in the timing of restoration activities with sensitive animal species. Schedule trail closure activities to avoid critical periods for wildlife (e.g., bird nesting).

Background: Consult with an OSMP wildlife ecologist to determine if any sensitive species are likely to occur in the project area. During the reproductive period, wildlife species are generally most sensitive to disturbance from human activity, particularly those disturbances to which they are not accustomed (**Appendix N**). In many cases, shifting trail closure and restoration activities away from the breeding season (generally spring into early summer) will help minimize potential conflicts with wildlife. A list of conservation targets, which includes sensitive wildlife species for grasslands, is included in **Appendix G**. Activities related to trail closure should be avoided in wildlife closure areas during the closure period and all activity within the closure period will require consultation with an OSMP wildlife ecologist.

Aquatic areas (BMPs 67 – 68)

Best Management Practice Trail Closure - 67 **(Required)**

If the trail to be closed crosses a wetland or wetland buffer, and restoration involves ground disturbing activities, consult with the OSMP Wetland and Riparian Ecologist to determine whether a permit is needed.

Background: The City's Stream, Wetland, and Water Body Protection Ordinance protects wetlands and their associated buffers from certain development activities. Currently, a buffer of either 25 or 50 feet wide runs along the boundary of each mapped wetland in the City. An interactive map of the City's wetlands is available on line at www.bouldercolorado.gov.

Best Management Practice Trail Closure - 68

Remove the build up of accumulated sediments in the trail, as needed, to re-establish an effective hydrologic connection across the closed trail.

Background: Trail closure may offer an opportunity to re-establish hydrologic connections that were disrupted as the undesignated trail formed. For example, soil may have eroded from the trail or berms may have formed such that the flow of surface waters

is reduced or prevented. Regrading can be done by hand or machine so that the original surface flows are restored. If excess soil must be removed and is at risk of containing invasive plant species, remove and dispose of the soil. Consult with an OSMP IPM coordinator to select the appropriate place for disposal. Otherwise, spread the material thinly (see standards for spreading excess material in BMP 29 for trail construction) in a nearby upland area where is not likely to be carried into a wetland via erosion.

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Appendices

Appendix A: Best Management Practices for Trail Planning and Design by Category

Appendix B: Best Management Practices for Trail Construction by Category

Appendix C: Best Management Practices for Trail Maintenance by Category

Appendix D: Best Management Practices for Trail Closure and Restoration by Category

Appendix E: List of Acronyms

Appendix F: Watch Out Situations for Minimizing Environmental Impacts During Trail Projects

Appendix G: Conservation Targets for OSMP Grasslands

Appendix H: Conservation Targets for OSMP Forests

Appendix I: Open Space and Mountain Parks Habitat Conservation Areas Map

Appendix J: Invasive Plant Species that are Priorities for Management on OSMP lands

Appendix K: Recommended Actions for Preventing the Spread of New Zealand Mudsnails

Appendix L: Map of known locations of New Zealand Mudsnails on OSMP lands

Appendix M: OSMP Trail Design and Management Guidelines Matrix

Appendix N: Annual Timeline for Standard Seasonal Wildlife Protection Closures

Appendix A

Best Management Practices for Trail Planning and Design by Category

General considerations	
BMP 1	*Specify the minimum width of trail tread that is needed to accommodate the designed uses of the trail, as defined by the OSMP Trail Design and Management Guidelines (Appendix M).*
BMP 2	*Specify the minimum necessary construction access adjacent to the trail or within the tread of the trail under construction.*
BMP 3	*Identify and avoid existing research and monitoring sites when designing new trails and rerouted sections of existing trails.*
Soil erosion	
BMP 4	*Specify trail design features to minimize the time water flows on the trail.*
BMP 5	*Avoid planning trails in wet areas and/or flat areas.*
BMP 6	*Use OSMP Trail Design and Management Guidelines (Appendix M) for planning and design.*
BMP 7	*Identify areas of highly erosive soils and areas of soil with high clay content and avoid routing trails across such soils. If not possible, specify appropriate measures to minimize the effects of these conditions.*
BMP 8	*Prepare a plan for erosion control during construction.*
Invasive species	
BMP 9	*Survey the proposed trail alignment, identify significant invasive plant occurrences, and suggest alternate alignment(s) to avoid these occurrences or control invasive plant species prior to construction. In cases where infestations are likely to be disturbed by trail construction, plan for post-construction, follow-up weed treatments.*
BMP 10	*Specify imported trail tread fill material (e.g., soil, aggregates, and crusher fines) only from known sources confirmed to be free of weed seeds.*
Native wildlife and plants	
BMP 11 (Required – Federal T&E)	*Identify conservation targets and nested conservation targets, that may occur near the proposed trail alignment, survey the proposed trail alignment, and consider alternate trail alignment(s) that avoid occurrences of the conservation targets.*
BMP 12	*Minimize trails in Habitat Conservation Areas (as defined in the VMP) and other areas of significant vegetation or significant wildlife habitat.*
BMP 13 (Required)	*Specify that only native plant species are to be used for revegetation of areas disturbed by trail construction. Work with OSMP plant ecologists to determine suitable native plant species to use in post-construction revegetation.*
BMP 14 (Required – Federal T&E)	*Specify that construction should avoid critical times in the life cycles (e.g., bird nesting) of key wildlife species.*
BMP 15 (Required)	*Incorporate City requirements for wildlife protection that are relevant to trail construction into trail planning. Provide OSMP trail construction staff and contractors with relevant wildlife protection information.*
BMP 16	*Consult with OSMP Ecological Systems staff prior to specifying the use of local native rock for building retaining walls and other structures.*

Aquatic areas	
BMP 17	*Minimize the length of trail and the number of trail crossings in aquatic areas.*
BMP 18	*Specify construction techniques and trail design to minimize impacts to hydrology, water quality or aquatic biota where trails cross aquatic areas.*
BMP 19 (Required)	*Consult with the OSMP Wetland and Riparian Ecologist to determine if a proposed trail falls within a wetland or a wetland buffer area.*
BMP 20	*Specify equipment and timing of its use to minimize environmental damage while accomplishing trail construction in wetlands and riparian areas.*
BMP 21 (Required)	*Specify the use of non-toxic building materials (e.g., boardwalk pilings) in wetlands.*

Appendix B

Best Management Practices for Trail Construction by Category

General considerations	
BMP 22	*Install barriers and/or signs during and after construction to keep visitors on designated trails and to discourage off-trail use.*
BMP 23	*Stage materials and equipment in sites which are not sensitive to disturbance. Demarcate the boundaries of staging areas.*
BMP 24	*Specify construction access on or along the trail alignment in which construction equipment must stay. Minimize the number of vehicles and frequency of vehicle travel along the access corridor.*
BMP 25	*Avoid research and monitoring sites during construction, in accessing construction sites, and when gathering native rock or other surface materials for use in trail building.*
Soil erosion	
BMP 26	*Avoid construction activities when soils are wet or muddy.*
BMP 27	*Install erosion control materials to prevent soil disturbed by construction from moving off of the construction site.*
BMP 28	*Dispersed spoils should be spread along the trail corridor within 50 feet of the location of the cut to allow continued growth of the underlying vegetation. No trail construction spoils may be placed in streams, wetlands, or waterbodies or their adjacent buffer areas. Scattered soil should be no more than 2 inches in depth, and added cobbles and larger rocks should cover 20% or less of the ground surface. At least 50% vegetation cover should remain after dispersion of spoils. In forested settings where there is limited space for disposing of spoils, soil and small rock may be piled in an unvegetated upland area. The locations for spoils piles should be selected in collaboration with the forest ecologist.*
BMP 29	*Complete timely post-construction revegetation by seeding at the appropriate time of year with a mixture of hand-collected native plant species or commercially purchased seed, and/or native plantings suitable for the site.*
Invasive species	
BMP 30	*Include in trail construction specifications the requirement for construction equipment to be washed before coming to the construction site and inspected for plant seeds, propagules, and soil prior to entry onto OSMP land. Recommend the washing and cleaning of equipment after finishing OSMP projects to prevent the spread of weed species and aquatic nuisance species (ANS) to other work sites.*
BMP 31	*Encourage contractors or OSMP staff to leave all pieces of heavy construction equipment at the job site for the duration of the project, or if equipment leaves the site and returns, require that equipment be washed and then inspected by OSMP staff before returning.*
BMP 32	*Inspect off-road transportation corridors leading to staging and work sites for noxious weeds. Pretreat noxious weeds before access routes and staging areas are used.*
BMP 33	*If native plants are salvaged from the trail construction, install them adjacent to or as close as possible to locations where they were obtained to reduce the risk of spreading invasive plant seeds and plant fragments present in the soil.*
BMP 34	*Where seeding is used in revegetation, evaluate whether it is necessary to cover the soil surface with an appropriate mulch or jute netting to prevent erosion, facilitate seedling establishment, and prevent the introduction of invasive, non-native plant species. Hay, straw, and plastic netting are not used for post-construction*

