Eldorado Mountain/Doudy Draw Trail Study Area
Sustainable Recreation Monitoring

Trail Condition Monitoring
in the Spring Brook/Goshawk Ridge Area

2008-2010 Monitoring Report

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September 26, 2011

Acknowledgments

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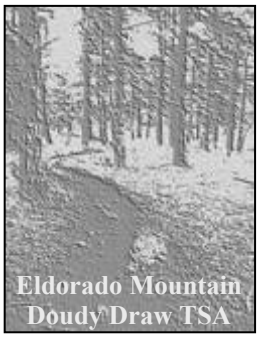

Eldorado Mountain
Doudy Draw TSA

Executive Summary

In 2010, the City of Boulder Open Space and Mountain Parks (OSMP) Department completed three years of monitoring associated with two new trails, Spring Brook Loop and Goshawk Ridge Trail in the Eldorado Mountain/Doudy Draw Trail Study Area (EM/DD-TSA). These monitoring efforts included projects that evaluated the sustainability of designated trails under new visitor activities and an assessment of the reduction in the extent and severity of undesignated trails in the surrounding area. This document presents the results of three related monitoring projects:

1. Goshawk Ridge Trail – Trail Condition
2. Goshawk Ridge Trail – "Segment Two" Condition
3. Spring Brook Loop and Goshawk Ridge Trail - Undesignated Trails

For the three projects, staff measured trail tread conditions at 100-foot intervals along designated and undesignated trails prior to the opening of new trails for visitor travel (baseline data) and at least annually for 2 years afterwards.

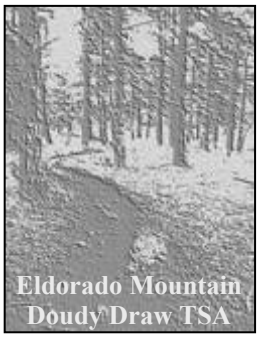
Results presented in this report will be used by OSMP managers in their evaluation of the effectiveness of visitor management, trail management and trail closure strategies at improving upon or maintaining desired conditions described in the EM/DD-TSA Plan. Results will also be used to inform adaptive management responses as necessary.

Key elements of each of the three monitoring projects are summarized below and reported in more detail in this report.

Goshawk Ridge Trail – Trail Condition	
What was monitored?	Physical conditions of the Goshawk Ridge Trail (GRT) by: 1. measuring tread width and incision depth and comparing those measurements to OSMP standards; 2. photo-documenting selected trail locations and 3. documenting evidence of equestrian and other visitor travel in close proximity to unacceptable tread width or incision
Why?	To evaluate the ability of the current trail design to sustain human and equestrian travel at current use levels, determine if modifications are needed to support continued human and equestrian travel and identify trail sections that require immediate maintenance
Where?	Along the length of the GRT (except Segment One and Segment Two—see **Figure 3**)
When?	Baseline trail conditions were assessed just before opening of the GRT in January 2009. After opening the GRT to visitor travel, trail conditions were monitored quarterly (March, June, September and December) in 2009 and 2010.
Results:	► Trail incision is **acceptable**. Trail incision has generally remained stable between baseline conditions and monitoring completion. ! Trail width is ***not within the acceptable range***. Trail width ranged between 16 and 82 inches (outside the range of acceptability for both trail width indicators).
Highlights for Managers:	Tread incision has generally remained within ranges of acceptability under current use patterns. Localized trail erosion has been addressed by annual maintenance. Trail width has exceeded the range of acceptability on numerous occasions. In 2009 and early 2010, excessive tread width was addressed by the construction of water bars and camouflaging trampled areas along trail edges. Managers will need to address more recently measured unacceptable conditions. Excessive trail incision showing evidence of horse travel was found only once during the 2 years of monitoring. The incision problem at this location improved by the subsequent monitoring session. The monitoring data do not suggest a link between equestrian travel and physical trail conditions.

Goshawk Ridge Trail - Segment Two Condition	
What was monitored?	Physical sustainability of Segment Two (**Figure 5**) of the GRT by: 1. measuring tread width, tread incision, development and severity of trail braiding, development of new undesignated trails and the number of structures constructed to support sustainability of Segment Two; 2. photo-documenting selected trail locations and 3. documenting evidence of visitor travel in close proximity to trail braiding or new undesignated trails
Why?	To promptly detect and correct problems with the physical condition of Segment Two and evaluate the physical sustainability of the provisional alignment to determine if it meets minimally acceptable conditions established under the GRT Segment Two Limits of Acceptable Change (LAC) process.
Where?	Along the second northern-most segment of the GRT alignment (Segment Two)
When?	Baseline trail conditions were assessed just before opening of the GRT in January 2009. After opening the GRT to visitor travel, Segment Two trail conditions were monitored quarterly (March, June, September and December) in both 2009 and 2010.
Results:	► Trail incision is **acceptable**. Trail incision generally remained stable between the baseline survey and monitoring completion. ► Number of trail structures is **acceptable**. No additional trail structures have been installed by OSMP since trail opening. ► The extent of trail braiding and undesignated trail is **acceptable**. One braided segment was recorded in 2009 and zero braided segments or undesignated trails were recorded during 2010 monitoring. ! Trail width is ***not within the acceptable range***. Trail width exceeded 30 inches during the last three monitoring periods and a few continuous sections greater than 36 inches wide remain.
Highlights for Managers:	A few segments where width exceeded 36 inches in 2010 should be considered for management actions such as the addition of wood or rock water bars and risers. Based on LAC trail standards used to assess trail conditions and allowing for minor seasonal maintenance, there is little evidence to suggest the provisional Segment Two alignment was unsustainable in the given time frame.

Spring Brook Loop and Goshawk Ridge Trail - Undesignated Trails	
What was monitored?	Condition and status of undesignated trails by: 1. measuring tread width, trail length and trail condition class and 2. mapping locations for existing and any newly developed undesignated trail segments
Why?	To detect new undesignated trails and to determine if desired reductions in length and width and improvement of conditions classes of existing undesignated trails have occurred.
Where?	In two monitoring sites: 1) a predefined area around the Spring Brook Loop Trail; and 2) near the Goshawk Ridge Trail corridor
When?	Baseline undesignated trail conditions were assessed just before trail opening in December 2008 (SBL) and January 2009 (GRT). After opening the SBL and GRT to visitor travel, the extent and condition of undesignated trails were monitored in fall and early winter of 2009 and 2010.
Results:	At both monitoring sites: ► Total length is **acceptable**. Trail length of existing undesignated trails decreased slightly between 2008 and 2010. ► Tread width is **acceptable**. Average tread width decreased in both sites between 2008 and 2009 and again between 2009 and 2010. ► Trail condition classes improved during each monitoring year. ! Development of new undesignated trails is ***not within the acceptable range***. Short undesignated trail segments branching from existing trails were located and mapped in 2009 and/or 2010; however whether visitors travel on these trails is uncertain.
Highlights for Managers:	Over the two-year time frame, reductions in length and width of undesignated trails fell within OSMP's ranges of acceptability, while development of new undesignated trails was outside of the acceptable range. However, evidence suggests that conditions are changing towards desired conditions. Managers should consider the following recommendations: ► End EM/DD-TSA focused undesignated trail monitoring and continue monitoring these undesignated trails at less frequent intervals starting in 2011 and periodically thereafter through OSMP's system-wide undesignated trail monitoring. ► Consider alternative closure and/or tracking strategies for the few undesignated trails that are not improving or that have developed since opening of the GRT and SBL.



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1.0 Introduction

Two new trails, the Spring Brook Loop Trail (SBL) and the Goshawk Ridge Trail (GRT) were approved for construction in the Eldorado Mountain/Doudy Draw Trail Study Area (EM/DD-TSA) Plan (City of Boulder, 2006, pp. 31-33, 38-39). Because these trails lie within sensitive landscapes and allow new visitor activities (i.e., dog walking, cycling), the EM/DD-TSA Plan also contained a commitment to conduct a suite of monitoring designed to both: 1) assess how visitor and trail management strategies were working; and 2) provide OSMP with information needed to adjust these management strategies to protect natural resources and provide the opportunity for high quality visitor experiences (City of Boulder, 2006, pp. 21-23).

1.1 Trail condition monitoring projects

Among the monitoring efforts included in the EM/DD-TSA Plan were three projects intended to evaluate change, if any, in trail conditions on either newly established designated trails or nearby undesignated trails after visitor and trail management strategies were implemented. These three projects are:

1. Goshawk Ridge Trail – Trail Condition
2. Goshawk Ridge Trail – Segment Two Condition
3. Spring Brook Loop and Goshawk Ridge Trail - Undesignated Trails

The visitor and trail management strategies implemented (i.e., building designated trails, allowing new recreational uses, closing undesignated trails and requiring on-trail travel for some activities) were designed to provide sustainable recreational opportunities on designated trails while shifting visitor travel away from undesignated trails in sensitive areas and thus promoting their restoration.

1.2 Monitoring sites and trail descriptions

The monitoring projects were conducted on and/or in the vicinity of the three trails or trail segments described below. These trails lie within the west-central portion of the EM/DD-TSA where the Eldorado Mountain Habitat Conservation Area (HCA) and the Doudy Draw Natural Area meet (Figure 1, inset).

The **Goshawk Ridge Trail** is a new pedestrian and equestrian trail in the Eldorado Mountain HCA. This trail (Figure 1) extends from an access bridge along the Denver Water Board Road (DWB Road) from the southeast to the Conda Mine Road and Fowler Trail junction to the northwest. On-trail travel on the GRT is required unless an off-trail HCA permit is obtained.

GRT Segment Two was previously an undesignated trail that was incorporated into the GRT alignment. This trail segment extends from the ridge north of the Spring Brook drainage on the southern end to the Conda Mine Road on the northern end.

The **Spring Brook Loop Trail** is a new multiple-use loop trail with connector trails within the Doudy Draw Natural Area (Figure 1). The trail traverses diverse topography in both grassland and forested habitats, while avoiding Spring Brook, Lindsay Pond and other sensitive natural resources.

1.3 Adaptive management and monitoring framework for the EM/DD-TSA

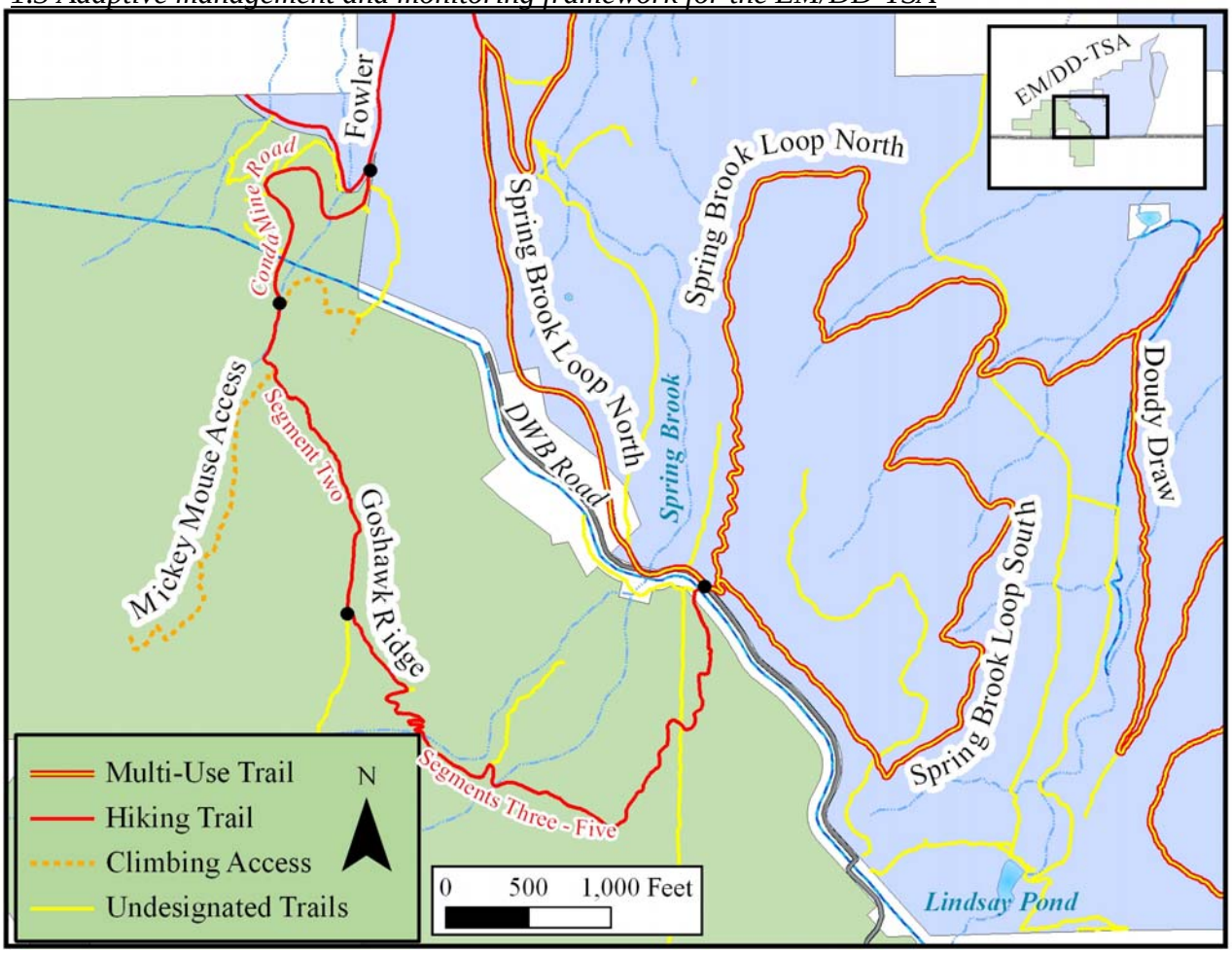

Figure 1. Location of the Spring Brook Loop, Goshawk Ridge Trail and undesignated trails in the Eldorado Mountain HCA (green) and the Doudy Draw Natural Area (blue). Black points along the Goshawk Ridge Trail delineate the trail segments discussed in the text.

Often the most effective strategies for balancing recreation opportunities with resource protection must be discovered through objective monitoring and modification, an approach called adaptive management (City of Boulder, 2005, p. 35). The EM/DD-TSA Plan (pp. 21-22) recommended a number of monitoring steps that followed a standards-based adaptive management approach (Figure 2). For OSMP, two advantages of adaptive management using a standards-based approach are:

- Clear measures (indicators) and thresholds (levels of acceptability) for determining if OSMP management strategies are working; and
- Community and Open Space Board of Trustees (OSBT) endorsement of the conditions that would trigger changes to management strategies.

