

Trail Condition Monitoring

Boulder Open Space and Mountain Parks

North Trail Study Area



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Prepared by Donna Middleton, Jake Cseke, Mark Gershman and Jennifer Sherry





North Trail Study Area Trail Condition Monitoring Report

Background & Intent

Boulder's Open Space and Mountain Parks (OSMP) department manages over 140 miles of designated trails. OSMP lands receive an estimated 5.3 million visits each year (OSMP 2005). Trends indicate that visitation will continue to increase into the future (OSMP 2004). Increasing levels of use could impact the trail system, affect the quality of the visitor experience, and alter the condition of natural resources.

One of the goals of the OSMP Visitor Master Plan's (VMP) is to ensure that the designated trail system provides a high quality visitor experience while protecting and preserving environmental resources. To achieve this goal, it is essential to provide and maintain a sustainable trail system. The VMP calls for annual designated trail condition monitoring.

The purpose of this monitoring project is to assess the compliance of our trail system with sustainability standards (Attachment A). Trail condition monitoring identifies unsustainable trail segments, documents the location and condition of constructed features and provides management recommendations or prescriptions for trail maintenance and sustainability.

This monitoring report provides managers with information to allocate staffing and resources strategically, and to prioritize trail maintenance projects. Trail monitoring will also describe the condition of trails and trail features, enabling managers to document and communicate the extent and location of regular trail maintenance needs. This information can be used in conversations with the Open Space Board of Trustees, City Council and interested members of the community.

Methods¹

Trails were divided into segments based upon their combined *trail class* and *designed use*. Trail class refers to a trail's level of development and designed use refers to the allowed use on the trail which controls how it is designed, built and maintained. Each segment was visited in the field. OSMP staff measured trail parameters and compared the measurements to trail standards for a given

¹ A detailed protocol for trail condition monitoring is available upon request from the OSMP department.

trail class and designed use. Those sections of the trail out of compliance with standards require maintenance or, in some cases, more significant response such as reconstruction.

In addition to measuring parameters related to the trail standards, OSMP also collected information about other maintenance issues such drainage problems, erosion and trail braiding. These were detected by direct observation of evidence such as muddy areas, gullies and loose rocks. The department has no standards for erosion, drainage problems or trail braiding because they are unacceptable wherever they occur and therefore require maintenance.

For ease of communication, the term “area of concern” refers to portions of trail that are either out of compliance or exhibit maintenance issues. The following list contains the indicators that were monitored to identify areas of concern.

Trail Parameters Related to Design Standards	Maintenance Issues
Trail grade	Drainage
Tread width	Erosion
Outslope	Braiding
Clearing width, height	
Surface material	
Turn radius	

Staff also inventoried and evaluated constructed features as part of this project. Constructed features are human-made structures designed to help maintain a trail’s sustainability, by diverting water, retaining sediment, or raising the level of the tread. Examples include retaining walls, turnpikes, bridges, waterbars, steps, or culverts. Constructed features condition classes are described in Table 1.

Table 1: Condition Classes and Descriptions for Constructed Features

Condition Class	Description
Routine Maintenance	Feature is FUNCTIONING WITHIN STANDARD as designed and is within normal maintenance cycle (generally at a cost of less than 20% of replacement)
Repair/Rehab	Feature is in DISREPAIR , may or may not be useable, but needs to be repaired to bring feature to standard (generally at a cost between 21% & 50% of replacement)
Replace in-kind	Feature is DYSFUNCTIONAL and beyond it’s designed lifecycle or has deteriorated to a point where unable to perform as designed or constructed (generally at a cost of over 51% of new construction and includes demolition and removal of existing)
Decommission	Feature is NOT NEEDED for the operation of the trail or is inappropriate for the setting and should be removed from system with no replacement planned.
Expansion	Feature is basically functioning as designed but is UNDERSIZED . Would typically be lengthened or widened, but in some cases size may be reduced.
Alter Function	Modify feature to CHANGE FUNCTION to either increase capacity, change function, or durability.
Install New	NEW Feature is needed.