	revegetation.
BMP 35	*If slash from trees and shrubs is used in revegetation or to encourage visitors to stay on-trail, use only material from native species.*
Native plants and animals	
BMP 36 (Required – Federal T&E)	*Identify the locations of rare plant occurrences and minimize impacts during trail construction.*
BMP 37	*Schedule construction to avoid critical times in life cycles (e.g., nesting) of key wildlife species.*
BMP 38	*Comply with City requirements for wildlife protection that are relevant to trail construction. Provide OSMP trail construction staff and contractors with relevant wildlife protection information.*
Aquatic areas	
BMP 39	*As specified by wetland permitting, use appropriate erosion control materials during trail construction within 50 feet of a body of open water (stream, lake or pond) or wetland as needed to prevent soil disturbed by trail construction from entering a water body.*

Appendix C

Best Management Practices for Trail Maintenance by Category

General considerations	
BMP 40	*Monitor trail condition regularly throughout the system such that priority maintenance needs are addressed in a timely manner, and natural resource protection and management issues are considered in advance.*
BMP 41	*When it is necessary to prune or remove encroaching vegetation from trails, dispose of pruned material in a responsible manner.*
Soil erosion	
BMP 42	*Minimize soil disturbance by walking into sites and performing maintenance activities on foot when feasible; otherwise use motorized equipment that will cause the least amount of impact.*
BMP 43	*Install or renovate water bars, as needed, to minimize erosion of the trail surface.*
BMP 44	*Ensure proper trail outslope drainage by removing trail edge berms.*
Invasive species	
BMP 45	*Avoid spreading invasive non-native plant species through planning and collaboration between trail maintenance staff and IPM coordinators.*
BMP 46	*Spread soil cleaned from waterbars and drains thinly on the trail tread no more than 15 feet from the cleaned feature.*
BMP 47	*Wash mowing and other maintenance equipment or use other cleaning methods before moving from one project area to another. Equipment cleaning should be done off-site.*
Native plants and animals	
BMP 48 (Required – Federal T&E)	*Identify the locations of rare plant occurrences and avoid impacting them insofar as possible during trail maintenance.*
BMP 49 (Required – Federal T&E)	*Identify any potential conflicts of maintenance activities with sensitive animal species or habitat or with key times of the year (e.g., nesting). Schedule maintenance activities to avoid sensitive wildlife and sensitive periods for wildlife.*
BMP 50 (Required – Federal T&E)	*If emergency trail maintenance is needed due to hazardous conditions, wildlife and vegetation protection should be addressed and trail closures should be considered.*
BMP 51	*Leave trail sides unmowed unless there is a human safety concern or trail sustainability is compromised by vegetation encroachment. If mowing is warranted, blade height should be 6 to8 inches or higher.*
Aquatic areas	
BMP 52	*Do not cast soil and rocks removed from trails outside of wetland and riparian areas into wetlands, riparian areas, streams, and ponds.*

Appendix D

Best Management Practices for Trail Closure and Restoration by Category

General considerations	
BMP 53	*Identify priority undesignated trails for closure.*
Soil erosion and revegetation	
BMP 54	*Prepare a plan for trail closure.*
BMP 55	*Grade areas along the trail as needed to create surfaces that will likely revegetate.*
BMP 56	*Scarify the trail tread to loosen compacted soil and create a rough surface capable of absorbing and holding precipitation and providing suitable conditions for seeds to germinate.*
BMP 57	*Amend the graded / scarified soil with organic matter and/or other amendments if top soil is absent.*
BMP 58	*If seeding is part of the closure plan, seed the prepared soil at the appropriate time of year with a mixture of hand-collected native plant species or commercially purchased seed, and/or plantings of native species that are suitable for the site.*
BMP 59	*After seeding, evaluate whether it is necessary to cover the soil surface with an appropriate mulch to prevent erosion and facilitate seedling establishment. Hay, straw, and plastic netting are not used for post-construction revegetation.*
BMP 60	*Discourage use of the closed trail by placing rocks, branches, shrub plantings, jute netting, and/or temporary fencing at the edges of the re-seeded areas to create a visual barrier. Post signs, as needed.*
BMP 61	*Inspect annually for the first 3 years to gauge planting success. Re-seed and/or re-plant as needed. Water tree and shrub plantings during the first 2 growing seasons on a regular basis.*
Invasive species	
BMP 62	*Survey the length of the trail to be closed for significant invasive plant species prior to starting closure activities; control invasive species as needed to prevent spread to new locations.*
BMP 63	*Survey the closed trail during the first growing season following closure to locate new occurrences of significant invasive plant species.*
BMP 64	*Clean tools and equipment before and after maintenance work (mowers, graders, hand tools, etc.) to remove plant materials.*
Native plants and animals	
BMP 65 (Required – Federal T&E)	*Identify the locations of any rare plant occurrences adjacent to the trail closure, and avoid impacting them.*
BMP 66 (Required – Federal T&E)	*Identify any potential conflicts in the timing of restoration activities with sensitive animal species. Schedule trail closure activities to avoid critical periods for wildlife (e.g., bird nesting).*
Aquatic areas	
BMP 67 (Required)	*If the trail to be closed crosses a wetland or wetland buffer, and restoration involves ground disturbing activities, consult with the OSMP Wetland and Riparian Ecologist to determine whether a permit is needed.*
BMP 68	*Remove the build up of accumulated sediments in the trail, as needed, to re-establish an effective hydrologic connection across the closed trail.*

Appendix E

List of Acronyms

BMP = Best Management Practice
BTPD = Black-Tailed Prairie Dog
CNHP = Colorado Natural Heritage Program
FEMP = Forest Ecosystem Management Plan (City of Boulder)
GMAP = Grassland Ecosystem Management Plan (City of Boulder)
IPM = Integrated Pest Management
HCA = Habitat Conservation Areas (for Open Space and Mountain Parks)
OSMP = Open Space and Mountain Parks (City of Boulder)
VMP = Visitor Master Plan (for Open Space and Mountain Parks)
VOC = Volunteers for Outdoor Colorado

Appendix F. OSMP Ecological Best Management Practices for Trail Planning, Construction, Maintenance and Closure

"Watch Out" Situations for Minimizing Environmental Impacts During Trail Projects