Introduction

OSMP initiated the adaptive management process for the EM/DD-TSA through a number of planning and goal setting steps that incorporated feedback from community members and the OSBT (Figure 2, white boxes) and led to development of the final EM/DD-TSA Monitoring Plan (City of Boulder, 2008). The EM/DD-TSA Monitoring Plan outlined objectives, methods and measures (indicators), ranges of acceptable conditions and potential management actions that OSMP would consider to return unacceptable conditions to within established ranges of acceptability. With the collection of baseline data in October to December of 2008, OSMP began on-the-ground actions to implement the adaptive management approach (**Figure 2**, light blue boxes). The monitoring and assessment steps implemented between 2009 and 2011 (**Figure 2**, green boxes) for the three monitoring projects led to development of this report, providing managers with information to make informed decisions on future management.

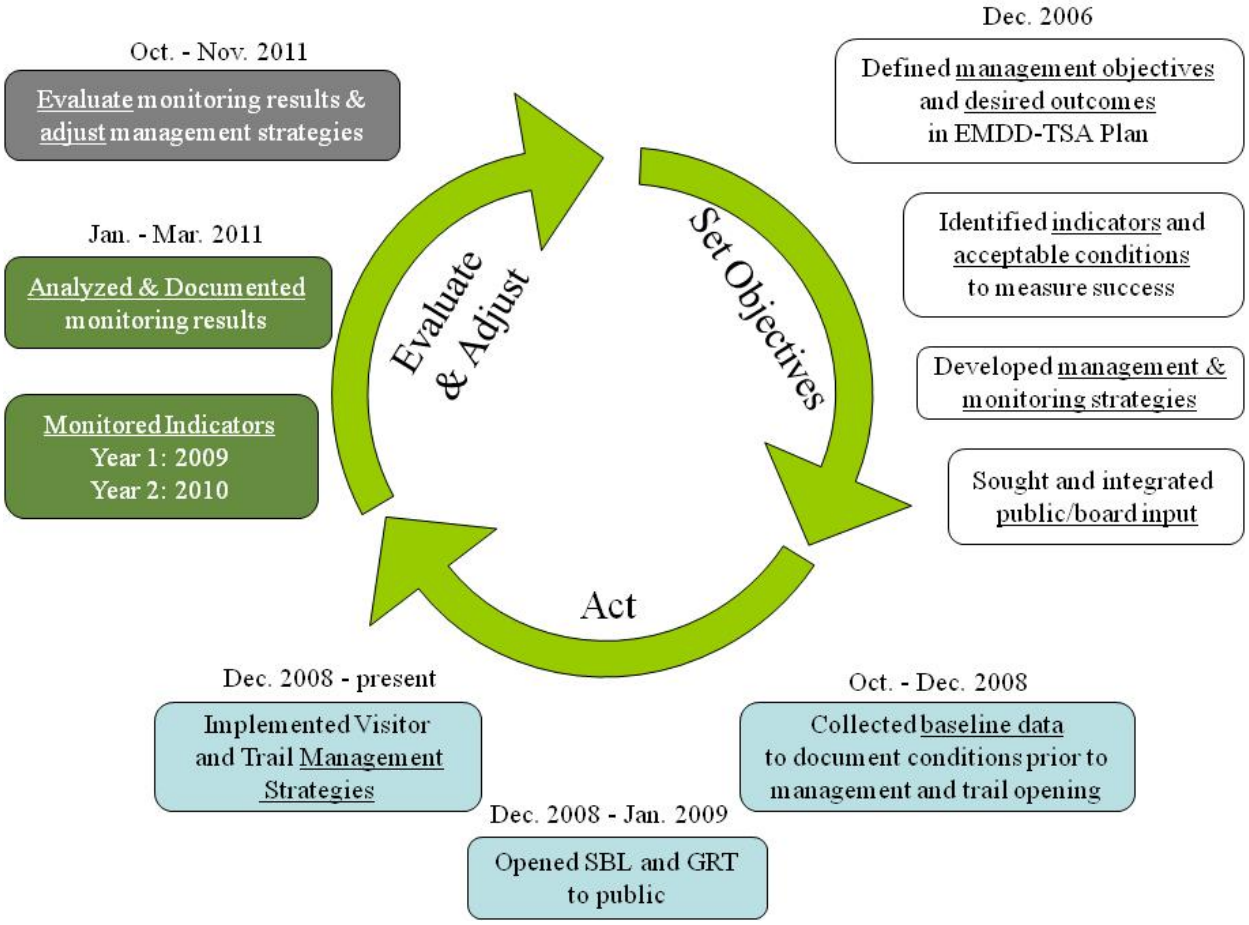

Figure 2. EM/DD-TSA adaptive management and monitoring steps for the GRT trail condition, GRT-Segment Two, and undesignated trail monitoring projects.

Goshawk Ridge Trail - Trail Condition

The Gohawk Ridge Trail – Trail Condition monitoring project evaluated the condition of portions of the GRT (Segments Three, Four and Five) from January, 2009 to December, 2010 (Figure 3). The Conda Mine Road (GRT Segment One) and GRT Segment Two are not included. Segment One is an official vehicle access road and Segment Two was monitored through a separate project documented later in this report.

Background:
As outlined in the EM/DD-TSA Plan (p. 38), equestrians have been allowed to travel on the GRT on a trial basis. During the 2-year trial period, OSMP monitored the physical condition of the GRT to determine if equestrian access to the trail should continue and, if equestrian access is continued, if modifications to the trail are necessary to support this activity. OSMP, with community and OSBT input, selected a set of indicators along with ranges of acceptability and possible management actions for each indicator to monitor the physical condition of the GRT.

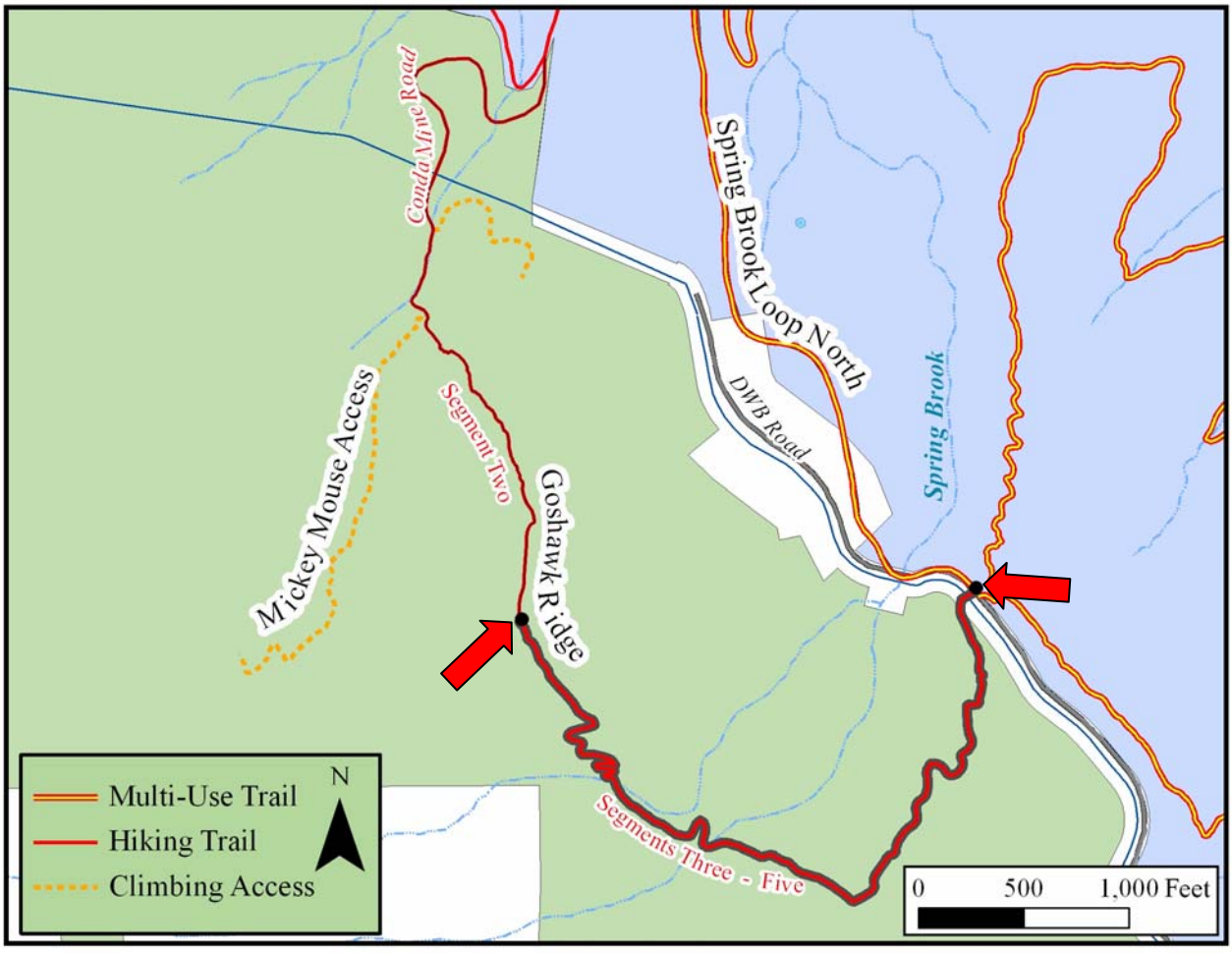

Figure 3. Vicinity map showing the location of the GRT relative to other nearby trails and roads. The monitored section is shown between the red arrows.

Goshawk Ridge Trail - Trail Condition

Monitoring Objective:
The objective of the GRT-Trail Condition monitoring in the EM/DD-TSA was to estimate the change, if any, in tread width and incision during the first two years of visitor activity post-opening to the public on January 29, 2009.

Monitoring Indicators:
To determine the condition of the GRT during the first two years of visitor activity, staff monitored five indicators of trail width and incision:

- Trail width indicators
  1. Range of trail width
  2. Percent of sample points in which trail width exceeded 30 inches
- Trail incision indicators
  3. Range of trail incision
  4. Number of trail sections 10 feet or longer in length in which trail incision was at least two inches greater than the baseline median[1]
  5. Percent of sample points in which trail incision was at least two inches greater than the baseline median

Additionally, discernible evidence of equestrian and other visitor travel was recorded if found in close proximity to any trail condition with an indicator exceeding the range of acceptable conditions.

Repeat photo points were also taken at six locations along the trail.

Acceptable Conditions:
OSMP defined acceptable conditions for the indicators listed above based on desired conditions for a Class 2 (minor developed) equestrian trail (**Appendix A**) along with public and OSBT input received during the EM/DD-TSA planning processes. The indicators and associated acceptable conditions were selected to detect incremental change in trail condition. Acceptable conditions were defined as:

- Trail width
  - The trail width is not 45 inches or more anywhere
  - At least 75% of sample points are 30 inches wide or less
- Trail incision
  - The trail incision does not exceed five inches anywhere
  - No section of the trail 10 feet or longer is incised two or more inches
  - At least 75% of sample points are not incised two or more inches

OSMP's intent is to maintain the GRT within acceptable OSMP trail management objective (TMO) standards for a Class 2 equestrian trail (**Appendix A**), while providing a new opportunity for recreational travel through the area.

[1] Baseline incision was 0 inches.

Methods:

Survey methods**:**

Staff monitored the GRT prior to its opening for visitor travel to establish baseline conditions. Staff repeated the monitoring on a quarterly basis (March, June and September 2009; April, June, September and December 2010)[2]. Staff measured trail width and trail incision near the origin and terminus and at evenly spaced points along the GRT. Additional sample points were taken anywhere along the GRT if:

- The trail width exceeded 45 inches;
- The trail incision exceeded five inches; or
- A 10-foot or longer contiguous trail section was incised two or more inches.

Monitoring staff mapped locations and recorded trail conditions near the trail origin and terminus and at evenly spaced interior points along the GRT using a Global Positioning System (GPS). Interior points were located at 100-foot intervals from an initial random point using a measuring wheel (**Figure 4**). A new initial random point was selected each monitoring period, so sample point locations differ from one monitoring period to the next.

Trail width was measured to the nearest inch perpendicular to the trail alignment by stretching a measuring tape between trail edges (**Appendix B**). Trail incision was measured to the nearest inch by placing a straight edge across the trail between trail edges and measuring the maximum depth of the trail (**Appendix B**).

Figure 4. Measuring wheel used to locate sample points.

Staff also documented discernible visitor activity, if any, in problems areas (i.e., areas exceeding the ranges of acceptability). Photo points along the trail were repeated with each monitoring interval. Monitoring concluded in December 2010.

Analysis methods**:**

Trail width indicator values were calculated from all sample points except those which fell within the climbing turns of Segment Three. The climbing turns were intentionally constructed wider than the rest of the trail to allow equestrians and their horses adequate room to travel and turn uphill or downhill (depending on direction of travel) through the area just west of North Spring Brook (**Figure 3**).

Trail incision indicator values were calculated from all sample points except those additional points taken at locations with a width of 45 inches or greater.

[2] Although monitoring was scheduled for December 2009, this monitoring was not completed because the GRT tread was covered by snow.

A detailed project protocol describing these methods is available upon request (VanderWoude, 2010).

Results:
Results are summarized by indicator below. The complete results can be found in **Appendix C.**

! **Trail Width is *not within the acceptable range*:** Trail width ranged between 16 and 82 inches (outside the range of acceptability for both trail width indicators).

During the study period, trail width ranged between 16 and 82 inches and exceeded 45 inches (outside acceptable range) during six of the seven monitoring periods (**Appendix C**).

- In March 2009, trail width at 11% of the sample points was greater than 45 inches. These points were generally in locations where visitors were bypassing short-term muddy trail patches.
- In September 2009, trail width at 4% of the sample points was greater than 45 inches. To discourage further growth, trail edges at these locations were covered with locally harvested organic material.
- In April 2010, trail width at 11% of the sample points was greater than 45 inches. These points were generally in between stream fords in locations where visitors were going around muddy patches. Trails staff constructed a few water bars in this section to discourage further trail widening and erosion.
- In June 2010, trail width at 9% of the sample points was greater than 45 inches. These points were generally in locations where visitors were bypassing short-term muddy trail patches.
- In September 2010, trail width at 5% of the sample points was greater than 45 inches. These points were near the trail origin (junction with DWB Road) where visitors were likely congregating to rest, talk or to read posted signs.
- In December 2010, trail width at 9% of the sample points was greater than 45 inches. These points were near the trail origin and also within the section of trail containing the water bars constructed in June 2010.