Trail condition monitoring was conducted in the **North Trail Study Area (TSA)** (see Figure 1) during October and November of 2007. Extensive database development time for this project was a one-time cost shared across all TSAs. Estimates of time to complete monitoring are given below:

Preparation:	45 days - Trails Management Framework and Protocol development (one time) 4 days - Data dictionary and TMO (standards) development (one time) <hr/> Subtotal: 49 days
Fieldwork:	11 days - Survey North TSA (18 trails - 19 miles) <hr/> Subtotal: 11 days
Post-processing:	2 days - GPS export to GIS, editing 5 days - GIS map production 1 day - database reporting <hr/> Subtotal: 8 days
GRAND TOTAL	68 days = 13 weeks inclusive 19 days for North TSA specific work

Trail Condition Monitoring - Designated Trails Surveyed North Trail Study Area

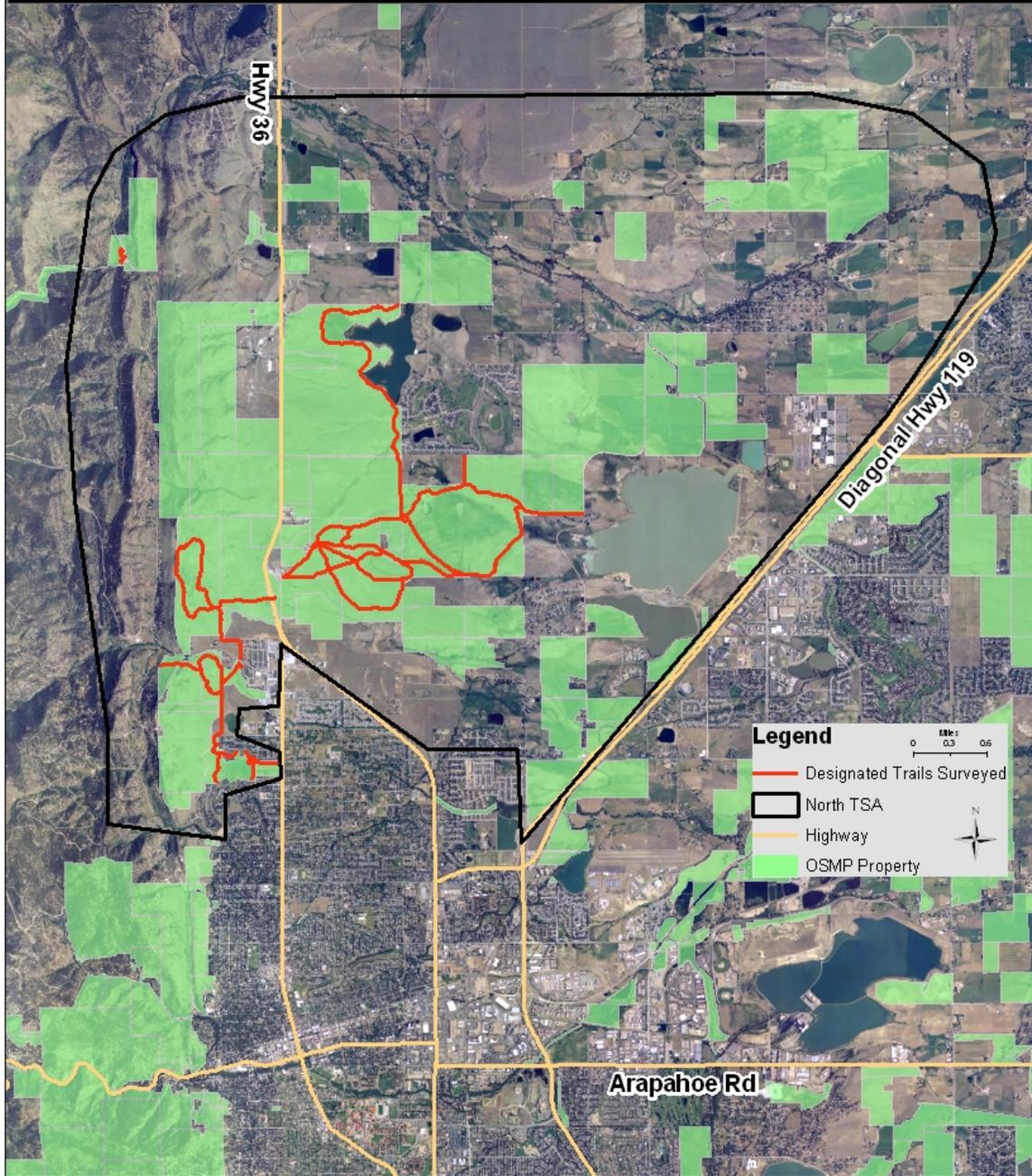


Figure 1: Designated trails surveyed for trail condition monitoring in North TSA.

Results

Trail Condition

Nineteen miles of trail were surveyed in the North TSA. Approximately thirteen percent of the trail system identified as either out of compliance with standards or exhibiting other maintenance issues. These areas of concern total about 12,565 feet or 3,830 meters (2.4 miles). The trail with the highest percentage of non-compliant/maintenance issues is the Old Mill Trail. Maps showing the location and extent of areas of concern in the North TSA are included as Attachment B. Details about the areas of concern are included in Attachment C.

Tables 2 and 3 show the percentages of areas of concern for **trails** and **trail segments** within the North TSA.