Watch Out Situations	Recommended Actions for Impact Prevention or Minimization
Construction or maintenance disturbance during sensitive periods for wildlife, or prairie dog colony is near project	• Consult with wildlife ecologist when planning and scheduling project • Schedule construction or maintenance to avoid sensitive periods in life cycle • Check OSMP website or contact wildlife ecologist for seasonal closures • Comply with COB Wildlife Protection Ordinance
Trail alignment planned in wetland or wetland buffer	• Attempt to route trail outside of wetland and buffer • Consult with wetland ecologist when planning project • Initiate wetland permit application process as early as possible
Trail alignment planned or maintenance in or near rare plants	• Consult with plant ecologist when planning and scheduling project • Avoid direct disturbance to rare plants
Trail alignment planned in research or monitoring area, and/or possible monitoring or research marker(s) observed in or near project	• Consult with monitoring and research coordinators when planning project
Construction or maintenance in priority weed infested area	• Consult with IPM coordinator when planning project • Develop post-construction restoration and IPM plan with resource management staff
Emergency trail maintenance needed due to excessively muddy conditions, blocked trail or other safety issues	• Work with rangers to close trail temporarily to provide time to plan ways to minimize potential impacts from trail maintenance • Check OSMP website or contact wildlife ecologist for seasonal closures, if maintenance includes off-trail work
Need to stockpile materials for construction	• Consult with IPM and plant ecology staff when planning project • Develop post-construction restoration and IPM plan with IPM and plant ecology staff
Need for imported soil on a project	• Consult with IPM and plant ecology staff when planning project • Work with IPM and plant ecology staff to locate source for soil with lowest possible risk of introducing new weeds to project area • Develop post-construction restoration and IPM plan with IPM and plant ecology staff
Excess soil and rock generated by project	• Consult with IPM and plant ecology staff when planning project • Follow BMPs to scatter small amounts of excess soil/rock • Work with IPM and plant ecology staff to plan for use or disposal of soil/rock that can't be used within project
Need to drive vehicles and/or heavy equipment off-trail into site to install bridge or other infrastructure (short-term access)	• Consult with Ecological Systems staff when planning and scheduling project • Consult with Ecological Systems staff to plan least damaging route and to develop post-construction restoration plan, as needed
Construction access for vehicles or other equipment is outside of trail tread (long-term access)	• Consult with Ecological Systems staff to plan least damaging route and to develop post-construction restoration plan, as needed • Minimize frequency of vehicle travel on access corridor; walk into site whenever possible
Project involves collecting native rock to build trail structures (e.g. walls, drainage crossings)	• Consult with Ecological Systems staff and research and monitoring program coordinators when planning project

Appendix G. Conservation Targets for OSMP Grasslands

(Excerpted from OSMP Grassland Ecosystem Management Plan)

Common name	Scientific Name	ESA	G-Rank	S-Rank	CDOW	Boulder County	BVCP	OSMP
Mixedgrass Prairie Mosaic								
American badger	*Taxidea taxus taxus*							SC-2
American elk	*Cervus elaphus nelsoni*							SC-X
Cross-line skipper	*Polites origenes rhena*		G5	S3				SC-2
Ferruginous hawk	*Buteo regalis*		G4	S3B,S4N	SC	SC		SC-1
Golden eagle	*Aquila chrysaetos*					SC		SC-2
Grasshopper sparrow	*Ammodramus savannarum*					SC		SC-2
Lark bunting	*Calamospiza melanocorys*					SC		SC-2
Loggerhead shrike	*Lanius ludovicianus*					SC		SC-2
Mottled duskywing	*Erynnis martialis*		G3G4	S2S3			LC	SC-2
Northern harrier	*Circus cyaneus*					SC		SC-2
Ottoe skipper	*Hesperia ottoe*		G3G4	S2			LC	SC-1
Plains pocket gopher	*Geomys bursarius lutescens*							SC-3
Prairie Arogos skipper	*Atrytone arogos iowa*		G3	S2			LC	SC-3
Prairie tiger beetle	*Cicindela nebraskana*		G4	S1?				
Savannah sparrow	*Passerculus sandwichensis*					SC		SC-3
Short-eared owl	*Asio flammeus*					SC	LC	SC-2
Short-horned lizard	*Phrynosoma douglassii*							SC-3
Swainson's hawk	*Buteo swainsoni*					SC		SC-2
Beebalm, horsemint	*Monarda pectinata*							Sensitive
Bell's twinpod	*Physaria bellii*		G2G3	S2S3		RP	LC	
Lilac penstemon	*Penstemon gracilis*							Sensitive
Silver-leaf scurf pea; s-l wild alfalfa	*Psoralidium argophyllum*							Sensitive
Weatherby's spike-moss	*Selaginella weatherbiana*					RP		Sensitive

Animals shown in black text , plants in green text.
Species shown with white background, Natural Communities shown with green.

Common name	Scientific Name	ESA	G-Rank	S-Rank	CDOW	Boulder County	BVCP	OSMP
Mixedgrass Prairie Mosaic								
Shale Barrens Sparsely Vegetated Herbaceous Alliance								Sensitive
Indian Ricegrass Shale Barren Herbaceous Vegetation	*Achnatherum hymenoides* Shale Barren Herbaceous Vegetation		G2	S2				
New Mexico Feathergrass Herbaceous Vegetation	*Hesperostipa neomexicana* Herbaceous Vegetation		G3	S3		SNC		
Western Wheatgrass - Green Needlegrass Herbaceous Vegetation	*Pascopyrum smithii - Nassella viridula* Herbaceous Vegetation		G3G4	S2				
Western Wheatgrass - Blue Grama Herbaceous Vegetation	*Pascopyrum smithii - Bouteloua gracilis* Herbaceous Vegetation		G5	S4				
Needle-and-Thread Colorado Front Range Herbaceous Vegetation	*Hesperostipa comata* Colorado Front Range Herbaceous Vegetation		G1G2	S1S2		SNC		
Little Bluestem - Sideoats Grama Western Great Plains Herbaceous Vegetation	*Schizachyrium scoparium - Bouteloua curtipendula Western* Great Plains Herbaceous Vegetation		G3	S1				
Green Needlegrass Herbaceous Vegetation	*Nassella viridula* Herbaceous Vegetation		GU	SNR				

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Appendix G. Conservation Targets for OSMP Grasslands

(Excerpted from OSMP Grassland Ecosystem Management Plan)

Common name	Scientific Name	ESA	G-Rank	S-Rank	CDOW	Boulder County	BVCP	OSMP
Xeric Tallgrass Mosaic								
American elk	*Cervus elaphus nelsoni*							SC-X
Cross-line skipper	*Polites origenes rhena*		G5	S3				SC-2
Ferruginous hawk	*Buteo regalis*		G4	S3B,S4N	SC	SC		SC-1
Golden eagle	*Aquila chrysaetos*					SC		SC-2
Grasshopper sparrow	*Ammodramus savannarum*					SC		SC-2
Lark bunting	*Calamospiza melanocorys*					SC		SC-2
Lark sparrow	*Chondestes grammacus*							SC-X
Northern harrier	*Circus cyaneus*					SC		SC-2
Ottoe skipper	*Hesperia ottoe*		G3G4	S2			LC	SC-1
Prairie Arogos skipper	*Atrytone arogos iowa*		G3	S2			LC	SC-3
Prairie regal fritillary	*Speyeria idalia*		G3	S1			LC	SC-1
Short-eared owl	*Asio flammeus*					SC	LC	SC-2
Swainson's hawk	*Buteo swainsoni*					SC		SC-2
Ball cactus	*Pediocactus simpsonii*							Sensitive
Birdfoot violet, prairie violet	*Viola pedatifida*		G5	S2			LC	
Dwarf leadplant, dwarf indigo bush	*Amorpha nana*		G5	S2S3		RP	LC	
Grassyslope sedge	*Carex oreocharis*		G3	S1				
Narrow-leaved milkweed	*Asclepias stenophylla*		G4G5	S2				
Porcupine grass	*Hesperostipa spartea*							Sensitive
Prairie dropseed	*Sporobolus heterolepis*							Sensitive
Silver-leaf scurf pea; s-l wild alfalfa	*Psoralidium argophyllum*							Sensitive
Weatherby's spike-moss	*Selaginella weatherbiana*					RP		Sensitive

Animals shown in black text , plants in green text.
Species shown with white background, Natural Communities shown with green.