The proportion of sample points in which trail width was greater than 30 inches ranged from 13 to 43 percent for all seven monitoring periods. During four of the seven monitoring periods, the proportion of sample points in which trail width was greater than 30 inches exceeded 25 percent (outside acceptable range) (**Appendix C**).

- In March 2009, trail width at 28% of the sample points was greater than 30 inches.
- In April 2010, trail width at 43% of the sample points was greater than 30 inches.
- In June 2010, trail width at 39% of the sample points was greater than 30 inches.
- In December 2010, trail width at 32% of the sample points was greater than 30 inches.

👍 **Trail Incision is** *Acceptable*: Trail incision has generally remained stable between baseline conditions (January 8, 2009) and monitoring completion in December 2010.

Generally speaking, the GRT trail incision remained within the ranges of acceptability (**Appendix C**). For all seven monitoring periods, trail tread incision ranged from 0-5 inches for all sample points (including origin and terminus points) and the proportion of points incised 2 or

more inches remained under 25 percent. During two monitoring periods, June 2009 and June 2010, staff observed sections of trail that were 10 feet or greater in length with tread incision 2 inches or more beyond baseline median. The June 2009 trail incision problem was due to visitors going through a short-term muddy trail segment. The June 2010 incision problem was likely due to spring run-off creating a short gully in the trail tread. To reduce the potential for trail tread incision problems, additional water bars were constructed in areas prone to tread erosion and gullying in June 2010. Incised areas observed in June 2009 and June 2010 were no longer present during the September and December 2010 monitoring.

Photo Points

Photo points along the trail were repeated with each monitoring interval to document trail and near-trail conditions. The photo points are intended to complement the trail attribute data when evaluating the physical sustainability of the GRT. A sampling of GRT trail condition repeat photo points is included in **Appendix D.**

Evidence of Visitor Travel

During GRT monitoring, discernible evidence of visitor travel near problem areas (i.e., points or segments outside of the ranges of acceptability) included footprints, horse hoof prints and bicycle tracks even though bicycling is prohibited on the GRT. During one monitoring period (June 2009), one problem area, a 10-foot segment with excessive trail incision, contained evidence of horse travel (no footprints or bicycle tracks). Trail incision at this location returned to an acceptable level by the next monitoring period.

Goshawk Ridge Trail – Segment Two Condition

The Goshawk Ridge Trail – Segment Two Condition monitoring project evaluated the condition of a previously undesignated section of trail that was integrated into the GRT.

Background:
OSMP included a section of previously undesignated trail in the final GRT alignment. This section, Segment Two (Figure 5), was not designed or constructed to OSMP trail standards. OSMP committed to a 2-year sustainability trial for this section and developed a site-specific monitoring project to promptly detect and correct any problems.

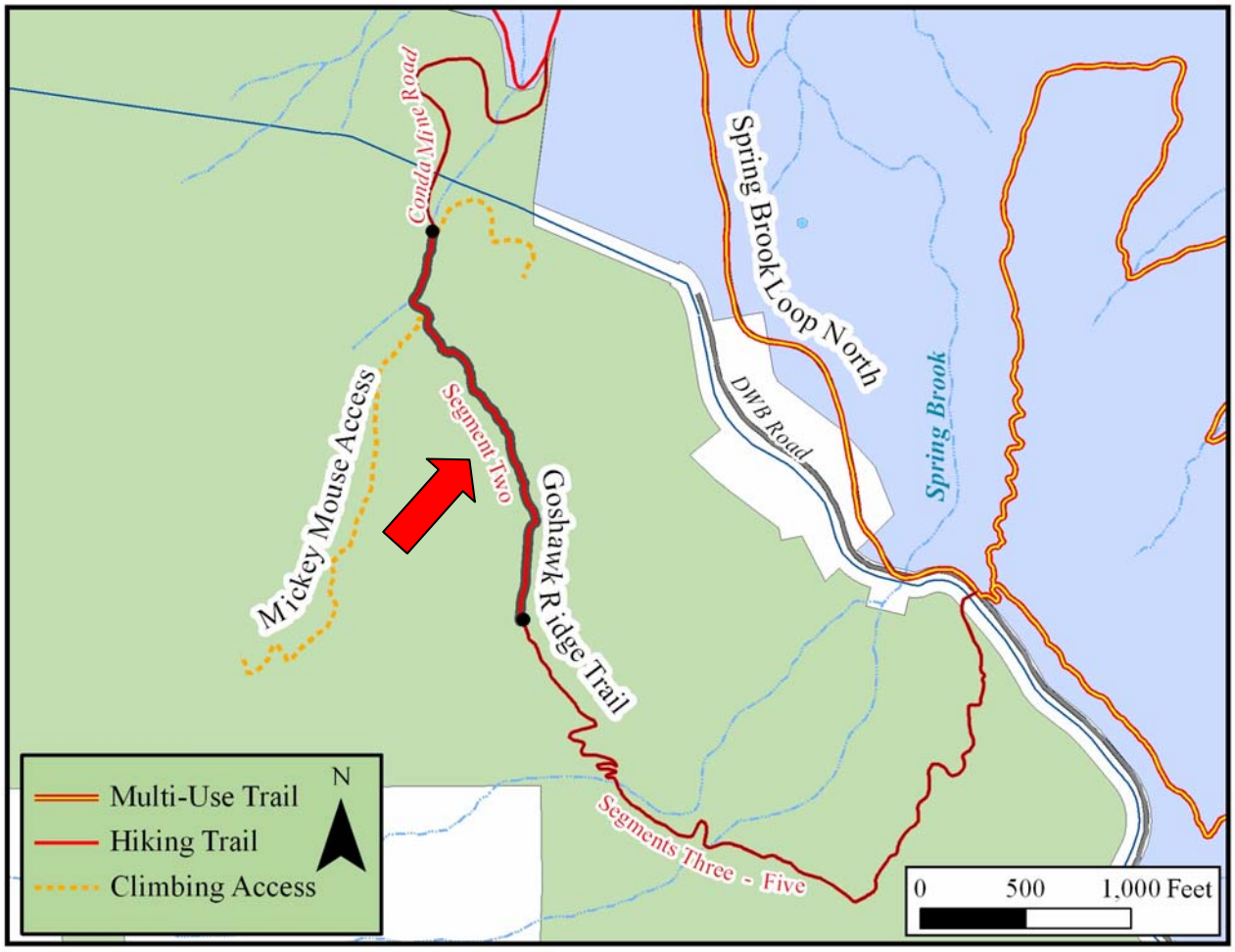

Figure 5. GRT-Segment Two vicinity map showing monitored section adjacent to red arrow.

OSMP applied a modified version of the Limits of Acceptable Change (LAC) process (Stankey et al., 1985) (**Appendix E**) for Segment Two. The LAC process requires an explicit definition of the compromise between resource protection and visitor experience goals. The most critical and unique element of the process is the specification of LAC standards that define minimally acceptable conditions. OSMP conducted monitoring to determine whether these minimally acceptable conditions were being met.

Goshawk Ridge Trail – Segment Two Condition

Monitoring Objective:
The objective of the GRT-Segment Two Condition monitoring in the EM/DD-TSA was to estimate the change, if any, in tread width and tread incision, and document trail braiding and undesignated trail development, if any, on Segment Two of the Goshawk Ridge Trail. OSMP staff also tracked the number of existing structures (e.g. drainage bars or steps) and any newly added structures for improving the physical sustainability of this portion of the trail.

Monitoring Indicators:
To determine if the condition of the GRT-Segment Two remained within the ranges of acceptability during the 2-year trial period, staff monitored five indicators of trail condition:
1. Range of trail width
2. Median trail incision
3. Number of trail structures
4. Presence of trail braiding/condition class of any trail braids
5. Number of undesignated trails/condition class of any undesignated trails

Additionally, discernible evidence of visitor travel (e.g., footprint or horse print) in or near trail braids and/or undesignated trails was recorded and trail conditions were documented at select locations with repeat photo points.

Acceptable Conditions:
OSMP defined acceptable conditions for the indicators listed above based on desired conditions for a minimally developed trail along with public and OSBT input received during the EM/DD-TSA planning processes. Indicators and associated levels of acceptable conditions were selected to detect incremental change in trail condition. The minimally acceptable conditions were defined as:
- The trail width does not exceed 30 inches
- Any braided section does not exceed condition class 0 (**Appendix F**)
- The median trail incision does not exceed two inches
- No (0) new undesignated trails develop
- The trail segment contains fewer than 30 trail structures

Methods:

Survey methods:

Staff monitored GRT-Segment Two prior to the opening of the GRT to establish baseline conditions. Staff then repeated the monitoring on a quarterly basis (March, June, and September 2009; April, June, September and December 2010)[3]. Monitoring concluded in December 2010.

Monitoring staff mapped and recorded trail conditions near the origin and terminus and at evenly spaced interior points along the GRT-Segment Two using a GPS. Interior points were located at 100-foot intervals from an initial random point. The 100-foot intervals were located using a measuring wheel (**Figure 4**). A new initial random point was selected each monitoring period, so sample point locations differed from one monitoring period to the next. Additional sample points were taken anywhere along the GRT-Segment Two if:

- A section of trail (one foot minimum) was greater than 36 inches wide;
- Trail braiding was present; or
- An undesignated trail was present.

Staff measured trail width and trail incision at all randomly selected sample points along the GRT-Segment Two. Trail width was measured to the nearest inch perpendicular to the trail alignment by stretching a measuring tape between trail edges (**Appendix B**). Trail incision was measured to the nearest inch by placing a straight edge across the trail between trail edges and measuring the maximum depth of the trail (**Appendix B**). Staff also counted the number of trail structures (e.g., drainage dips, water bars or steps) encountered along Segment Two.

The surveyor also documented the condition class and discernible visitor activity at the additional sample points where trail braiding or undesignated trails were present and recorded the length of any braided segment or section of trail greater than 36 inches wide. Photo points along Segment Two were also repeated with each monitoring interval.

Analysis methods**:**

Trail width and incision indicator values were calculated from all sample points except those additional points taken for trail braiding and/or undesignated trail presence.

A detailed project protocol has been developed (VanderWoude, 2010) and is available upon request.

Results:

Results are summarized by indicator below. The complete results can be found in **Appendix G**.

! **Trail Width is *not within the acceptable range*:** Trail width exceeded 30 inches during the last three monitoring periods and a few continuous sections greater than 36 inches wide remain.

[3] Although monitoring was scheduled for December 2009, this monitoring was not completed because the trail was covered by snow.

For all monitoring periods, trail width ranged between 9 and 40 inches and during three of the seven monitoring periods exceeded 30 inches (outside acceptable range) (**Appendix G**).

- In June 2010, trail width exceeded 36 inches in a 6-foot section of trail at 1,514 linear feet from the origin (south end junction with GRT Segment Three), near an interpretive sign. This section no longer exceeded the width threshold during the September 2010 monitoring.
- In September 2010, trail width exceeded 36 inches in a few short sections of trail (10 feet or less) between 975 and 1,050 linear feet from the origin, near where Segment Two begins to descend into the meadow (if traveling south to north). Trail width was 34 inches at approximately 1,125 linear feet from the origin (in the meadow).
- In December 2010, trail width again exceeded 36 inches in a few short sections (10 feet or less) between 975 and 1,050 linear feet from origin. Staff observed a down slope rock retaining wall here (**Figure 6**). OSMP staff did not construct this retaining wall. Trail width was 36 inches wide just north of the junction with the Mickey Mouse Climbing Access Trail.

Figure 6. Rock retaining wall in area prone to erosion shown outlined in red. OSMP staff did not construct this wall.

Trail Incision is *Acceptable***:** Trail incision generally remained stable between the baseline survey (January 8, 2009) and monitoring completion in December 2010.

Trail incision along GRT-Segment Two remained within the range of acceptability (**Appendix C**). The median trail tread incision of all randomly selected sample points (including origin and terminus points) ranged from 0-2 inches for all monitoring periods.

Number of Trail Structures is *Acceptable***:** No additional trail structures have been installed by OSMP since trail opening (January 29, 2009).

One structure was recorded during the December 2010 monitoring (**Figure 6**).

Goshawk Ridge Trail – Segment Two Condition

- **Trail Braiding and Undesignated Trail Presence is** *Acceptable***:** One braided segment was recorded in 2009 and zero braided segments or undesignated trails were recorded during 2010 monitoring.

One 24-foot braided trail segment was discovered during the March 2009 monitoring. This segment appeared to be a short-lived diversion around a muddy patch of trail and had a condition class of 0 (no management response required). This braided segment was no longer apparent by the June 2009 monitoring. Zero new undesignated trails were recorded during the entire 2-year monitoring period.

Photo Points

Photo points along Segment Two were repeated with each monitoring interval to document trail and near-trail conditions. The photo points are intended to complement the trail attribute data when evaluating the physical sustainability of the GRT-Segment Two. A sampling of GRT Segment Two repeat photo points is included in **Appendix H**.

Visitor Evidence

During GRT-Segment Two monitoring, discernible evidence of visitor travel near the one braided segment included only footprints.

Spring Brook Loop and Goshawk Ridge Trail - Undesignated Trails

The Spring Brook Loop and Goshawk Ridge Trail – Undesignated Trails monitoring project evaluated changes, if any, in the extent and condition of undesignated trails in the vicinity of the SBL and GRT from 2008 to 2010.

Background:
Undesignated trails (i.e., visitor-created or "social" trails) are discernible and continuous trail segments that have been created or perpetuated by visitor travel and not designed or developed as part of a formal trail system (Leung, Shaw, Johnson & Duhaime, 2002). Undesignated trails in the vicinity of the SBL and GRT not otherwise identified for designation or vehicle access during the EM/DD-TSA planning process were slated for closure because they were considered unsustainable and redundant with newly built trails, and had potential to promote off-trail travel in areas of high conservation value. In keeping with the need to balance recreational experiences with natural and cultural resource protection, OSMP aimed to minimize off-trail activities and reduce the extent and severity of undesignated trails in the SBL and GRT areas. To evaluate the success of meeting these management goals, OSMP committed to monitor the extent of undesignated trail development and to detect newly formed undesignated trails promptly to facilitate their effective closure and restoration (OSMP, 2005, p. 61; OSMP, 2006, pp. 19, 22).