Table 2: Areas of concern for each **trail** in the North TSA. *The shaded areas in tables 2 and 3 identify trails with less than five percent of their length in undesirable condition.*

Trail Name	% of Total Trail Length with Areas of Concern
Old Mill	100%
Old Kiln	35%
Foothills - Wonderland Lake Spur	28%
Hogback Ridge	21%
Old Kiln Spur	16%
Lefthand	14%
Foothills North	13%
Eagle	11%
Foothills South	10%
Wonderland Lake	10%
North Rim	9%
Buckingham Park	8%
Mesa Reservoir	6%
Degge	6%
Sage	6%
Cobalt	4%
Hidden Valley	3%
Foothills Spur	0%

Table 3: Areas of concern for each **trail segment** in the North TSA.

Trail Name	Trl Seg ID	% of Trail Segment Length with Areas of Concern
Old Mill	413.01	100%
Wonderland Lake	407.05	78%
Old Kiln	404.01	35%
Foothills-Wonderland La	406.01	28%
Wonderland Lake	407.04	27%
Hogback Ridge	402.02	26%
Buckingham Park	417.02	26%
Eagle	410.02	23%
Buckingham Park	417.03	19%
Old Kiln Spur	405.01	16%
Hogback Ridge	402.01	15%
Eagle	410.04	15%
Lefthand	408.01	14%
Sage	409.03	14%
Foothills North	401.01	13%
Wonderland Lake	407.01	12%
Foothills South	403.01	10%
North Rim	411.01	9%
Eagle	410.01	8%
Sage	409.02	7%
Mesa Reservoir	415.01	6%
Degge	416.01	6%
Eagle	410.03	5%
Wonderland Lake	407.02	4%
Cobalt	412.01	4%
Buckingham Park	417.04	4%
Wonderland Lake	407.03	3%
Hidden Valley	414.01	3%
Buckingham Park	417.01	3%
Sage	409.01	2%
Foothills Spur	418.01	0%

Figure 1 shows the factors most responsible for non-compliance with standards. Figure 2 shows the relative proportion of different types of maintenance issues.