Appendix G. Conservation Targets for OSMP Grasslands

(Excerpted from OSMP Grassland Ecosystem Management Plan)

Common name	Scientific Name	ESA	G-Rank	S-Rank	CDOW	Boulder County	BVCP	OSMP
Xeric Tallgrass Mosaic								
Big-Bluestem - Little Bluesetem Western Great Plains Herbaceous Vegetation	*Andropogon gerardii - Schizachyrium scoparium* Western Great Plains Herbaceous Vegetation		G2?	S2		SNC		
Big Bluestem - Prairie Dropseed Western Great Plains Herbaceous Vegetation	*Andropogon gerardii - Sporobolus heterolepis* Western Foothills Herbaceous Vegetation		G2?	S1S2		SNC		
Ponderosa Pine / Big Bluestem Xeric Tallgrass Tree Savannah Herbaceous Vegetation	*Pinus ponderosa / Andropogon gerardii* Xeric Tallgrass Tree Savannah Herbaceous Vegetation		NA	NA				Sensitive
Ponderosa Pine / Mountain-mahogany / Big Bluestem Wooded Herbaceous Vegetation	*Pinus ponderosa / Cercocarpus montanus / Andropogon gerardii* Wooded Herbaceous Vegetation		G2	S2?				
Yucca / Big Bluestem Xeric Tallgrass Shrub Savannah	*Yucca glauca / Andropogon gerardii* Xeric Tallgrass Shrub Savannah		NA	NA				Sensitive
Mesic Bluestem Prairie								
American elk	*Cervus elaphus nelsoni*							SC-X
Bobolink	*Dolichonyx oryzivorus*		G5	S3B		SC		SC-2
Common garter snake	*Thamnophis sirtalis parietalis*		G5S3		SC			SC-2
Dickcissel	*Spiza americana*							SC-3
Northern harrier	*Circus cyaneus*					SC		SC-2
Prairie Arogos skipper	*Atrytone arogos iowa*		G3	S2			LC	SC-3
Prairie regal fritillary	*Speyeria idalia*		G3	S1			LC	SC-1
Short-eared owl	*Asio flammeus*					SC	LC	SC-2
Wilson's phalarope	*Phalaropus tricolor*		G5	S4B,S4N				
Ute ladies'-tresses	*Spiranthes diluvialis*	LT	G2	S2		RP	LC	
Big Bluestem - Yellow Indiangrass Western Great Plains Herbaceous Vegetation	*Andropogon gerardii - Sorghastrum nutans* Western Great Plains Herbaceous Vegetation		G2	S1S2				

Animals shown in black text , plants in green text.
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Appendix G. Conservation Targets for OSMP Grasslands

(Excerpted from OSMP Grassland Ecosystem Management Plan)

Common name	Scientific Name	ESA	G-Rank	S-Rank	CDOW	Boulder County	BVCP	OSMP
Agricultural Operations								
Bobolink	*Dolichonyx oryzivorus*		G5	S3B		SC		SC-2
Dickcissel	*Spiza americana*							SC-3
Grasshopper sparrow	*Ammodramus savannarum*					SC		SC-2
Lark sparrow	*Chondestes grammacus*							SC-X
Northern harrier	*Circus cyaneus*					SC		SC-2
Savannah sparrow	*Passerculus sandwichensis*					SC		SC-3
Swainson's hawk	*Buteo swainsoni*					SC		SC-2
Toothcup	*Rotala ramosior*		G5	S1			LC	
American groundnut	*Apios americana*		G5	S1		RP	LC	
Tulip gentian, showy prairie gentian	*Eustoma grandiflorum*					RP		Sensitive
Wild hops	*Humulus lupulus*							Sensitive
Ute ladies'-tresses	*Spiranthes diluvialis*	LT	G2	S2		RP	LC	
Semi-native Irrigated Meadows			NA	NA				Sensitive
Black-tailed Prairie Dog and Associates								
American badger	*Taxidea taxus taxus*							SC-2
Bald eagle	*Haliaeetus leucocephalus*		G5	S1B,S3N	T		LC	SC-1
Black-tailed prairie dog	*Cynomys ludovicianus ludovicianus*		G4	S3	SC		LC	SC-1
Burrowing owl	*Athene cunicularia*		G4	S4B	T	SC	LC	SC-1
Ferruginous hawk	*Buteo regalis*		G4	S3B,S4N	SC	SC		SC-1
Golden eagle	*Aquila chrysaetos*					SC		SC-2
Northern harrier	*Circus cyaneus*					SC		SC-2
Prairie tiger beetle	*Cicindela nebraskana*		G4	S1?				
Rough-legged hawk	*Buteo lagopus*							SC-X

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Appendix G. Conservation Targets for OSMP Grasslands

(Excerpted from OSMP Grassland Ecosystem Management Plan)

Common name	Scientific Name	ESA	G-Rank	S-Rank	CDOW	Boulder County	BVCP	OSMP
Wetlands								
American bittern	*Botaurus lentiginosus*					SC		SC-1
American elk	*Cervus elaphus nelsoni*							SC-X
American white pelican	*Pelecanus erythrorhynchos*		G3	S1B				
Black-necked stilt	*Himantopus mexicanus*		G5	S3B				
Bobolink	*Dolichonyx oryzivorus*		G5	S3B		SC		SC-2
Common garter snake	*Thamnophis sirtalis parietalis*		G5S3		SC			SC-2
Dickcissel	*Spiza americana*							SC-3
Eared grebe	*Podiceps nigricollis*					SC		SC-2
Least bittern	*Ixobrychus exilis*					SC		SC-2
Northern harrier	*Circus cyaneus*					SC		SC-2
Northern leopard frog	*Rana pipiens*		G5	S3	SC			SC-1
Osprey	*Pandion haliaetus*					SC		SC-2
Prairie Arogos skipper	*Atrytone arogos iowa*		G3	S2			LC	SC-3
Prairie regal fritillary	*Speyeria idalia*		G3	S1			LC	SC-1
Sharp sprite	*Promenetus exacuous*		G5	S2			LC	SC-2
Short-eared owl	*Asio flammeus*					SC	LC	SC-2
Two-spotted skipper	*Euphyes bimacula*		G4	S2			LC	SC-2
Wilson's phalarope	*Phalaropus tricolor*		G5	S4B,S4N				
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*					SC		SC-2
Checker mallow	*Sidalcea neomexicana*							Sensitive
Colorado butterfly plant	*Gaura neomexicana*	LT	G3T2	S1			LC	
Oceanspray, rock spirea	*Holodiscus discolor*							Sensitive
Toothcup	*Rotala ramosior*		G5	S1			LC	
Tulip gentian, Showy prairie gentian	*Eustoma grandiflorum*					RP		Sensitive
Ute ladies'-tresses	*Spiranthes diluvialis*	LT	G2	S2		RP	LC	
Wild hops	*Humulus lupulus*							Sensitive
Nebraska Sedge Herbaceous Vegetation	*Carex nebrascensis* Herbaceous Vegetation		G4	S3				
Clustered Sedge Herbaceous Vegetation	*Carex praegracilis* Herbaceous Vegetation		G3G4	S2				
Ameican Mannagrass Herbaceous Vegetation	*Glyceria grandis* Herbaceous Vegetation		G2?	S2				
Western Snowberry Shrubland	*Symphoricarpos occidentalis* Shrubland		G4G5	S3				
Prairie Cordgrass Western Herbaceous Vegetation	*Spartina pectinata* Western Herbaceous Vegetation		G3?	S3				

Animals shown in black text , plants in green text.