Scope of Monitoring:
Staff monitored pre-existing undesignated trails, excluding those designated or authorized for vehicle access, and any newly detected undesignated trails within two different sites: the area defined as the Spring Brook Target Area[4] and areas immediately adjacent to, parallel to, or emanating from the GRT (i.e., GRT vicinity) (**Figure 7**).

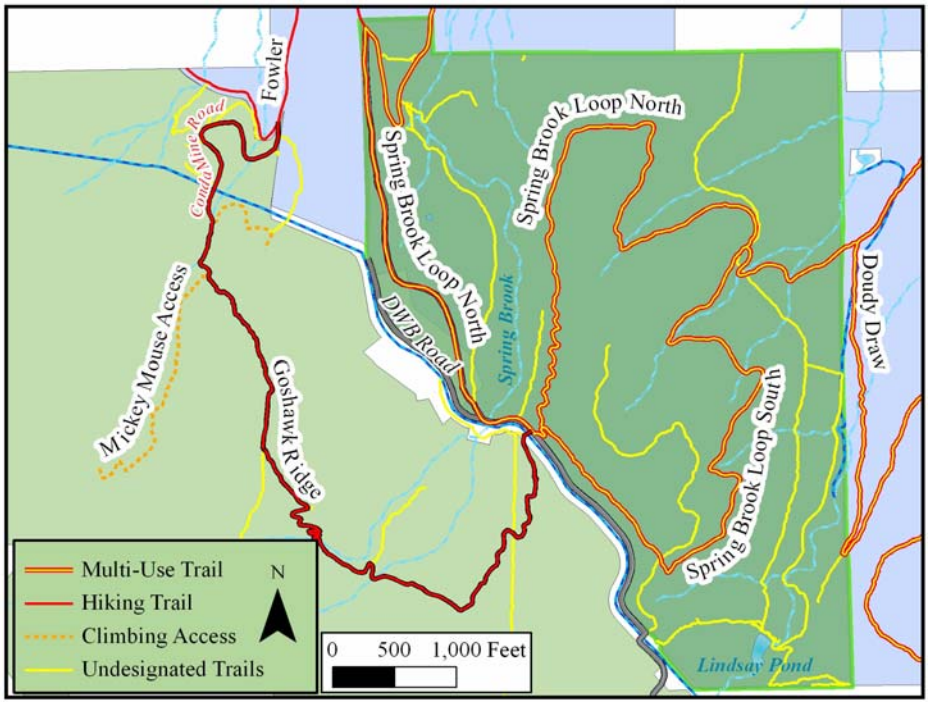

Figure 7. Undesignated trail monitoring occurred in the Spring Brook Target Area (dark green shading) and the GRT vicinity (proximate to the GRT depicted in thick red lines).

7[4] The Spring Brook Target Area corresponds roughly to the area proposed for HCA designation in the development of the Visitor Master Plan (VMP), but later adopted as part of a Natural Area to be monitored for visitor impacts.

Monitoring Objective:
The objective of undesignated trail monitoring in the EM/DD-TSA was to locate and characterize the extent and condition of undesignated trails in the vicinity of the Spring Brook Loop and Goshawk Ridge trails before and after their construction and opening to the public.

Monitoring Indicators:
To determine if the extent and condition of undesignated trails in the Spring Brook Target Area and GRT vicinity had "improved" one and two years after the opening of the two designated trails, staff monitored three indicators:
1. Total length of undesignated trails
2. Mean tread width of undesignated trails
3. Presence of new undesignated trails

Additionally, the tread surfaces along monitored undesignated trails were classified into condition classes[5] to visually illustrate spatial and temporal trends in undesignated trail conditions more effectively.

Acceptable Conditions:
OSMP defined acceptable conditions for the indicators listed above based on desired conditions for undesignated trails. Desired conditions were formulated with public and OSBT input during the VMP and EM/DD-TSA planning processes. Specifically, acceptable conditions were defined as:
- A decrease in the total length of pre-existing undesignated trails (i.e. mapped during the 2008 baseline survey)
- A decrease in mean tread width of pre-existing undesignated trails (i.e. mapped during the 2008 baseline survey)
- Absence of new undesignated trails or trail segments

OSMP desired yearly improvements in condition classes (i.e., decreased lengths in higher, more degraded condition classes) of undesignated trails in both the Spring Brook Target Area and GRT vicinity. However, OSMP was unable to define an acceptable level of change for condition class because an incremental change by one condition class is not necessarily equivalent at all points of the scale. Furthermore, staff believed that they could not develop adequate quality assurance procedures to minimize subjectivity and ensure consistency in data collection.

Methods:
Survey methods**:**
Pre-existing undesignated trails
Staff monitored previously-established undesignated trails prior to the opening of the Spring Brook Loop and Goshawk Ridge trails (2008 baseline surveys) and approximately 1 and 2 years later (2009, 2010). Surveys occurred between November and January when bordering vegetation

[5] Condition classes are a qualitative classification of impact conditions in visitor use areas, typically applied to undesignated trails and areas of concentrated use. Condition class systems consist of several descriptive statements describing substrate and vegetative conditions representing increasing levels of impact. Field observers assign the condition class rating that most closely matches field conditions on the undesignated trail (Marion, Leung, & Nepal, 2006; Wimpey & Marion, 2011).

was no longer growing and trails were snow-free[6], hard and dry or only slightly moist. Monitoring staff used system-wide undesignated trail surveys, 2008 aerial photographs and personal communications with other field staff to locate undesignated trails within the Spring Brook Target Area and GRT vicinity. Monitoring staff developed criteria and methods to distinguish the many wildlife trails from these undesignated trails but there remains subjectivity in this categorization.

Monitoring staff mapped the origin, terminus and interior points along the alignment of observed undesignated trails using a GPS. On each trail, interior points were located at 100-foot intervals from an initial random point using a measuring wheel, so that sample point locations differed from one survey period to the next. Staff measured trail tread width at each interior point. Tread width was measured to the nearest inch perpendicular to the trail alignment by stretching a measuring tape between trail edges. Additionally, staff recorded the condition class, evidence of visitor activities (e.g., foot prints, dog prints or horse manure) and presence of restoration treatments (2008 only) for each undesignated trail segment preceding the interior points. A detailed project protocol describing these methods is available upon request (Lezberg, 2010).

New undesignated trails

New undesignated trail segments (those evident in 2009 or 2010 but not mapped during the 2008 baseline survey) were located by searching in the vicinity of all documented undesignated trails[7] within the two project sites. OSMP monitoring staff also searched near existing roads, designated trails and disturbed areas evident in aerial photographs. New undesignated trails (i.e. trails not noted in the 2008 baseline survey) were measured for width, length and condition class using methods described above for pre-existing trails and examined to determine if the trails were created by people or wildlife.

Analysis methods**:**

Indicator values were calculated separately for the Spring Brook Target Area and GRT vicinity, using all undesignated trail segment or point measurements taken within a site in a given year. New undesignated trail data was summarized separately from pre-existing undesignated trail data to avoid masking recovery of pre-existing undesignated trail segments. Data collected on individual undesignated trails were also summarized to depict localized conditions that could highlight problem segments or guide further management. However, since individual trail characteristics for short trails were frequently based on only one or a few measured segments or points (See Appendix I), changes over time at the scale of individual trails were not used to evaluate "acceptable conditions".

[6] One trail had a few points obscured by snow in both years due to the long-term persistence of snow under dense forest cover. Obscured points were treated as missing data.

[7] "Documented undesignated trails" means any undesignated trails mapped during the 2008 baseline survey, trails mapped during earlier system-wide surveys and any trails noted by other OSMP staff or volunteers

Total length

Length was determined by summing horizontal length (rather than slope length) of digitized segments connecting points mapped in the field with the GPS (Figure 8). Length was calculated using algorithms in XTools Pro© for ArcGIS. To increase accuracy while digitizing trail segments, 2008 aerial photos and GPS-derived paths followed during mapping were displayed in the backdrop. "Recovered" segments of undesignated trails that were no longer evident on the ground were not included in summed trail lengths. Recovery, minor alignment shifts, or extension of trail segments over time were evident on maps and accounted for most of the calculated inter-annual differences in length. Other sources of inter-annual variation including level of GPS accuracy, subjectivity in digitization of segments and inconsistencies in measured trail lengths when using the measuring wheel were minimized as much as possible through detailed operating procedures documented in the project protocol and appeared to account for a relatively minor component of yearly variation.

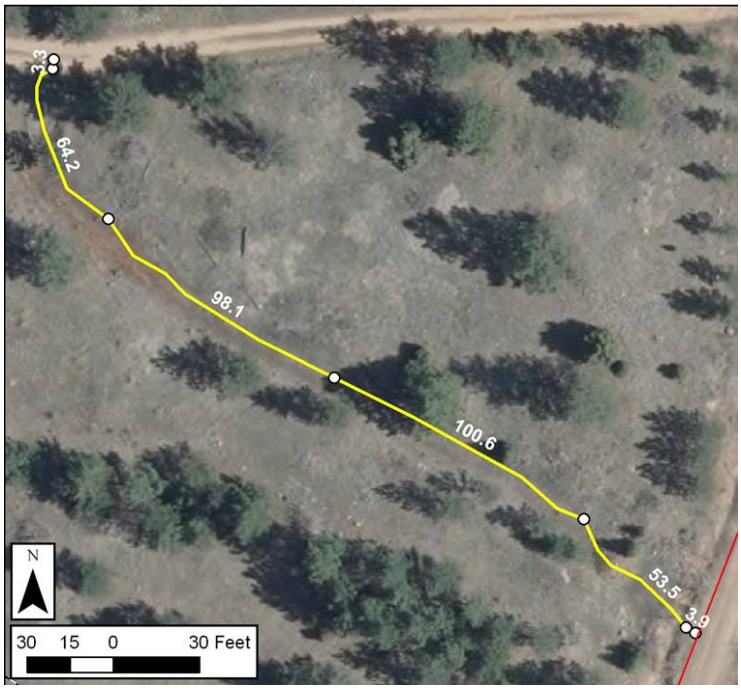

Figure 8. Undesignated trail segments (yellow lines) were digitized between GPS mapped sample points (white points). GIS tools were used to calculate horizontal length (feet) of each segment (white labels).

Tread width

Tread width was averaged across all interior sample points within a given site. Median width and frequency of sampled points in 10-inch width classes were also calculated to derive statistics less influenced by extreme values. Interior sample points falling along recovered trail segments were assigned a width of 0 inches and included in analyses. Width measurements taken near the trail origin or terminus, on former roads or two-tracks mapped as undesignated trails and along newly developed undesignated trails were not included in analyses.

Condition classes

Condition classes were determined for each 100-foot segment and shorter interior segments along the undesignated trail[8]. One of seven descriptive condition classes (including "Class R" or "recovered" for segments that were visible in the baseline survey but were no longer discernible in 2009 or 2010 due to vegetation growth on the trail tread) was assigned to characterize the predominant condition along the segment. Summed length and percent length in each condition class were calculated and compared between years for each site. Condition classes and changes in condition classes were also illustrated on GIS maps. Detailed methods for

[8] The monitoring protocol contains detailed procedures for when and how condition class information was collected.

analyzing distribution of undesignated trails by condition class and for conducting spatial analyses of condition class change are described in the project protocol (Lezberg, 2010).

Results:
Each report section below summarizes the results by undesignated trail indicators and site (Spring Brook Target Area, GRT vicinity) and then highlights noteworthy results for individual undesignated trails. Appendices at the end of this report contain complete tables summarizing individual trail results and a set of maps depicting conditions and locations of undesignated trails.

- **Total Length is** *Acceptable***:** Trail length of existing undesignated trails decreased slightly between 2008 and 2010.

Between 2008 baseline surveys and 2010, a net reduction of 3.7 percent and 0.8 percent in undesignated trail length (**Table 1**) was calculated for the Spring Brook Target Area and GRT vicinity, respectively. Larger proportional decreases in trail length were measured in the Spring Brook Target Area than in the GRT vicinity during each yearly monitoring increment. The 867-foot net decrease across both sites between 2008 and 2010 includes decreases in length associated with the recovery of 1093 feet of trail tread in SBL and 81 feet of trail tread in GRT (Figure 9) offset by an approximate 212-foot extension on one end of an undesignated trail in SBL which may have been created or maintained by wildlife. By 2010, one entire undesignated trail and portions of ten others had recovered to the point that treads were no longer discernible (**Appendix I: Tables I1 and I2, Maps 1 and 2**).

Table 1. Total length and percent change in length of undesignated trails mapped in the Spring Brook Target Area and the GRT vicinity during 2008 (baseline), 2009, and 2010 surveys. Negative values indicate reductions in length.

Undesignated Trail Survey Area	Total Undesignated Trail Length (ft)			Change in Length (percent change)		
	2008	2009	2010	2008-2009	2009-2010	2008-2010
Spring Brook Target Area	21,307	20,559	20,516[9]	-3.5	-0.2	-3.7
GRT Vicinity	9,611	9,434	9,535[10]	-1.8	+1.1	-0.8
Total	30,918	29,992	30,051	-3.0	+0.2	-2.8

[9] Length includes a 212-foot extension to one undesignated trail, mapped for the first time in 2010, offsetting some of the reduction in trail length due to undesignated trail recovery.
[10] The increase in length between 2009 and 2010 was primarily due to a segment classified as "recovered" in 2009, but mapped in the highest quality condition class in 2010 along a slightly different alignment. The segment may have been obscured by tall pushed-over vegetation in 2009 or it may have received more trampling in 2010.