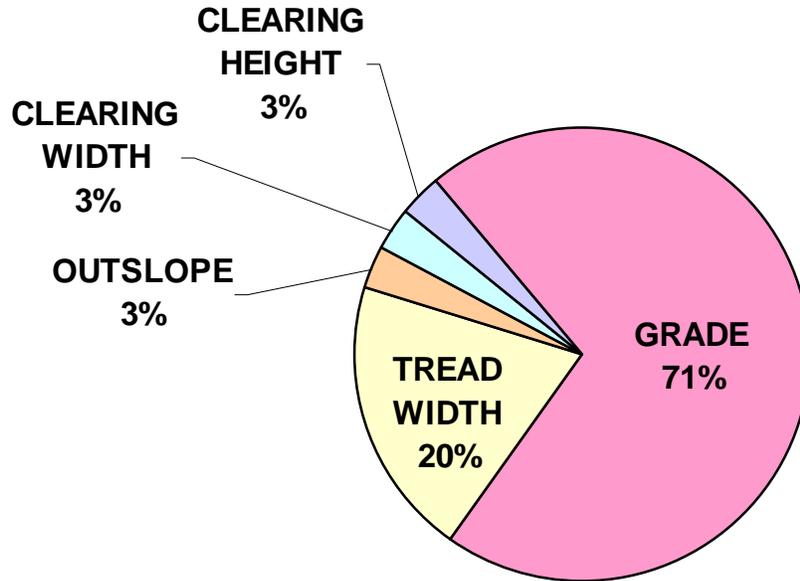


Figure 2: Contribution of various trail sustainability factors to **non-compliance** in the North TSA. (total distance of trail out of compliance = 2,653ft or 809m)

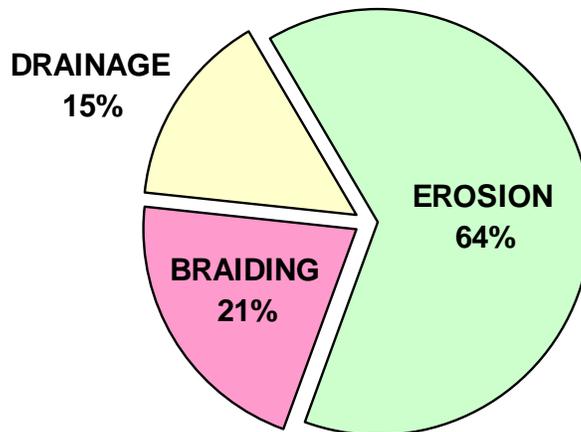


Figure 3: Contribution of various **maintenance issue** categories in the North TSA. (total distance of trail with maintenance issues = 965ft or 294m)

Constructed Features

Figure 3 shows the condition class distribution of the 735 constructed features associated with trails in the North TSA. Three fourths of the features are functioning within standard. Maps showing the location and condition of constructed features in the North TSA are included as Attachment D. Details about the constructed features are included in Attachment C.

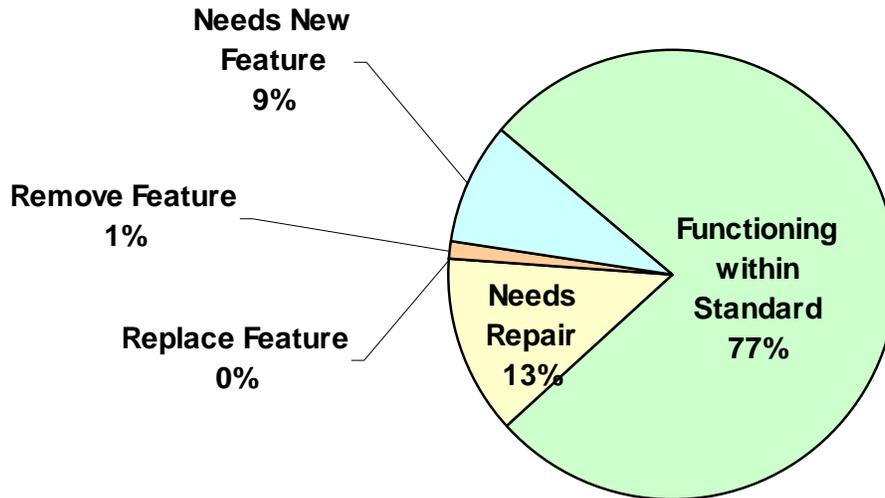


Figure 4: Condition class of constructed features in the North TSA.