Species shown with white background, Natural Communities shown with green.

Common name	Scientific Name	ESA	G-Rank	S-Rank	CDOW	Boulder County	BVCP	OSMP
Riparian Areas								
American elk	*Cervus elaphus nelsoni*							SC-X
American redstart	*Setophaga ruticilla*					SC	LC	SC-2
Bald eagle	*Haliaeetus leucocephalus*		G5	S1B,S3N	T		LC	SC-1
Black bear	*Ursus americanus amblyceps*							SC-1
Black-crowned night-heron	*Nycticorax nycticorax*					SC		SC-2
Brassy minnow	*Hybognathus hankinsoni*				T			SC-1
Brown thrasher	*Toxostoma rufum*					SC		SC-2
Common garter snake	*Thamnophis sirtalis parietalis*		G5S3		SC			SC-2
Common shiner	*Luxilus cornutus*				T		LC	SC-1
Cylindrical papershell	*Anodontoides ferussacianus*		G5	S2	SC		LC	SC-2
Fringed myotis	*Myotis thysanodes thysanodes*		G4G5	S3				SC-2
Gray catbird	*Dumetella carolinensis*					SC		SC-3
Great blue heron	*Ardea herodias*					SC		SC-2
Hops azure	*Celestrina humulus*		G2G3	S2			LC	SC-1
Lark sparrow	*Chondestes grammacus*							SC-X
Lazuli bunting	*Passerina amoena*							SC-3
Lewis' woodpecker	*Melanerpes lewis*		G4	S4		SC		SC-2
Long-eared owl	*Asio otus*					SC		SC-2
Mottled duskywing	*Erynnis martialis*		G3G4	S2S3			LC	SC-2
Mountain lion	*Felis concolor hippolestes*							SC-1
Northern leopard frog	*Rana pipiens*		G5	S3	SC			SC-1
Northern redbelly dace	*Phoxinus eos*		G5	S1	E		LC	SC-1
Olive-sided flycatcher	*Contopus cooperii*					SC		SC-2
Plains topminnow	*Fundulus sciadicus*						LC	SC-2
Preble's meadow jumping mouse	*Zapus hudsonius preblei*	LT	G5T2	S1	T		LC	SC-1
Snowy egret	*Egretta thula*		G5	S2B				
Spiny softshell	*Apalone spinifera hartwegi*							SC-3
Two-spotted skipper	*Euphyes bimacula*		G4	S2			LC	SC-2
Umbillicate sprite	*Promenetus umbilicatellus*							SC-2
Willow flycatcher	*Empidonax traillii*					SC		SC-2
Wood duck	*Aix sponsa*					SC		SC-3
Yellow warbler	*Dendroica petechia*							SC-X
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*					SC		SC-2

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Species shown with white background, Natural Communities shown with green.

Appendix G. Conservation Targets for OSMP Grasslands

(Excerpted from OSMP Grassland Ecosystem Management Plan)

Common name	Scientific Name	ESA	G-Rank	S-Rank	CDOW	Boulder County	BVCP	OSMP
Riparian Areas								
American groundnut	*Apios americana*		G5	S1		RP	LC	
Carrionflower	*Smilax lasioneuron*							Sensitive
Chaffweed	*Centunculus minimus*		G5	S1			LC	
Colorado butterfly plant	*Gaura neomexicana*	LT	G3T2	S1			LC	
Oceanspray, rock spirea	*Holodiscus discolor*							Sensitive
Pondweed	*Potamogeton diversifolius*		G5	S1				
Ute ladies'-tresses	*Spiranthes diluvialis*	LT	G2	S2		RP	LC	
Wild hops	*Humulus lupulus*							Sensitive
Narrowleaved Cottonwood / Bluestem Willow Woodland	*Populus angustifolia / Salix irrorata* Woodland		G2	S2				
Plains Cottonwood - (Peachleaf Willow) / Coyote Willow Woodland	*Populus deltoides - (Salix amygdaloides) / Salix (exigua, interior)* Woodland		G3G4	S3				
Skunkbush Intermittently Flooded Shrubland	*Rhus trilobata* Intermittently Flooded Shrubland		G2G3	S2				
White Rock Cliffs								
Barn owl	*Tyto alba*					SC		SC-3
Long-eared owl	*Asio otus*					SC		SC-2
Six-lined racerunner	*Cnemidophorus sexlineatus viridis*							SC-3
American groundnut	*Apios americana*		G5	S1		RP	LC	
Beebalm, horsemint	*Monarda pectinata*							Sensitive
Forktip three-awn	*Aristida basiramea*		G5	S1		RP	LC	
Spleenwort	*Asplenium adiantum-nigrum*		G5	S1		RP	LC	

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Appendix H. Conservation Targets for OSMP Forests

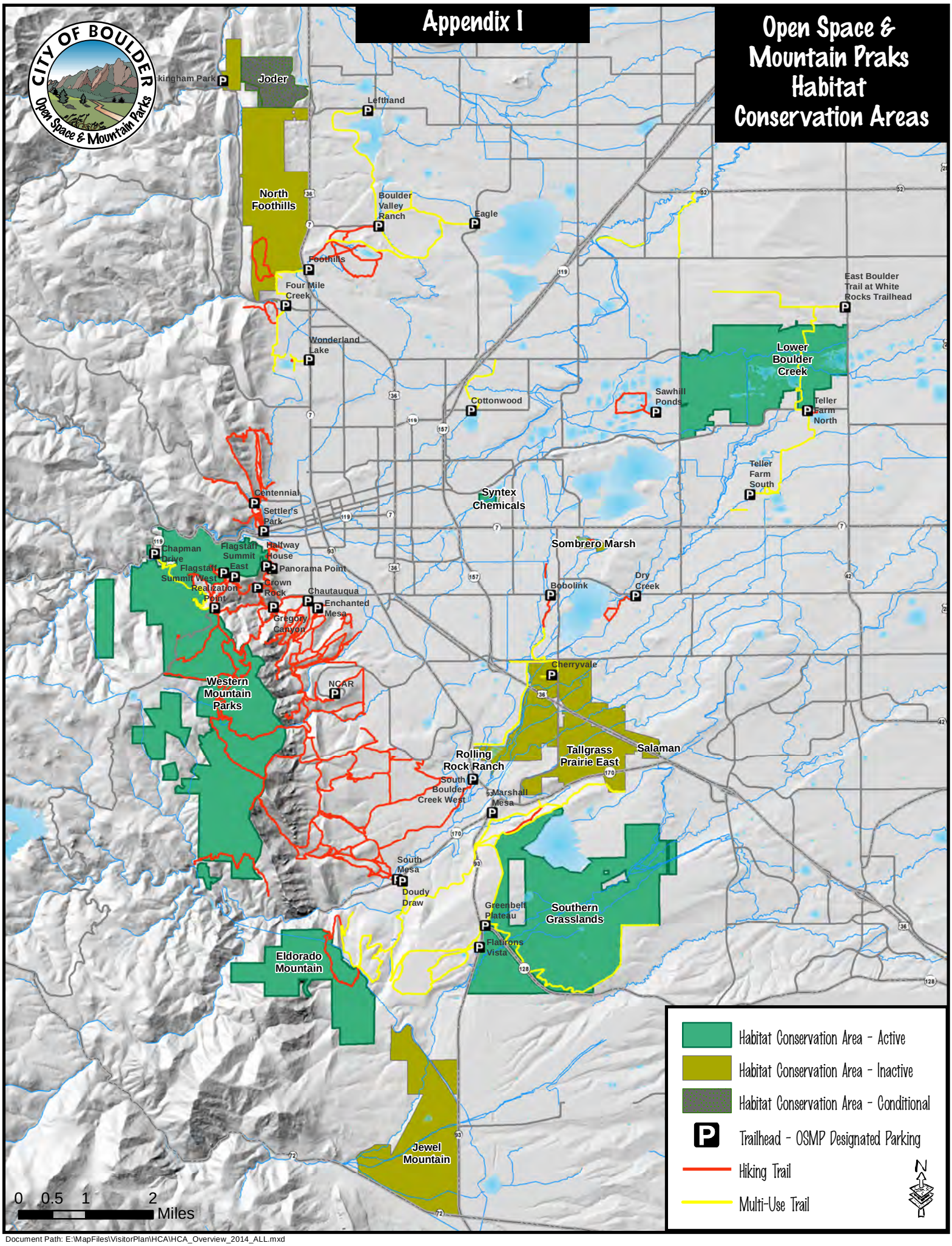
(Excerpted from the West Trail Study Area Inventory Report)