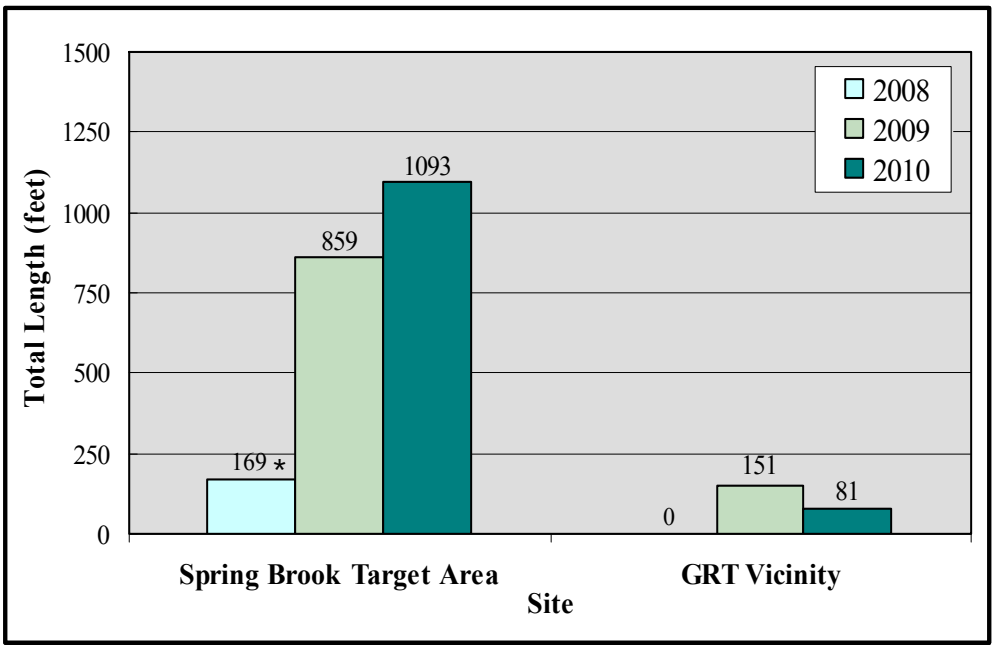

Figure 9. Length of "recovered" segments mapped in the Spring Brook Target Area and the GRT vicinity during 2008 (baseline), 2009 and 2010 surveys. *The "recovered" segment mapped in 2008 represents a vegetated gap (recovered since the trail was first developed) in an otherwise continuous length of undesignated trail.

Individual Undesignated Trails - Total Length**:**
Annual changes in length for individual undesignated trails are presented in Appendix I: Tables I1 and I2. Most decreases in length of more than 25 feet[11] were associated with recovery of undesignated trail segments. A few of these recovered segments reappeared as minimally trampled paths in 2010 along slightly different alignments. Changes in mapped alignments occasionally accounted for relatively large inter-annual differences in length, as found for one long undesignated trail (UDT #21) and one meandering trail where wildlife paths were abundant (UDT #82). Only one trail (UDT #55) increased more than 25 feet in length over the 2008 to 2010 period, due to an extension from the former terminus to another undesignated trail.

Tread Width is *Acceptable***:** Average tread width decreased in both sites between 2008 and 2009 and again between 2009 and 2010.

The mean tread width of undesignated trail segments in the Spring Brook Target Area and the GRT vicinity decreased during each of the annual surveys (**Figure 10**). On average, tread widths decreased by 4 inches between baseline surveys and 2009 surveys at both sites, but decreased only slightly between the 2009 and 2010 surveys at both sites.

[11] Inter-annual variation in undesignated trail length in the absence of recovery rarely exceeded 25 feet.

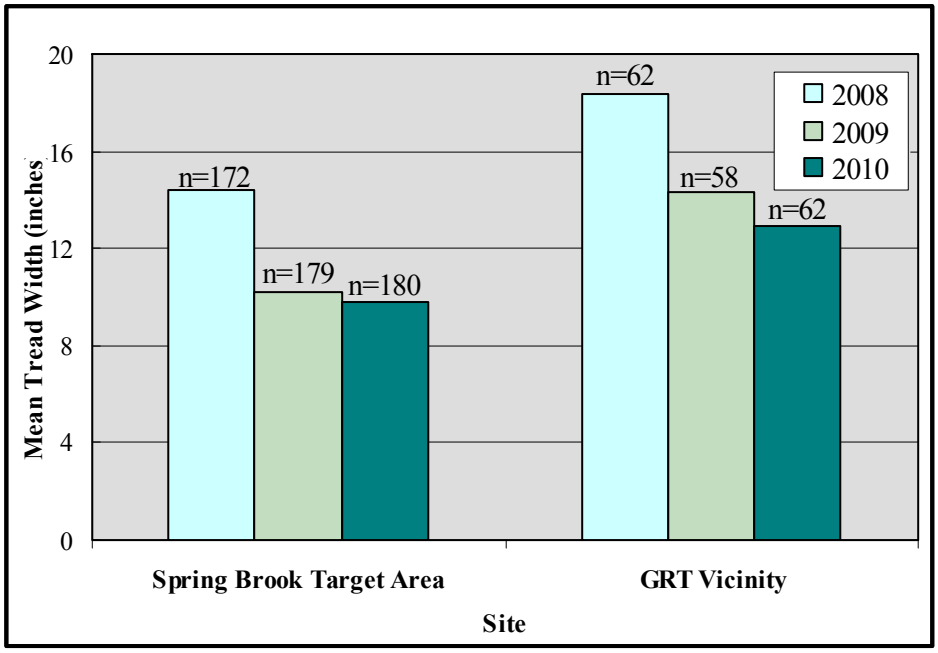

Figure 10. Mean tread width of undesignated trails in the Spring Brook Target Area and GRT vicinity found during 2008 (baseline), 2009 and 2010 surveys. Sample sizes are given above each bar.

The proportion of sampled points with widths of 10 inches or less increased between 2008 and 2010 in both sites (Table 2). While proportions of points with widths of 10 inches or less increased yearly in the Spring Brook Target Area, proportions of sample points in this smallest size class initially increased between 2008 and 2009 but then decreased in 2010 in the GRT vicinity (Table 2). Median trail width values exhibited a pattern much like that for the distribution of small width classes. In the Spring Brook Target Area, the median trail width decreased between 2008 and 2009 and again between 2009 and 2010, where as in the GRT vicinity, median trail width increased slightly in 2010 after an initial decrease (Appendix J).

Increases in median trail widths in the GRT vicinity between 2009 and 2010 can be partially explained by larger trail width measurements sampled along a few undesignated trails (UDTs #8, #9, #69, and #97). In particular on UDT #9, the frequency of sampled widths less than or equal to 10 inches decreased by more than half between 2009 and 2010. Furthermore, condition class data for this trail show a slight decline in trail tread condition between 2009 and 2010. However, no evidence exists to suggest a recent increase in visitor use of this undesignated trail.

Individual Undesignated Trails –Tread Width**:**
Annual mean tread width values for individual undesignated trails are presented in **Appendix K: Tables K1 and K2**. Virtually all undesignated trails exhibited net decreases in mean width between 2008 and 2010 with the exception of two short trails with single sample points. A few individual trails (UDT#9; UDT#14) exhibited increases in mean width between 2009 and 2010. Mean widths for undesignated trails not included in the above calculations (e.g., two-tracks) are also given in this appendix.

Table 2. Percent of sampled points in each of eight width classes in the Spring Brook Target

Tread Width Class (inches)	Percent of Sample Points					
	Spring Brook Target			GRT Vicinity		
	2008	2009	2010	2008	2009	2010
0 (recovered)	1.2	5.6	4.4	0.0	1.7	0.0
>0 and ≤10	11.6	53.1	60.6	3.2	48.3	38.7
>10 and ≤20	79.7	38.0	31.7	72.6	39.7	56.5
>20 and ≤30	5.8	2.8	2.8	21.0	5.2	1.6
>30 and ≤40	0.6	0.6	0.6	0.0	1.7	1.6
>40 and ≤50	0.6	0.0	0.0	1.6	0.0	0.0
>50 and ≤60	0.0	0.0	0.0	0.0	1.7	1.6
>60	0.6	0.0	0.0	1.6	1.7	0.0
Total	100	100	100	100	100	100
≤10 inches	12.8	58.7	65.0	3.2	50.0	38.7
>10 inches	87.2	41.3	35.0	96.8	50.0	61.3

! **New Undesignated Trail Indicator is *not within acceptable range*:** Short undesignated trail segments branching from existing trails were located and mapped in 2009 and/or 2010; however whether visitors travel on these trails is uncertain.

By 2010, staff had mapped six short undesignated trail segments branching from pre-existing undesignated trails (**Appendix L: Table L1, Figure L1, Maps 3 and 4**). However, none showed evidence of human travel (i.e., footprints, horse tracks, bike tire tracks). By 2010, these new undesignated trails accounted for 229 feet in the Spring Brook Target Area and 78 feet in the Goshawk Ridge vicinity.

Individual Undesignated Trails – New Trails:
In the Spring Brook Target Area (**Appendix L: Map 3**), an undesignated trail branching from UDT #59 was mapped in the vicinity of Lindsay Pond in 2009 and 2010. Although a beer can was seen near this new undesignated trail, the steep slope, highly erosive substrate and heavy deer use in the area suggests that this trail may have developed without human use; if this undesignated trail was observed under similar conditions in 2008, it may have been considered a wildlife trail and passed over during the baseline survey. In 2010, three new trail branches connecting the DWB Road and UDT #90 (which shortcuts the switchback in the road) were mapped along a short steep slope where slash had been placed to discourage visitor travel (**Appendix L: Map 3**).

In the GRT vicinity, new trail segments of 79 and 39 feet were detected branching from the terminus or origin of undesignated trails mapped in 2008 (**Appendix L: Map 4**). These two segments appeared to provide alternative access routes to existing undesignated trails. The 79-foot segment bypassed a buck-rail fence and connected the northern GRT (along the Conda Mine Road) to UDT #64. In 2010, the undesignated trail was still evident but the fence had been removed. The 39-foot segment provided a route with a gentler slope that connected the northern segment of the GRT to UDT #69. In 2010, this access route was not apparent although the hill

slope itself was eroded over broad areas. Although these trails may simply be new wildlife trails, their visibility could attract human travel.

Undesignated trails mapped for the first time in 2009 and 2010 are listed by assigned number, summed length and average width in **Appendix L, Table L1**.

- **Condition Classes of Undesignated Trails:** Condition classes of undesignated trail segments improved between 2008 and 2009 and between 2009 and 2010.

Overall, length of undesignated trails in the most degraded condition classes (Class 4 and 5) decreased in both the Spring Brook Target Area and the GRT vicinity (**Table 3**) such that these condition classes comprised less than nine percent of measured undesignated trail length in both sites by 2010. By 2010, undesignated trail segments in Class 2 comprised the largest proportion of undesignated trail length in both areas (**Table 3; Appendix M: Maps 5a, 5b, 6a, 6b**). Between 2008 and 2010, the proportion of undesignated trail length in Class 1 or better had increased by factors of 2.9 (GRT vicinity) to 5.1 (Spring Brook Target Area).

Additional Results -Condition Class Spatial Analyses

Spatial analysis conducted in ArcGIS assessing differences in rasterized[12] condition class maps showed that condition classes of undesignated trail segments improved over most of the measured trails between 2008 and 2010 (**Appendix M: Maps 7 and 8**). The 2010 condition class GIS layer was subtracted from the 2008 GIS layer to estimate the degree in which map cells along undesignated trails improved or degraded in condition class increments. Calculated differences in condition classes showed that while about 21 percent of mapped undesignated trail segments showed no change in condition class between 2008 and 2010, 75 percent improved by at least one condition class and less than 4 percent degraded in condition class. Between 2008 and 2010, 26 percent of the undesignated trail length showed improvement by two or more condition classes.

[12] *Rasterized* condition class maps are GIS maps depicting undesignated trails as a series of grid cells assigned a condition class value. Rasterized condition class maps are converted from the original map of linear features and are required to conduct these spatial analyses.

Table 3. Percent of undesignated trail length mapped in each of seven condition classes in the Spring Brook Target Area and the GRT vicinity during 2008 (baseline), 2009 and 2010 surveys.

Condition Class	Class Description *(Adapted from Marion, Wimpey & Park, 2009)*	Percent of measured length (%)					
		Spring Brook Target Area			GRT Vicinity		
		2008	2009	2010	2008	2009	2010
Class R	Recovered; trail tread no longer discernible	0.8	4.0	5.0	0.0	1.5	0.8
Class 0	Trail barely distinguishable; no or minimal disturbance of vegetation and/or organic litter	0.8	4.1	5.8	0.0	3.2	0.3
Class 1	Trail distinguishable; slight loss of vegetation cover and/or minimal disturbance of organic litter	4.1	19.0	18.1	4.9	8.7	13.5
Class 2	Trail obvious; vegetation cover lost and/or organic litter pulverized in primary use area	17.2	31.4	35.3	13.7	31.6	46.4
Class 3	Vegetation cover lost and/or organic litter pulverized within the center of the tread; some bare soil exposed.	32.2	28.1	29.7	52.0	38.2	30.2
Class 4	Nearly complete or total loss of vegetation cover and organic litter within the tread; bare soil widespread.	44.5	13.4	6.1	22.3	16.8	8.9
Class 5	Soil erosion obvious as indicated by exposed roots and rocks and/or gullying	0.4	0.0	0.0	7.0	0.0	0.0
Total		100.0	100.0	100.0	100.0	100.0	100.0

Additional Results: Visitor Evidence along Undesignated trails

Observations of visitor evidence such as foot prints, dog prints and horse manure were less frequent during each subsequent annual survey. In 2008, visitor evidence was recorded on 16 of the 33 trails surveyed, while visitor evidence was recorded on only four trails in 2010. Horse manure, an encounter with a visitor on an undesignated trail, a possible human foot print and evidence that slash had been moved from the trail were recorded during the 2010 surveys. In all surveys, evidence of visitor travel on undesignated trails was rare.

Summary and Management Recommendations

Adaptive management often necessitates adjustments to initial management strategies based on information acquired through monitoring. These three monitoring projects evaluated conditions of designated and undesignated trails following the opening of two new trails and implementation of new visitor regulations and designated activities. The results presented in the preceding sections are intended to help identify problems with current visitor management, trail management and undesignated trail closure strategies. The summary and management recommendations outlined below are provided to help refine these strategies to move toward desired conditions for the EM/DD-TSA.

Goshawk Ridge Trail – Trail Condition

Summary

Monitoring of GRT trail conditions found that trail width exceeded 45 inches (outside acceptable conditions) during six of the seven monitoring periods. In addition, the proportion of sampled points greater than 30 inches wide exceeded 25 percent (outside acceptable conditions) during four monitoring periods. In contrast, trail incision generally remained stable with a few sections that were not within the acceptable range returning to acceptable conditions by the final monitoring period.