Discussion

North Trail Study Area

Trail condition

All designated trails in the North TSA were surveyed (19 miles). Thirteen percent of this trail system is either out of compliance with standards or exhibiting other maintenance issues. Taken together these two categories are referred to as areas of concern.

The Old Mill Trail is exhibiting areas of concern for 100 percent of its length (1,115 ft). This trail is barely visible at its beginning and end locations due to overgrown vegetation from lack of maintenance and/or use. Other issues with this trail are steep grades and extensive erosion problems. Two sections of this trail have become huge gullies.

The Old Kiln Trail has a third of its length exhibiting areas of concern. Certain sections on the north side have steep grades and erosion issues. These sections might require a reroute to achieve sustainability.

The Hogback Ridge Trail has twenty-one percent of its length exhibiting areas of concern. This is due to the significant amount of steep grades located on this trail. To address this issue, hundreds of log and rock steps were installed, as well as a significant amount of erosion control structures. Nevertheless, there are a few small sections that might need re-alignment to achieve sustainability.

The Foothills North and South Trails, the Lefthand Trail, the Eagle Trail, and the Wonderland Lake Trail all exhibit high percentages in areas of concern.

The Lefthand Trail has extensive erosion, drainage, and braiding issues. This might be due to the sandy substrate found on this trail and low angle of the surrounding side slope.

Most of the trail segments in the North TSA have sustainable designs and should require only routine maintenance. The following are recommended trail reroutes or major re-construction locations.

1. The Old Mill Trail will need considerable time and effort to address its problems. The trail is hardly visible in some places, one section is located in a gully, and one section reaches a grade of 20 percent. A reroute would be necessary to achieve sustainability.
2. Sections of the Old Kiln Trail have steep grades, trail braiding and severe erosion problems on the north side of this trail. Erosion control structures were installed in the past to address the steep grade but have failed to mitigate problems. A new trail braid has formed. Either major re-construction or a reroute is necessary to address these continuing issues.
3. A section on the Foothills North Trail has a grade of 30 percent. Erosion and widening of the trail is also occurring. A reroute is recommended in this section.
4. A section of the Foothills South Trail has grades of almost 20 percent. Erosion is occurring despite erosion control structures in place. A reroute or re-alignment might be necessary for this section as volumes of use are high on this trail creating high impact.
5. The Lefthand Trail has a couple sections that might need re-aligning to achieve sustainability. The trail is located in a couple gullies making it nearly impossible to divert run-off. Locating these sections on higher ground with the installation of erosion control structures might be a solution.

6. The Wonderland Lake Trail is out of compliance in several categories and several areas. The loop going near the water will need extensive maintenance to comply with Accessible standards – as wheelchair accessible is the designed use for this trail. Also, a short re-alignment might be necessary at the southern end of the dam to mitigate a grade issue.

Types of Non Compliance/Maintenance Issues

Trail grade was responsible for almost three-fourths of the non-compliant portions while erosion contributed to over half of the maintenance issue portions. This is not surprising, as erosion is more likely to occur where grades are steeper and run-off is moving more rapidly. Also, the sandy soils underlying these trails could be a major reason for the extensive erosion problems.

Constructed Features

Three fourths of the 735 constructed features associated with trails in the North TSA are functioning within standard. The most common features in need of repair are drain dips and culverts, which will require extensive cleaning to regain proper function. Approximately 60 drain dips are recommended to be installed to assist with grade or erosion issues associated with certain trail segments.

Attachments

- A. Trail Design Standards
- B. Maps of Areas of Concern in the North TSA
- C. Details About Areas of Concern and Constructed Features in the North TSA
- D. Maps of Constructed Features in the North TSA

Literature Cited:

City of Boulder Open Space and Mountain Parks (OSMP). 2005 Visitor Master Plan. Accessed. 6/19/2007.