Conservation Target	Attribute	Indicator
Mixed Conifer Forests	Vegetation Composition	Coverage of weeds (Percentage of target with a prevalence of management priority weed species)
		Rare plants and communities (Size of populations of local suite of rare species and communities)
	Habitat Effectiveness	Northern goshawk habitat (Percent of target with highly suitable northern goshawk habitat)
Ponderosa Pine Woodlands and Savannahs	Vegetation Composition	Coverage of weeds (Percentage of target with a prevalence of management priority weed species)
		Rare plants and communities (Size of populations of local suite of rare species and communities)
	Habitat Effectiveness	Abert's squirrel habitat (Percentage of target with highly suitable Abert's squirrel habitat)
Cliffs and Talus	Vegetation Composition	Rare plants and communities (Size of populations of local suite of rare species and communities)
	Habitat Effectiveness	Protection of raptor nest sites (Percent of highly suitable falcon nest sites protected)

Target	Attribute	Indicator
Foothills and Montane Riparian Areas	Vegetation Composition	Rare plants and communities (Size of populations of local suite of rare species and communities)
		Coverage of weeds (Percentage of target with a prevalence of management priority weed species)
	Habitat Effectiveness	Bear habitat quality (Trail density in seasonally critical bear foraging habitat)
		Shrub-nesting bird habitat (Percentage of target with highly suitable shrub-nesting bird habitat)
	Habitat Connectivity	Riparian fragmentation (Density of roads and trails within 100m of riparian areas)
Foothills and Montane Forest Openings	Vegetation Composition	Rare plants and communities (Size of populations of local suite of rare species and communities)
		Coverage of weeds (Percentage of target with a prevalence of management priority weed species)
	Habitat Effectiveness	Wild turkey habitat (Percent of target with highly suitable wild turkey habitat)

Appendix I

Open Space & Mountain Praks Habitat Conservation Areas



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	NON-NATIVE / INVASIVE SPECIES Common Name	Scientific Name	STATE DESIGNATION	Boulder County Eradatication Requirements	Public Road, Parking/ Waterway Eradication Requirements	PRESENT ON OSMP	CONSIDERED FOR ACTIVE MANAGEMENT	TOTAL	2004 Bo. Co. Wd Mgt Plan Spec .	CO. MGT	Species Profile
1	Absinth wormwood	*Artemisia absinthium*	B+	County Wide	Public Road, Parking	Yes	Yes	1		X	x
2	African rue	*Peganum harmala*	A						A		
3	Bermudagrass	*Cynodon dactylon*				Yes	Yes	1			
4	Black henbane	*Hyoscyamus niger*	B+	County Wide		Watch					
5	Black locust	*Robinia pseudoacacia*				Yes	Yes	1			
6	Bladder senna	*Colutea arborescens*				Yes	Yes	1		X	x
7	Bohemian knotweed	*Polygonum bohemica*	A			Yes	Yes	1		X	x
8	Bouncingbet	*Saponaria officinalis*	B+	County Wide	Pub Rd, Pking/ W-ways	Yes	Yes	1		X	x
9	Bull thistle	*Cirsium vulgare*	B+	West of 93/Broadway/36	Public Road/ Parking	Yes	Yes	1	B		
10	Camelthorn	*Alhagi pseudalhagi*	A						A		
11	Canada thistle	*Cirsium arvense*	B			Yes	Yes	1	B	X	x
12	Cattail	*T. angustifolia & x glauca*				Yes	Yes	1		X	x
13	Cheatgrass	*Bromus tectorum*	C			Yes	Yes	1		X	x
14	Chicory	*Cichorium intybus*	C			Yes	Yes	1		X	x
15	Chinese clematis	*Clematis orientalis*	B+	County Wide	X	Watch					
16	Common buckthorn	*Rhamnus cathartica*				Yes	Yes	1			x
17	Common Bugloss	*Anchusa officinalis*	Watch			Yes	Yes	1			
18	Common burdock	*Arctium minus*	C			Yes	Yes	1			
19	Common crupina	*Crupina vulgaris*	A						A		
20	Common mullein	*Verbascum thapsus*	C			Yes	Yes	1		X	x
21	Common reed	*Phragmities australis var australis*				Yes	Yes	1			
22	Common tansy	*Tanacetum vulgare*	B+	County Wide exc. far west	X	Yes	Yes	1		X	x
23	Common teasel	*Dipsacus fullonum*	B +	West of 93/Broadway/36	Pub Rd, Pking/ W-ways	Yes	Yes	1	B	X	x
24	Corn chamomile	*Anthemis arvensis*	B								
25	Cotoneaster					Yes	Yes	1		X	x
26	Crack Willow	*Salix Fragilis*				Yes	Yes	1			
27	Creeping buttercup	*Ranunculus repens*				Yes	Yes	1			
28	Crown vetch	*Securigera [Coronilla] varia*				Yes	Yes	1		X	x
29	Cutleaf teasel	*Dipsacus laciniatus*	B+	County Wide	X	Yes	Yes	1		X	x
30	Cypress spurge	*Euphorbia cyparissias*	A						A	X	
31	Dalmatian toadflax	*Linaria genistifolia subsp. dalmatica*	B +	Far western Boulder Co	Public Road, Parking	Yes	Yes	1	B	X	x
32	Dame's rocket	*Hesperis matronalis*	B +		Pub Rd, Pking/ W-ways	Yes	Yes	1		X	x
33	Diffuse knapweed	*Centaurea diffusa*	B+	Far western Boulder Co	Public Road, Parking	Yes	Yes	1	B	X	x
34	Dyer's woad	*Isatis tinctoria*	A			Watch/Pks			A		
35	Elongated mustard	*Brassica Elongata*	A								
36	Eurasian watermilfoil	*Myriophyllum spicatum*	B			Yes	Yes	1		X	x
37	European barberry	*Berberis vulgaris*				Yes	Yes	1			
38	European privet	*Ligustrum vulgare*				Yes	Yes	1			x
39	Field bindweed	*Convulvulus arvensis*	C			Yes	Yes	1		X	
40	Garden loosestrife	*Lysimachia vulgaris*				Yes					x
41	Garlic mustard	*Alliaria petiolata*	Watch			Yes	Yes	1		X	x
42	Giant knotweed	*Polygonum sachalinense*	A			Watch-S.Den					
43	Giant reed	*Arundo donax*	A			No					
44	Giant salvinia	*Salvinia molesta*	A						A		
45	Green Ash	*Frazinus pennsylvanica var.*				Yes	Yes	1			
46	Hairy willow-herb	*Epilobium hirsutum*	Watch			Yes	Yes	1		X	x
47	Halogeton	*Halogeton glomeratus*	C								
48	Himalayan blackberry	*Rubus armeniacus*	Watch			Yes					
49	Hoary cress	*Cardaria draba*	B+	Far western Boulder Co	Pub Rd, Pking/ W-ways	Yes	Yes	1		X	x
50	Honeysuckle	*lonicera morrowii* and l. *tatarica*				Yes	Yes	1			x
51	Houndstongue	*Cynoglossum officinale*	B+	Far western Boulder Co	Public Road, Parking	Yes	Yes	1	B	X	x
52	Hydrilla	*Hydrilla verticillata*	A						A		
53	Japanese barberry	*Berberis vulgaris*				Yes	Yes	1			x
54	Japanese blood grass	*Imperata cylindrica*	Watch								
55	Japanese brome	*Bromus japonicus*				Yes					
56	Japanese knotweed	*Polygonum cuspidatum*	A			?	Yes	1		X	x
57	Jointed goatgrass	*Aegilops cylindrical*	B+	Far western OSMP?	Public Road, Parking	Yes	Yes	1		X	x
58	Honeylocust	*Gleditsia triacanthos*				Yes	Yes	1		X	x
59	Kochia	*Kochia scoparia*				Yes	Yes	1		X	
60	Leafy spurge	*Euphorbia esula*	B +	Far western Boulder Co	Pub Rd, Pking/ W-ways	Yes	Yes	1	B	X	x
61	Mayweed chamomile	*Anthemis cotula*	B								
62	Meadow hawkweed	*Hieracium pratense*	Watch								
63	Meadow knapweed	*Centaurea pratensis*	A						A		
64	Mediterranean sage	*Salvia aethiopis*	A			Yes	Yes	1	A	X	x
65	Medusahead	*Taeniatherum caput-medusae*	A						A		
66	Moth mullein	*Verbascum blattaria*	B +	Far western OSMP?	Public Road, Parking	Yes	Yes	1		X	
67	Musk thistle	*Carduus nutans*	B		Pub Rd, Pking/ W-ways	Yes	Yes	1	B	X	x
68	Myrtle spurge	*Euphorbia myrsinites*	A			Yes	Yes	1	A		x
69	Onionweed	*Asphodelus fistulosus*	Watch								
70	Orange hawkweed	*Hieracium aurantiacum*	A			Yes	Yes	1	A	X	x
71	Oxeye daisy	*Chrysanthemum leucanthemum*	B +	East of 93/Broad/36 + far	Public Road, Parking	Yes	Yes	1		X	x
72	Perennial pepperweed	*Lepidium latifolium*	B+	West of 93/Broadway/36	Public Road, Parking	Yes	Yes	1		X	x
73	Perennial sowthistle	*Sonchus arvensis*	C			Yes	Yes	1		X	x
74	Perennial sweetpea	*Lathyrus latifolius*				Yes	Yes	1			x
75	Plumeless thistle	*Carduus acanthoides*	B+	County Wide	X	Watch					
76	Poison hemlock	*Conium maculatum*	C			Yes	Yes	1		X	
77	Puncturevine	*Tribulus terrestris*	C			Yes				X	
78	Purple loosestrife	*Lythrum salicaria*	A			Yes	Yes	1	A	**X**	x
79	Quackgrass	*Elytrigia repens*	B			Yes	Yes	1			
80	Queen of the Meadow	*Filipendula ulmaria*				Yes	Yes	1			x
81	Red horned poppy	*Glaucium corniculatum*				Yes					
82	Redstem filaree	*Erodium cicutarium*				Yes					
83	Reed canarygrass	*Phalaris arundinacea*				Yes	Yes	1			x
84	Rush skeletonweed	*Chondrilla juncea*	A			Watch/			A	**X**	
85	Russian knapweed	*Acroptilon repens*	B+	West of 93/Broadway/36	Pub Rd, Pking/ W-ways	Yes	Yes	1	B	X	x
86	Russian-olive	*Elaeagnus angustifolia*	B			Yes	Yes	1		X	x