Recommendations

During the 2-year monitoring project, the addition of water bars in an area prone to spring run-off and camouflaging trampled areas along trail edges were the only documented management responses implemented along the GRT. Given the specific problems identified during this monitoring project, the associated management actions listed for consideration in the EM/DD-TSA Monitoring Plan (City of Boulder, 2008, p. 16) were to:

- *Correct trail back to Class 2 Equestrian TMO standards through maintenance or minor trail adjustments;*
- *Add additional trail/drainage structures in areas prone to incision, widening or erosion;*
- *Add a physical barrier to restrict further widening (near the junction with the DWB Road);*
- *Disguise excess width with locally harvested organic material;*
- Change education, outreach, signs or enforcement;
- Meet with stakeholders to determine strategies to minimize tread incision and trail widening associated with visitor activity; and
- Consider use restrictions (e.g., temporal closure).

Staff recommends that adaptive management responses focus on the first four bulleted actions at specific problem areas when feasible and continue to monitor the width of the GRT during the recurring system-wide trail condition monitoring project at 5 to 10 year intervals. Additionally, temporary trail closures during extensively wet and muddy conditions may be applied to reduce trail widening that occurs when visitors avoid muddy trail sections. Temporary trail closures during wet and muddy conditions are implemented throughout the OSMP system.

Goshawk Ridge Trail – Segment Two Condition

Summary

Monitoring of Segment Two of the GRT found that during three of the seven monitoring periods, trail width exceeded 30 inches (outside acceptable range) and a few continuous sections greater

than 36 inches wide persisted (outside acceptable range). Trail incision generally remained stable and stayed within the acceptable range.

Recommendations

To date, no management actions were implemented in response to the GRT-Segment Two monitoring. Based upon the monitoring results presented in this report, the associated management actions listed for consideration in the EM/DD-TSA Monitoring Plan (City of Boulder, 2008, p. 16) were to:

- De-berm the trail tread and adding drain dips; and
- Add wood or rock water bars and risers along sections that remained greater than 36 inches wide.

Staff recommends adaptive management responses focus on both of these bulleted actions at specific problems areas when feasible. Additionally, OSMP should construct a rock wall or another erosion control feature in the area susceptible to erosion located approximately 975 - 1,050 linear feet from origin of Segment Two. OSMP should also continue to monitor the GRT-Segment Two during the recurring system-wide trail condition monitoring project at 5 to 10 year intervals.

Spring Brook Loop and Goshawk Ridge Trail – Undesignated Trails

Summary

Monitoring revealed that two of the three undesignated trail indicators (i.e., decreases in both width and length) showed improvements from baseline conditions, suggesting that travel on these undesignated trails had decreased since the creation and opening of SBL and GRT. Condition classes along mapped segments also improved during each subsequent monitoring session. Construction of designated trails in this area did not appear to have facilitated continued use of existing undesignated trails when closure and restoration measures were in place. However, detection of new undesignated trail segments in 2009 and/or 2010 highlights an unacceptable condition for one indicator. The visibility of these new trails and their use by human visitors should be considered in developing future management actions.

Recommendations

The following recommendations for adaptive management responses should be considered given results from the 2 years of undesignated trail monitoring:

- Consider implementing alternative closure, restoration, or management strategies for UDT #90 in light of repeated slash removal, minimum trail tread improvements (particularly between 2009 and 2010), and development of branching trails near one end.
- Evaluate the need to take actions on newly developed undesignated trail segments considering both their likely use as wildlife trails versus their potential to invite visitor travel. Staff should evaluate if any of the listed responses in the EM/DD-TSA Monitoring Plan (**Appendix N**) could curtail the development of these new undesignated trail branches. Staff should also consider informally tracking the condition of these branch trails in the future to see if they are ephemeral, persistent, and/or displaying evidence of human or horse travel.

Summary and Management Recommendations

- End EM/DD-TSA focused undesignated trail monitoring given the improved conditions on undesignated trails over the two year monitoring period and the inefficiencies associated with mapping recovered segments.
- Continue to monitor these undesignated trails at a less frequent interval starting in 2011 and periodically thereafter through OSMP's system-wide undesignated trail monitoring.
- Continue to encourage reporting by rangers, other field staff, and volunteer trail guides of the development of new undesignated trails or the degradation of existing undesignated trails, particularly near their intersection with designated trails where they are obvious to visitors. Such reporting can provide a rapid means to alert managers to problems before they become irreversible and can prioritize those undesignated trails of greatest concern (i.e., UDT #90, #14, and #9).

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Appendices

Appendices (GRT-Trail Condition)
Appendix A. OSMP system-wide trail management objectives and GRT-specific form
Appendix B. Photographs illustrating different types of boundary determinations
Appendix C. Complete GRT-Trail Condition monitoring results
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Appendix N. Range of thresholds and responses for monitored indicators presented in the 2008 EM/DD-TSA Monitoring Plan

Appendix A. OSMP system-wide trail management objectives with the GRT classification highlighted in yellow (City of Boulder, 2007) and GRT-specific TMO form.

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
Class 0	Example:	N/A	0-2'	N/A	<=15%	N/A	N/A	N/A	ok	No	No	No	No	No
	climging access													

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

Trail Management Objectives

TSA: EM/DD | Trail Management Area: Eldorado Mountain HCA

Trail Name: Goshawk Ridge Trail | **Trail Number:**

Trail Beginning Termini:

Trail Ending Termini:

Trail Length (Miles):

Trail Mileage Source: [ ] Wheel [ ] GPS [ ] Map [ ] Unknown

TMO Trail Segment

Seg. #:

Seg. Beg. Termini: | **Beg. Milepost:**

Seg. End. Termini: | **End. Milepost:**

Designed Use Objectives

Trail Class

(Check one)

- [ ] 1 (Primitive/Undeveloped)
- [X] 2 (Simple/Minor Development)
- [ ] 3 (Developed/Improved)
- [ ] 4 (Highly Developed)
- [ ] 5 (Fully Developed)

Designed Use

(Check one)

- [ ] Hiker/Pedestrian
- [X] Equestrian/Horse
- [ ] Bicycle
- [ ] Wheelchair
- [ ] Authorized Motor Vehicles

Alignment Origin

(Check all that apply. Circle appropriate clarifier in parenthesis)

- [X] Official Trail Design
- [X] Visitor Created/Social Trail
- [ ] 4+ Wheeled Vehicle/Road
- [ ] Rail Road
- [ ] Easement (Ditch / Utility)
- [ ] Easement (Trail/Access)
- [ ] _____

Design Parameters

(Fill in all that apply)

- 18 TO 30 Tread Width Range (inches)
- 6 Clearing Width (feet)
- 10 Clearing Height (feet)
- 12 Max. Sustained Grade (%)
- 8 Max. Sustained Pitch (%)
- 8 Turn Radius (feet)
- [ ] _____
- natural Surface Material

Target Frequency Per Year

(Fill in all that apply)

- [ ] Condition Survey
- [ ] Tread Repair
- [ ] Bridge Inspection
- [ ] Drainage Cleanout
- [ ] Use Survey
- [ ] Logging Out
- [ ] _____
- [ ] Brushing

TRACS TMO Form v1.0 - Side 1 (32/15/2004) modified for OSMP Use 4/19/2007

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Travel Management Strategies

Managed Use

(Fill in all that apply)

		From Date (mm/dd)	To Date (mm/dd)
X	Hiker / Pedestrian	1/1	12/31
X	Equestrian / Horse	1/1	12/31
	Bicycle		
	Wheelchair		
	Authorized Motor Vehicles*		
	_____		
	Dogs / Voice & Site (V&S)		
	Dogs / V&S On Corridor		
	Dogs / On Leash		
	Dogs/On Leash On Trail		
	Trad Climbing / Bouldering		
	Sport Climbing		

Prohibited Use

(Check if applicable)

		From Date (mm/dd)	To Date (mm/dd)
	Authorized Motor Vehicles*		

(Or, fill in all that apply)

	Hiker / Pedestrian		
	Equestrian / Horse		
X	Bicycle		
	Wheelchair		
	Strollers		
X	Wheeled Boards		
X	In-line Skates		
	Snowshoe		
	Cross-Country Ski		
X	Dogs		
X	Dog Drawn Vehicle		
X	Horse Drawn Vehicle		

* Authorized trail equipment is exempt

Other Use

(Fill in all that apply)

	Accept	Discourage	Eliminate
Hiker / Pedestrian	X		
Equestrian / Horse	X		
Bicycle			X
Wheelchair		X	
Authorized Motor Vehicles*			X
Strollers		X	
Snowshoe	X		
Cross-Country Ski	X		
Dog Drawn Vehicle			X
Horse Drawn Vehicle			X
In-line Skates			X
Wheeled Boards			X
Dogs			X

* Authorized trail equipment is exempt

Special Considerations

(Check any that apply. Circle appropriate clarifier in parenthesis. Provide specifics and reference information below.)

	Accessible per Current Agency Guidelines
	Mechanized Tools or Equipment Prohibited
X	T&E or Sensitive Species Present (Plant / Wildlife)
X	Heritage / Cultural Resource Present
X	Easement across Non-OSMP Land (Existing / Needed)
	Existing Permit or Agreement (Trail-Specific / Area)
	_____

Remarks / Reference Information

Native American prayer ring and fire ring

Name _____ Signature _____

Title _____ Date _____

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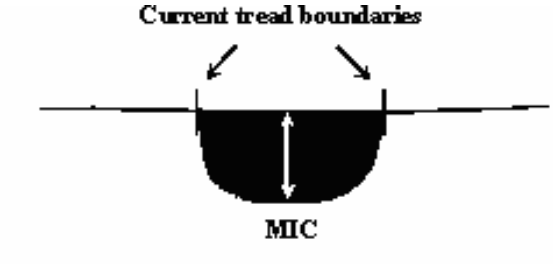
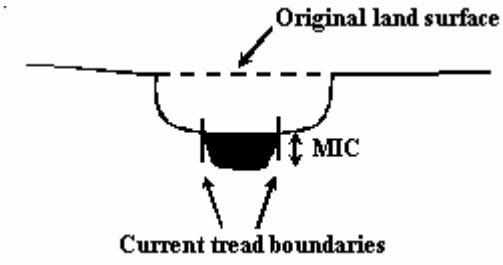
Appendix B. Trail tread boundary illustrations (top panel) and current tread boundary diagrams (bottom panel) used to guide trail edge and incision determinations (Marion & Hockett, 2008).

Trail tread boundaries are defined as the most pronounced outer boundary of visually obvious human disturbance created by trail construction/travel (not trail maintenance like vegetation clearing) used to delineate the trail tread that receives the majority (>95%) of traffic. These boundaries are defined by pronounced changes in ground vegetation height (trampled vs. untrampled), cover, composition, or, when vegetation cover is reduced or absent, as pronounced changes in organic litter (intact vs. pulverized).

MIC is the "maximum incision current tread"



GRT-Trail Condition Project
(Constructed trail)



GRT-Segment Two Project
(Historical erosion present; never constructed)

Appendix C. Complete GRT-Trail Condition monitoring results.

Table C1. Goshawk Ridge Trail - Trail Condition Monitoring
Baseline (January 2009) through December 2010 Results

Resource Indicator	Baseline Condition	March 2009 Condition	June 2009 Condition	September 2009 Condition
Trail Width Range	19 - 41 inches	20 - 66 inches (5 points ≥45", 11%)	18 - 40 inches	17 - 49 inches (2 points ≥45", 4%)
Trail Tread Incision Range	0 - 1 inch	0 - 2 inches	0 - 5 inches	0 - 3 inches
Incision: Any section of the trail 10 feet or longer is incised ≥2 inches beyond baseline median*	n/a to baseline	None	1 occurrence	None
(Length)			(10 feet)	
Trail Width: <25% of sample points >30 inches	14% >30 inches	28% >30 inches	14% >30 inches	13% >30 inches
Incision: <25% of sample points are incised ≥2 inches baseline median*	n/a to baseline	13% ≥2 inches	7% ≥2 inches	12% ≥2 inches
*** = 0 inches**	**Acceptable**		**Unacceptable**	

Resource Indicator	April 2010 Condition	June 2010 Condition	September 2010 Condition	December 2010 Condition
Trail Width Range	16 - 61 inches (5 points ≥45", 11%)	15 - 68 inches (4 points ≥45", 9%)	17 - 82 inches (2 points ≥45", 5%)	17 - 66 inches (4 points ≥45", 9%)
Trail Tread Incision Range	0 - 3 inches	0 - 3 inches	0 - 1 inch	0 - 2 inches
Incision: Any section of the trail 10 feet or longer is incised ≥2 inches beyond baseline median*	None	2 occurrences	None	None
(Length)		(11 feet, 10 feet)		
Trail Width: <25% of sample points >30 inches	43% >30 inches	39% >30 inches	23% >30 inches	32% >30 inches
Incision: <25% of sample points are incised ≥2 inches baseline median*	6% ≥2 inches	8% ≥2 inches	0% ≥2 inches	2% ≥2 inches
*** = 0 inches**	**Acceptable**		**Unacceptable**	

Appendix D. Sample of GRT-Trail Condition repeat photo points.

GRT eastern end @ pedestrian bridge – January 2009

GRT eastern end @ pedestrian bridge – December 2010

GRT ford two crossing – January 2009

GRT ford two crossing – December 2010

Appendix E. Limits of Acceptable Change (LAC) summary (adapted from Stankey et al., 1985) and GRT-specific LAC specifications.

Table E1. Limits of Acceptable Change summary

LAC Component	LAC Step	Description
Component One - Identify issues, concerns and opportunities	Step One	Identify area issues and concerns
	Step Two	Define and describe opportunity classes/zones
Component Two - Determine present condition of areas of concern	Step Three	Select indicators of resource and social conditions
	Step Four	Inventory existing resource and social conditions
	Step Five	Specify measurable standards for the resource and social indicators selected. These standards provide measures against which current conditions can be judged acceptable or not.
Component Three - Determine action plan	Step Six	Compile information from Components One & Two and identify alternative opportunity class allocations
	Step Seven	Identify what management actions would be needed for each alternative. Examples of possible management actions include: increased education efforts, relocating trails away from sensitive areas, redirect visitors to a certain area.
	Step Eight	Evaluate and select a preferred alternative. This determines an action plan.
Component Four - Implement and monitor action plan	Step Nine	Implement actions for preferred alternative and monitor conditions.