	NON-NATIVE / INVASIVE SPECIES Common Name	Scientific Name	STATE DESIGNATION	Boulder County Eradatication Requirements	Public Road, Parking/ Waterway Eradication Requirements	PRESENT ON OSMP	CONSIDERED FOR ACTIVE MANAGEMENT	TOTAL	2004 Bo. Co. Wd Mgt Plan Spec .	CO. MGT	Species Profile
87	Salt cedar	*Tamarix chinensis, T. parviflora, and T. ramosissima*	B+			Yes	Yes	1	B	X	x
88	Scentless chamomile	*Matricaria perforata*	B +		Pub Rd, Pking/ W-ways	Watch/ Bison				X	
89	Scotch Broom	*Cytisusscoparius*	Watch								
90	Scotch thistle	*Onopordum acanthium, O. tauricum*	B			Yes	Yes	1	B	X	x
91	Sericea lespedeza	*Lespedeza cuneata*	Watch								
92	Siberian elm	*Ulmus pumila*				Yes	Yes	1			
93	Spotted knapweed	*Centaurea maculosa*	B+	County Wide	X	Yes	Yes	1	B+	X	x
94	Spurred anoda	*Anoda cristata*	B								
95	Squarrose knapweed	*Centaurea virgata*	A						A		
96	Sulfur cinquefoil	*Potentilla recta*	B+		Public Road, Parking	Yes	Yes	1		X	x
97	Swainsonpea	*Sphayerophysa salsula*	Watch								
98	Syrian beancaper	*Zygophyllum fabago*	Watch								
99	Tall oatgrass	*Arrhenatherum elatius*				Yes	Yes	1			x
100	Tansy ragwort	*Senecia jacobaea*	A						A		
101	Tree of Heaven	*Ailanthus altissima*				Yes	Yes	1		X	x
102	Venice mallow	*Hibiscus trionum*	B								
103	Water Hyacinth	*Eichhomia crasshipes*	Watch								
104	Water lettuce	*Pistia stratites*	Watch								
105	Wayfaring Tree	*Viburnum lantana*				Yes	Yes	1			x
106	White bryony	*Brionia alba*	Watch								
107	White campion	*Silene alba*				Yes	Yes	1			x
108	White Horehound	*Marrubium vulgare*				Yes	Yes	1			
109	Wild caraway	*Carum carvi*	B								
110	Wild four o'clock *	*Mirabilis nyctaginea*	B+			Yes					
111	Wooly distaff thistle	*Carthamuslanatus*	Watch								
112	Yellow iris	*Iris pseudacorus*				Yes	Yes	1		X	x
113	Yellow nutsedge	*Cyperus esculentus*	B								
114	Yellow starthistle	*Centaurea solstitialis*	A			Watch/Broo			A	**X**	x
115	Yellow toadflax	*Linaria vulgaris*	B +	East of 93/Broadway/36	Public Road, Parking	Yes	Yes	1	B	X	x
	Animal Species							70			
	Bullfrog	Rana catesbeiana				Yes					
	New Zealand mud snails	Potamopyrgus antipodarum				Yes					
	Rusty crawfish	Orconectes rusticus				No					

NOTES

State Designations:

A = Eradication mandated.

"**B+**" = Eradication mandated unless otherwise noted in the state management plan for this species.

B = State currently developing management plans. Management to stop spread recommended until plan developed.

C = State will develop management plans to assist local governing bodies that choose to require management.

State Watch list species are invasive species that are not currently known to occur in the State, but are present adjacent to the State (or known to be/have been found in Boulder County)

Additional State Rules (pertaining to spread)

Public Road, Parking: Mandatory eradication of "All populations in this state that are within 15 feet from the edge of any public road and any immediately adjacent area used for parking must be eliminated prior to seed development in,,,"

Waterway: Mandatory eradication of "All populations in this state that are within the area from the center of any intermittent or perennial stream or river to 15 feet beyond the ordinary high watermark on both banks must be eliminated prior to seed development in ,,,."

Other

OSMP Watch list species are invasive species that are not currently known on OSMP lands, but are or have been present within the County or Front Range

Also included in the list are some (not all) non-native species that are found on OSMP but are not on the state list. OSMP staff have concerns about the potential threat these species pose and are monitoring them for expansion.

* = Native in parts of North America, but considered invasive in some states.

Adapted from Dinosaur National Monument Invasive Plant Management Plan & Environmental Assessment, October 2005.

Appendix K

New Zealand Mudsnail Spread Prevention (2006)

City of Boulder Open Space and Mountain Parks spread prevention methods entail placing boots in a small plastic tub and spraying boots down with 409 until they are thoroughly saturated. The boots are then scrubbed with a brush (especially the tread). The 409 wash is collected from the tub and strained back into the dispenser bottle for re-use. Please also see the web link below with a cleaning protocol from Oregon:

Prevention guide for New Zealand mudsnails (North America)
From: Mandy Tu (imtu (at) tnc.org)

The tiny New Zealand mudsnail (*Potamopyrgus antipodarum)* has greatly expanded its range in brackish and freshwaters over the last 10 years. The best way to slow its rate of spread is to prevent the transport of NZMS on your equipment and field gear. See this new prevention guide produced by The Nature Conservancy staff in Oregon:

Low Resolution: http://seagrant.oregonstate.edu/sgpubs/onlinepubs/g06006_lowres.pdf
High Resolution: http://seagrant.oregonstate.edu/sgpubs/onlinepubs/g06006_highres.pdf

New Zealand Mudsnail Closure

Due to confirmed presence of New Zealand Mudsnail (NZMS), these areas are CLOSED TO ALL USE until further notice.

Appendix L

NZMS Closure Area

P Open Space Trailhead (with parking)

Trail Managed By OSMP

- Hiking Trail
- Multi-Use Trail
- OSMP Land
- No Public Access
- Habitat Conservation Area (HCA) OFF-TRAIL permit required AT ALL TIMES - www.osmppermits.org

0 1 Miles

For up to date information call 303-441-3440 during business hours or log onto www.osmp.org

Document Path: E:\MapFiles\Regulatory\Wildlife Closures\MAPS\New_Zealand_Mudsnail_Overview.mxd

Appendix M

Trail Design & Management Guidelines Matrix

		X-Slope Range	Tread Width	Max. Sustained Grade	Max. Sustained Outslope	Clearing		Turn Radius	Surface Materials					
						Width	*Height*		*Natural*	*Gravel*	*Crusher*	*Roadbase*	*Concrete*	*Asphalt*
Accessible		0-50%	>=3'	8.33%	<2%	8'	8'	4'	ok	No	ok	ok	ok	ok
Class 5 *Fully Developed*	Hiking	0-30%	3-5'	8%	<=5%	6'	8'	2'	ok	ok	ok	ok	ok	ok
	Biking	0-30%	3-8'	8%	<=5%	10'	10'	6'	No	ok	ok	ok	ok	ok
	Equestrian	0-30%	3-8'	8%	<=5%	10'	10'	8'	No	ok	ok	ok	No	No
	Official Vehicle	N/A	*8-10'*	8%	<= 8%	28-40'	12'	10-12'	No	ok	ok	ok	ok	ok
Class 4 *Highly Developed*	Hiking	0-50%	2.5-5'	10%	<=5%	6'	8'	2'	ok	ok	ok	ok	No	No
	Biking	0-50%	3-8'	8%	<=5%	6-10'	10'	6'	ok	ok	ok	ok	No	No
	Equestrian	0-50%	3-8'	8%	<=5%	6-10'	10'	8'	ok	ok	ok	ok	No	No
	Official Vehicle	N/A	*8-10'*	6%	<= 6%	28'	12'	10-12'	No	ok	ok	ok	ok	ok
Class 3 *Developed/ Improved*	Hiking	0-75%	1.5-3'	15%	<= 8%	4-6'	8'	2'	ok	ok	ok	ok	No	No
	Biking	0-75%	1.5-5'	12%	<=5%	4-6'	10'	6'	ok	ok	ok	ok	No	No
	Equestrian	0-75%	1.5-6'	12%	<=5%	6'	10'	8'	ok	ok	ok	ok	No	No
	Official Vehicle	N/A	*8-10'*	6%	<=5%	12'	10'	10-12'	ok	ok	ok	ok	No	No
Class 2 *Minor Development*	Hiking	0-75%	1.5-2.5'	15%	<=10%	4'	8'	2'	ok	No	No	No	No	No
	Biking	0-75%	1.5-3'	12%	<= 8%	4-6'	10'	6'	ok	No	No	No	No	No
	Equestrian	0-75%	1.5-2.5'	12%	<= 8%	6'	10'	8'	ok	No	No	No	No	No
	Official Vehicle	N/A	*8-10'*	5%	<=5%	10'	10'	10-12'	ok	N/A	No	No	No	No
Class 1 *Primitive/ Undeveloped*	Hiking	0-90%	1.5-2'	15%	<=10%	N/A	N/A	2'	ok	No	No	No	No	No
	Biking	0-90%	1.5-2'	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	No	N/A	N/A
	Equestrian	0-90%	1.5-2'	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	No	N/A	N/A
	Official Vehicle	N/A	*8-10'*	4%	<= 3%	N/A	N/A	10-12'	ok	N/A	No	No	No	No
Climbing Access	Climbing	N/A	0-2'	N/A	<=15%	N/A	N/A	N/A	ok	No	No	No	No	No

Trail Design Parameters provide guidance for the assessment, survey and design, construction, repair and maintenance of trails, based on the Trail Class and Designed Use of the trail.

Exceptions and variances to these parameters can occur when site-specific circumstances demand such exceptions. These exceptions should be noted in the TMO for the trail.

* Accessible is currently a separate Trail Class. If assessing/designing trails for accessibility, refer to current Agency trail accessibility guidance.

Finalized 12/04/07

Appendix N. Wildlife Seasonal Closure Timeline

Taxa	Area	Dates	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Bald Eagle	Kolb/Weiser, Coal Creek	11/1 - 7/31	■	■	■	■	■	■	■				■	■
Osprey	Axelson, Sawhill	3/15 - 9/10				■	■	■	■	■	■			
Burrowing Owl	Map on website	3/15 - 10/31				■	■	■	■	■	■	■		
Bats	Harmon, Mallory Cave	Year-round	■	■	■	■	■	■	■	■	■	■	■	■
Bats	Der Zerkle	4/1 - 9/1				■	■	■	■	■				
Cliff-nesting Raptors	Map on website	2/1 - 7/31		■	■	■	■	■	■					
Grassland Birds	Map on website	5/1 - 7/31					■	■	■					
Shrub-nesting Birds	Consult Wildlife Ecologist	5/1 - 7/31					■	■	■					
Prebles meadow jumping mouse- active, restrict activities in occupied habitat	Consult Wildlife Ecologist- riparian areas, ditches	5/1-10/31					■	■	■	■	■	■		
Prebles meadow jumping mouse- hibernation, avoid shrub/tree removal in occupied habitat	Consult Wildlife Ecologist- riparian areas, ditches	8/1-6/1	■	■	■	■	■			■	■	■	■	■
New Zealand Mudsnail	Portions of Boulder Creek and Dry Creek east of Baseline Reservoir	Year-round	■	■	■	■	■	■	■	■	■	■	■	■

Note that closures may change or may be added for new species, and therefore consultation with an OSMP wildlife ecologist and/or the closure information posted on the OSMP website is advised in addition to use of this table.