Table E2. Goshawk Ridge Trail Segment 2 LAC Monitoring Ranges of Acceptability and Possible Management Responses		
Resource Indicator	**Ranges of Acceptability**	**Possible Management Responses**
Trail Width Range	≤ 30 inches	None (acceptable)
	31-36 inches	De-berm trail tread, drain dips
	>36 inches and < 200 linear feet	Add use of wood or rock water bars and risers
	>36 inches and > 200 linear feet	Re-route*
Trail Braiding Condition Class	Condition class 0	None (acceptable)
(Length)	Condition class 1	Install drainage structure, temporary closure
	Condition class 2-3 (and <100 linear feet)	Install drainage structure, temporary closure
	Condition class 2-3 (and >100 linear feet)	Re-route
Trail Tread Incision Median	0-2 inches	De-berm trail tread and drain dips
	3-7 inches	Add use of rock or wood water bars
	≥ 8 inches	Add use of risers
Number of Undesignated Trails	0 trails	None (acceptable)
	1-3 trails	Take action to close social trails that is consistent with condition class, increase ranger patrols, adjust number of off-trail permits
	>3 trails	Re-route
Undesignated Trail Condition Class	Condition class 0-1	Install carsonite closure sign
	Condition class 2	Install closure sign, seeding (if needed) and matting, increase ranger patrol
	Condition class 3	Re-route
Number of Structures	≤30 structures	None (acceptable)
	> 30 structures	Re-route
*Segment Two will be rerouted when conditions breach two or more indicators that include reroute as a management response		

Appendix F. Condition class ratings and descriptions (Marion, Wimpey, & Park, 2009).

Condition Class Rating	Description
Class 0	Trail barely distinguishable; no or minimal disturbance of vegetation or organic litter
Class 1	Trail distinguishable; slight loss of vegetative cover and/or minimal disturbance of organic litter
Class 2	Trail obvious; vegetative cover lost and/or organic litter pulverized in primary use areas
Class 3	Vegetative cover and organic litter pulverized within the center of the tread, some bare soil exposed
Class 4	Nearly complete or total loss of vegetation cover and organic litter within the tread, bare soil widespread
Class 5	Soil erosion obvious, as indicated by exposed roots and rocks and/or gullying

Appendix G. Complete GRT-Segment Two Condition monitoring results.

Table G1. Goshawk Ridge Trail - Segment Two Monitoring Baseline (October 2008) through December 2010 Results

Resource Indicator	Baseline Condition	Mar 2009 Condition	Jun 2009 Condition	Sep 2009 Condition
Trail Width Range	9 -18 inches	12 - 24 inches	12 - 22 inches	14 - 24 inches
Trail Braiding Condition Class	None	Class 0	None	None
(Length)		(24 feet)		
Trail Tread Incision Median	1 inch	2 inches	0 inches	1 inch
Number of Undesignated Trails	None	None	None	None
Undesignated Trail Condition Class	n/a - no undesignated trails to classify			
Number of Structures	28	28	28	28
	Acceptable			

Resource Indicator	Mar 2010 Condition	Jun 2010 Condition	Sep 2010 Condition	Dec 2010 Condition
Trail Width Range	14 - 21 inches	13 - 40 inches	15 - 40 inches	14 - 40 inches
Trail Braiding Condition Class	None	None	None	None
(Length)	n/a - no trail braiding to classify			
Trail Tread Incision Median	1 inch	0 inches	0 inches	0 inches
Number of Undesignated Trails	None	None	None	None
Undesignated Trail Condition Class	n/a - no undesignated trails to classify			
Number of Structures	28	28	28	28
	Acceptable		Unacceptable	

Appendix H. Sample of GRT-Segment Two Condition repeat photo points.

GRT-Segment Two southern end – October 2008

GRT-Segment Two southern end – December 2010

GRT-Segment Two northern end – October 2008

GRT-Segment Two northern end – December 2010

Appendix I. Length data and maps for individual undesignated trails and recovered segments (2008-2010).

Table I1. Length of undesignated trail (UDT) segments and associated recovered segments in the Spring Brook Target Area mapped during baseline (2008), 2009 and 2010 surveys.

Spring Brook Target Area	Mapped Length (ft) / Recovered Length (ft)			Comments
UDT ID#	2008	2009	2010	
10	896.1	672.8	700.1	Barrier fence near origin; slash placed near beginning and midpoints of trail; Used to access bouldering area; Segments through meadow recovered or very difficult to discern; Crosses creek
	0.0	229.1	208.7	
13	2688.4	2655.4	2646.5	Long trail primarily running through grassy meadow to west of forest edge; Somewhat parallel to DWB road; Recovered segment through grassy untreed area; Possible access to bouldering area
	0.0	22.9	51.5	
14	944.3	942.1	947.8	Large boulder and rocks placed near intersection with SBL; Parallels part of SBL-north
	0.0	0.0	0.0	
21	3876.9	3903.8	3836.7	Retained for forest management; Crosses SBL but originates from DWB road beyond "no trespass" sign; Inter-annual variability is due to small changes in mapped alignments at multiple locations where the trail edges are difficult to discern
	0.0	0.0	0.0	
22	130.3	139.6	125.7	Near Lindsay Pond; UDT joins UDT #70; much wildlife use
	0.0	0.0	0.0	
23	5665.8	5652.9	5519.6	Segments that cross SBL have been actively restored; Many short recovered segments; Closure measures included seeding, scarification, wattles, matting, organic litter, check dams, rocks, mulch, signs, fencing
	0.0	0.0	127.8	
24	993.9	976.0	982.8	Wildland Restoration Volunteer restoration project on steep eroded trail; Closure measures included scarification, wattles, matting, organic litter, check dams, rocks, water bars, signs, and barrier fences
	0.0	0.0	0.0	

Spring Brook Target Area	Mapped Length (ft) / Recovered Length (ft)			Comments
UDT ID#	2008	2009	2010	
25	307.5	308.1	311.0	Active restoration with mulching, scarification, wattles, seeding and grading; Joins UDT #71 and UDT #23; Fencing near intersection with social trail to Doudy Draw
	0.0	0.0	0.0	
55	446.6	450.1	662.1	~ 212 ft extension from old terminus mapped in 2010; extension meets up with UDT #71; deer use primarily?; Barrier fence, closure sign, and slash near intersection with Doudy Draw switchback; slash appears to have been moved in 2009 and 2010
	0.0	0.0	0.0	
59	1340.2	1200.4	1127.4	Recovered segment near origin through grassy field; Some steep areas along trail or above and below trail; Closure measures included slash placement; barrier fences and signs
	168.8	323.4	409.5	
70	268.3	252.1	246.2	Northern end of Lindsey Pond; alignment may shift with water level of pond
	0.0	0.0	0.0	
71	2648.7	2662.7	2658.8	Closure measures include barrier fence and signage near origin; wattles along steep portions of trail; seeding?
	0.0	0.0	0.0	
82	182.5	121.9	125.3	Much wildlife use; Alignment changed between 2009 and 2010 to a straighter, less meandering path
	0.0	0.0	0.0	
84	274.4	138.9	136.9	Connects UDT #13 and UDT #10 ~ parallel to DWB road; Wattle near origin; Recovered segments through grassy meadow
	0.0	136.0	149.9	
85	125.8	0.0	0.0	Trail completely recovered although heavy deer use in area
	0.0	124.9	126.0	

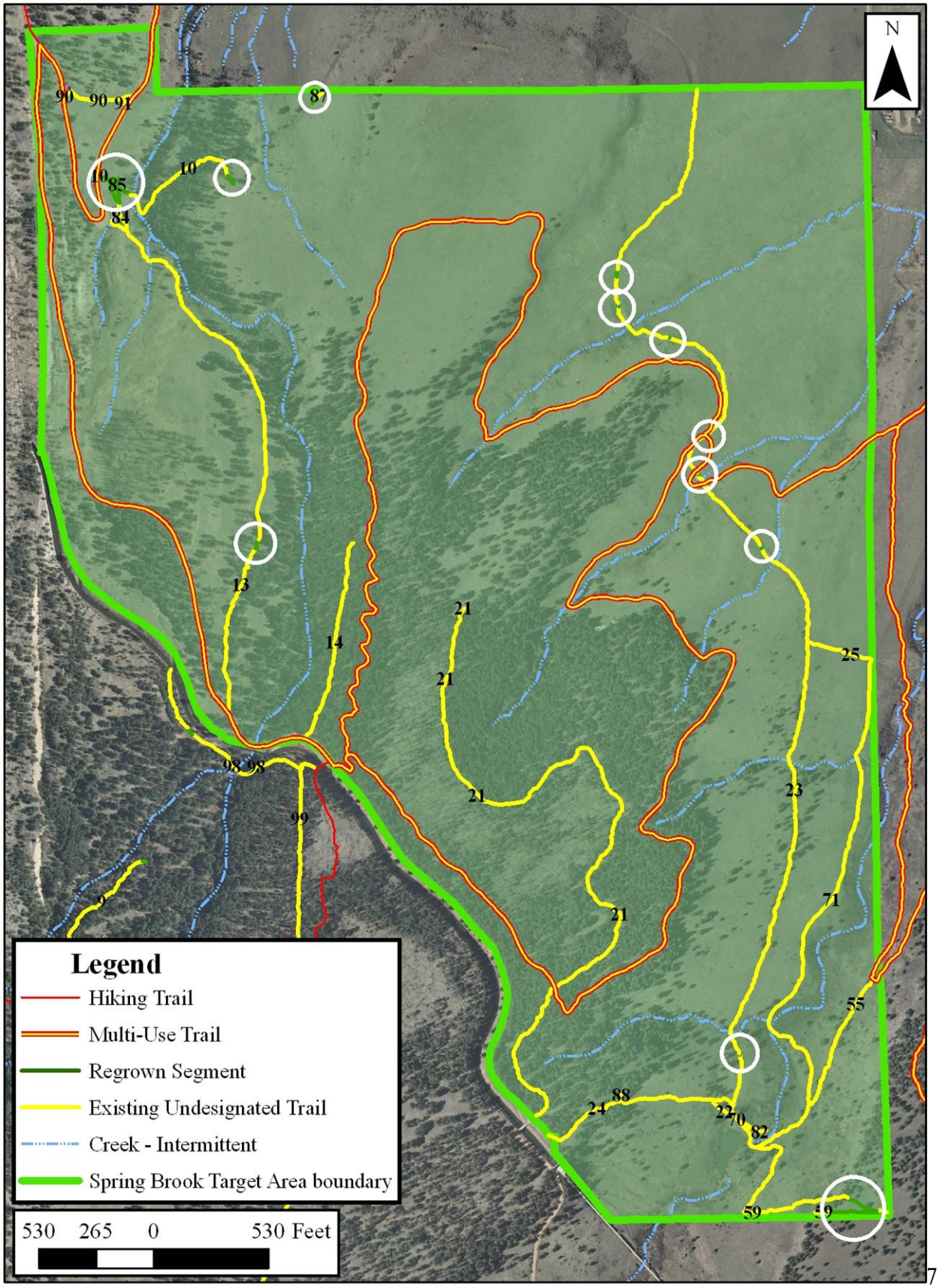
Spring Brook Target Area	Mapped Length (ft) / Recovered Length (ft)			Comments
UDT ID#	2008	2009	2010	
87	49.3	31.9	46.6	A small segment of the railroad grade UDT where it crosses back from private property onto our side of the fence; In 2008 and 2009, gaps along the bottom of fence were noted
	0.0	22.7	19.6	
88	38.9	44.8	38.4	Very short branch spur from UDT #24 treated with rocks, slash, and organic material; on relatively steep slope and difficult to relocate
	0.0	0.0	0.0	
90	361.9	341.4	344.3	Shortcuts switchback along DWB road/SBL-north; Slash blocking intersection moved off tread in 2009 and 2010; multiple branches developed at upper end of trail
	0.0	0.0	0.0	
91	67.3	63.8	60.6	Short branch from DWB road to UDT #90; alignment shifts from year to year
	0.0	0.0	0.0	

Table I2. Length of undesignated trail (UDT) segments and associated recovered segments in the GRT vicinity mapped during baseline (2008), 2009 and 2010 surveys.

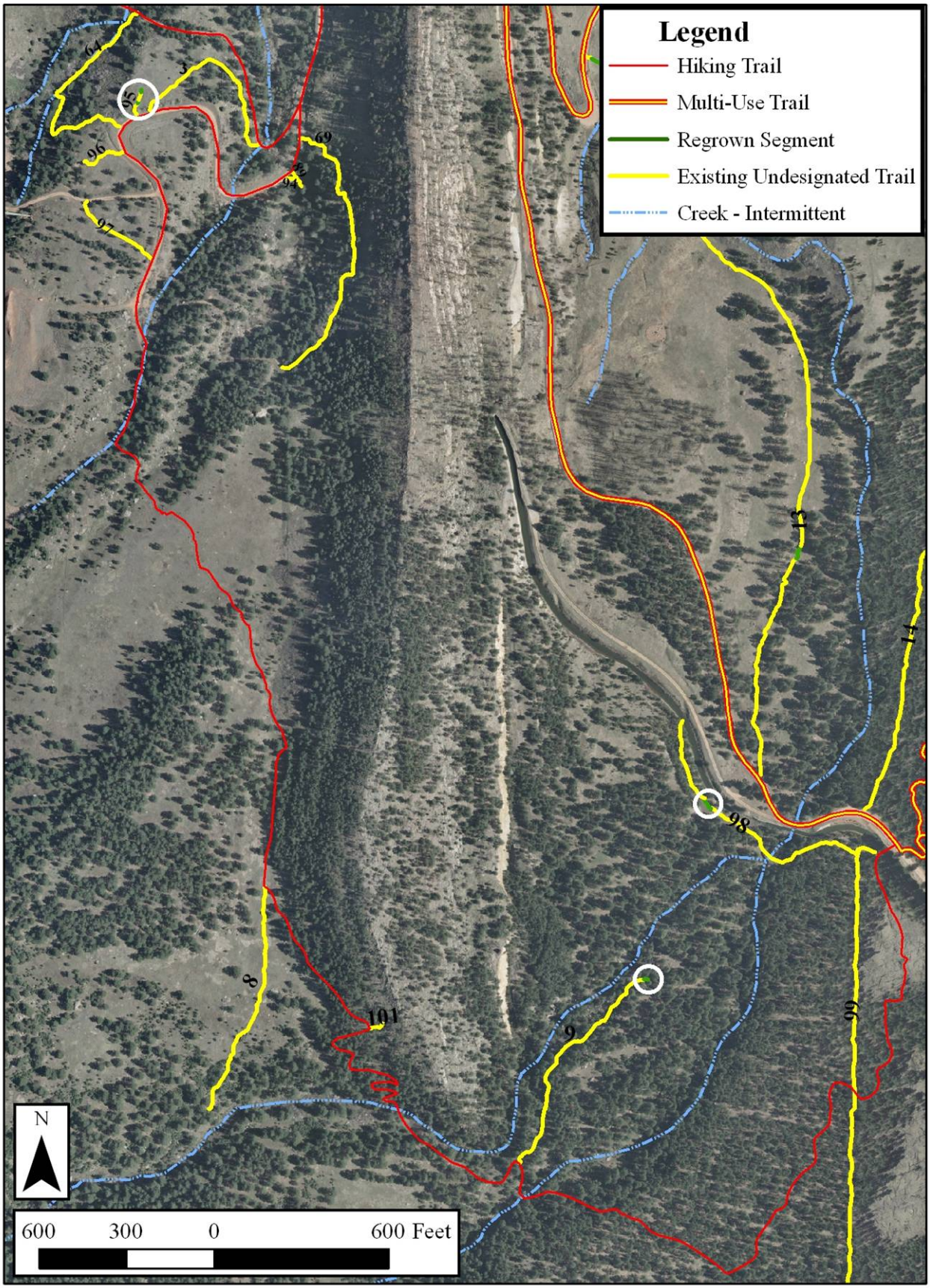
GRT vicinity	Mapped Length (ft) / Recovered Length (ft)			
UDT ID#	2008	2009	2010	Comments
3	685.3	661.9	681.7	Connects GRT to Fowler; Closure sign near junction with Fowler; Recovered segment (2009) in grassy meadow mapped in 2010 along different alignment
	0.0	16.7	0.0	
8	837.7	785.7	837.4	Slash and closure sign at intersection with GRT; Recovered segment through tall grass in 2009 relocated with slight trampling on slightly different alignment in 2010
	0.0	48.4	0.0	
9	877.5	861.0	858.1	Some rocks and slash placed near intersection with GRT
	0.0	11.8	15.7	
64	852.1	832.8	843.8	Closure measures included barrier fences at both ends (one later removed), wattles, plantings, slash and rocks; fence posted with HCA and closed sign
	0.0	0.0	0.0	
69	1033.4	1034.7	1046.5	Footprints and horse manure recorded in 2008 and 2009; Biker observed on trail in 2010 searching for climbing access; end of trail drops steeply down an eroded bank
	0.0	0.0	0.0	
89	63.9	66.0	66.6	Short spur provides access to creek; Small pile of newly placed slash ~ 30 ft down trail
	0.0	0.0	0.0	
94	36.6	36.8	34.4	Short spur provides access to creek and meets diagonally with UDT #89
	0.0	0.0	0.0	
95	98.3	30.8	73.3	Closure posted near intersection with GRT; Short trail into meadow; Recovered segments through meadow
	0.0	67.0	22.2	
96	166.5	158.0	165.9	Trail to “red-rock cola cabin”; Not fenced at intersection with GRT; Fence around cabin
	0.0	0.0	0.0	
97	326.3	327.0	323.6	Mulch applied to portions of trail; earthen barricade near intersection with GRT

GRT vicinity	Mapped Length (ft) / Recovered Length (ft)			
UDT ID#	2008	2009	2010	Comments
	0.0	0.0	0.0	
98	1028.9	1030.5	987.7	Parallels DWB canal; monitored but retained for access; Recovered segment where it crosses grassy non-forested section; Intersection with GRT blocked with slash
	0.0	0.0	42.6	
99	1545.3	1549.7	1552.8	Two-track monitored but retained for management access; Mulch applied.
	0.0	0.0	0.0	
100	2006.0	2007.8	2005.5	Two-track monitored but retained for access; Only the 1st 2000 feet were mapped; Continuation of UDT #99 that originates at intersection with another DWB access road.
	0.0	0.0	0.0	
101	53.4	51.1	57.4	Possibly access to rocky viewpoint; climbing area; Rockiness makes it difficult to discern path
	0.0	7.4	0.0	

Map 1. Regrown segments of undesignated trails (circled in white) mapped in 2010 in the Spring Brook Target Area. Numbers identify undesignated trail IDs.



Map 2. Regrown segments of undesignated trails (circled in white) mapped in 2010 in the GRT vicinity. Numbers identify undesignated trail IDs.



Appendix J. Median widths of undesignated trail segments in the Spring Brook Target Area and the GRT vicinity (2008-2010).

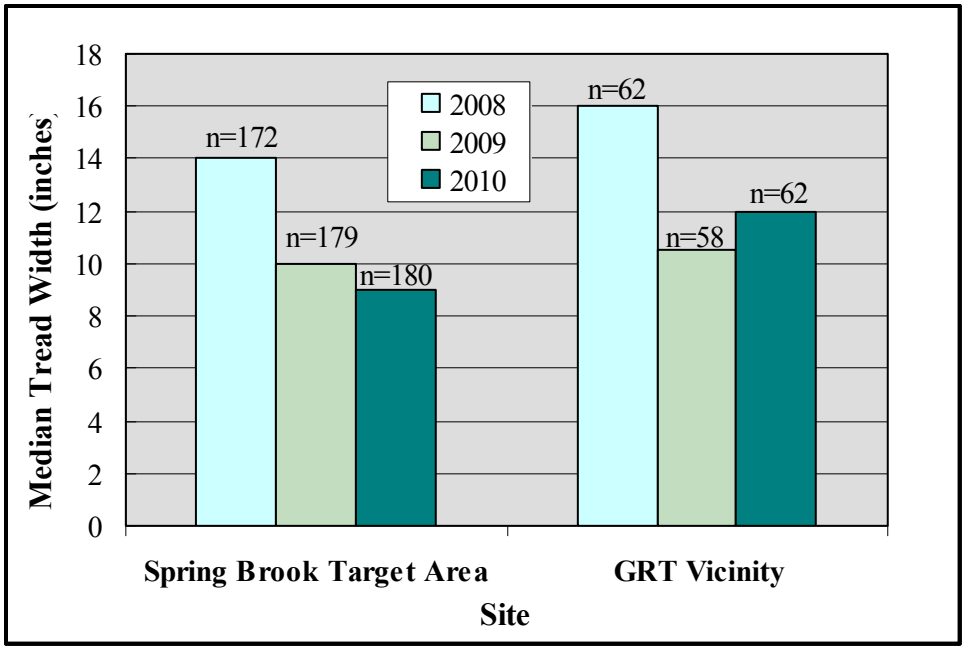


Figure J1. Median widths and sample sizes (above bars) for interior points measured on undesignated trails during the 2008 (baseline), 2009 and 2010 surveys in the Spring Brook Target Area and GRT vicinity.

Appendix K. Mean width of individual undesignated trails (2008-2010).

Table K1. Mean width and sample sizes for interior sample points mapped along undesignated trails during 2008 (baseline), 2009 and 2010 surveys in the Spring Brook Target Area.

SB Target Area Undesignated Trails	Mean Width (inches) N=sample points			
UDT ID#	2008	2009	2010	Comments
10	14.3	7.9	7.7	
	9	9	9	
13	12.9	9.0	9.2	
	26	27	27	
14	22.3	13.2	18.8	
	7	9	10	
21	84.9	63.5	88.6	This 2-track not included in calculations of mean width; width was not measured at a number of points in 2009 because the trail edge was not discernible
	38	32	38	
22	13.0	10.0	7.0	
	1	1	1	
23	12.8	10.4	9.1	
	56	57	57	
24	20.1	13.7	11.0	
	10	10	10	
25	18.7	19.0	11.3	
	3	3	3	
55	12.0	7.6	8.9	
	5	5	7	
59	14.6	10.1	8.5	
	15	16	15	
70	19.0	13.0	11.3	
	3	3	3	
71	14.6	10.9	9.6	
	26	27	27	
82	11.0	5.0	15.0	
	1	1	1	
84	15.3	3.0	4.7	
	3	3	3	
85	8.5	0.0	0.0	Entire undesignated trail recovered
	2	2	1	
87	9.0	0.0	5.0	
	1	1	1	
88	*missed*	8.0	10.0	Short spur (~ 38 ft) with width sample missed in 2008; Not included in calculations of mean width
	0	1	1	
90	18.0	10.3	16.5	
	3	4	4	
91	12.0	7.0	5.0	
	1	1	1	

Table K2. Mean width and sample sizes for interior sample points mapped along undesignated trails during 2008 (baseline), 2009 and 2010 surveys in the GRT vicinity.

GRT Undesignated Trails	Mean Width (inches) N=sample points			
UDT ID#	2008	2009	2010	Comments
3	13.0	11.0	9.4	
	7	7	7	
8	15.6	7.7	7.6	
	9	8	8	
9	17.0	8.0	11.1	
	9	8	9	
64	26.5	19.6	15.4	
	8	9	9	
69	16.2	12.2	12.6	
	11	11	11	
89	11.0	16.0	10.0	
	1	1	1	
94	12.0	5.0	6.0	
	1	1	1	
95	9.0	0.0	10.0	Sample point fell on recovered section in 2009 but not in 2010
	1	1	1	
96	27.0	10.0	14.0	Sample point fell on portion of trail that widens into historic 2-track in 2008 and 2010
	1	1	1	
97	18.0	37.0	13.3	
	3	3	3	
98	22.9	24.0	21.2	3 width points could not be measured in 2009 where persistent snow obscured the trail edges;
	10	7	10	
99	119.1	90.9	90.4	This 2-track not included in average width calculations
	15	15	15	
100	104.4	87.8	97.4	This 2-track not included in average width calculations
	5	5	5	
101	23.0	7.0	5.0	
	1	1	1	

Appendix L. Data, photographs, and maps of new trails mapped in the Spring Brook Target Area and GRT vicinity (2008-2010).

Table L1. Length, mean width, and condition classes recorded for new trail segments mapped in 2009 and 2010 monitoring surveys. GRT=GRT vicinity; SB=Spring Brook Target Area

UDT ID		Length (ft)		Width (in)		Condition Class		Comment
ID#	Site	2009	2010	2009	2010	2009	2010	
102	GRT	79.1	77.8	9	18	CC2	CC2	New branch around fence to UDT #64
104	GRT	39.2	0	9	0	CC2		Alternative "gentler" access to/from UDT #69; not apparent or remeasured in 2010
103	SB	112.7	135.3	9	7	CC3	CC3	Branch from UDT #59 in Lindsay Pond vicinity
108	SB	0	26.2	0	18		CC3	New branch to UDT #90 shortcutting road switchback; first mapped in 2010
109	SB	0	30.8	0	12		CC2	New branch to UDT #90 shortcutting road switchback; first mapped in 2010
112	SB	0	36.7	0	14		CC2	New branch to UDT #90 shortcutting road switchback; first mapped in 2010

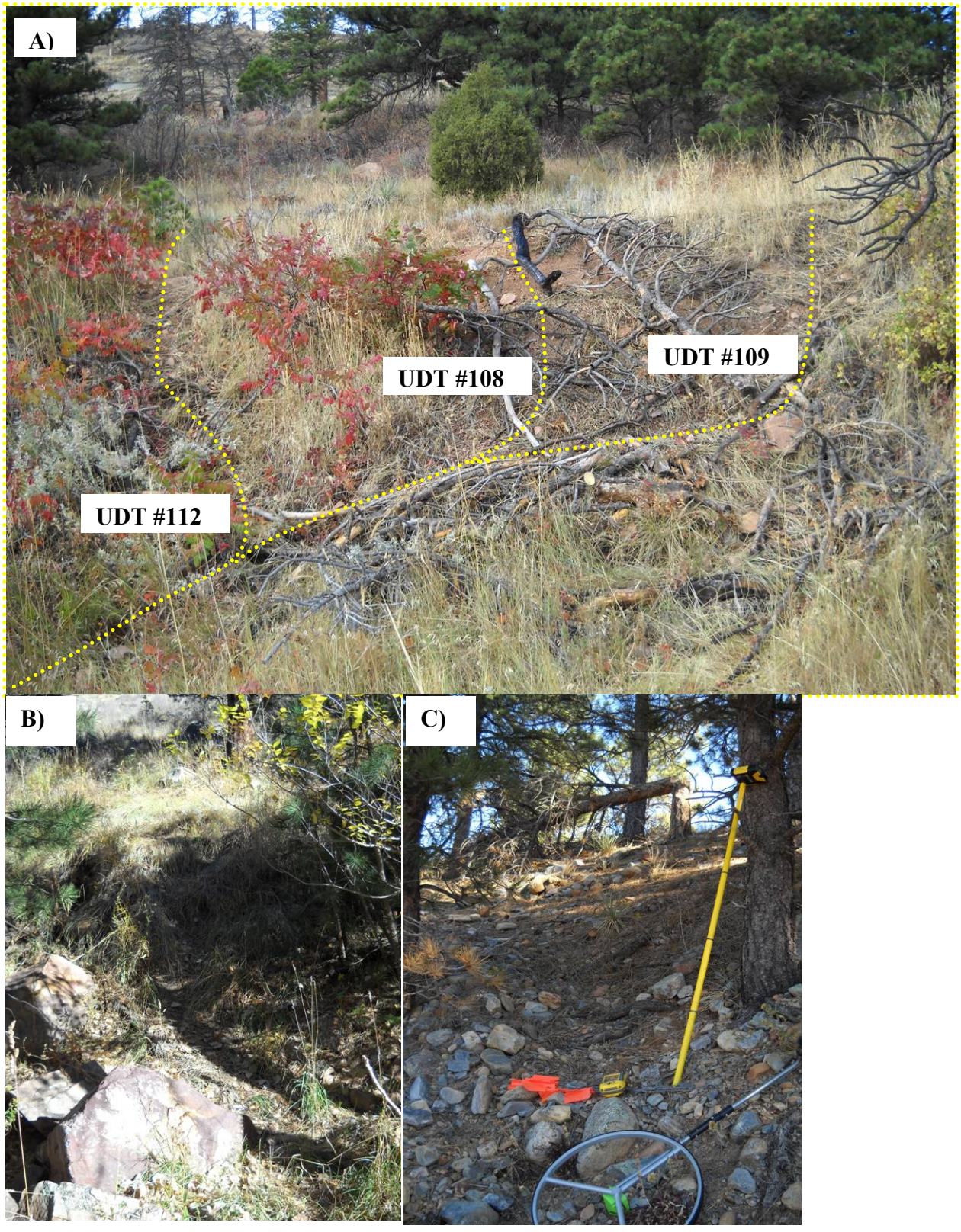
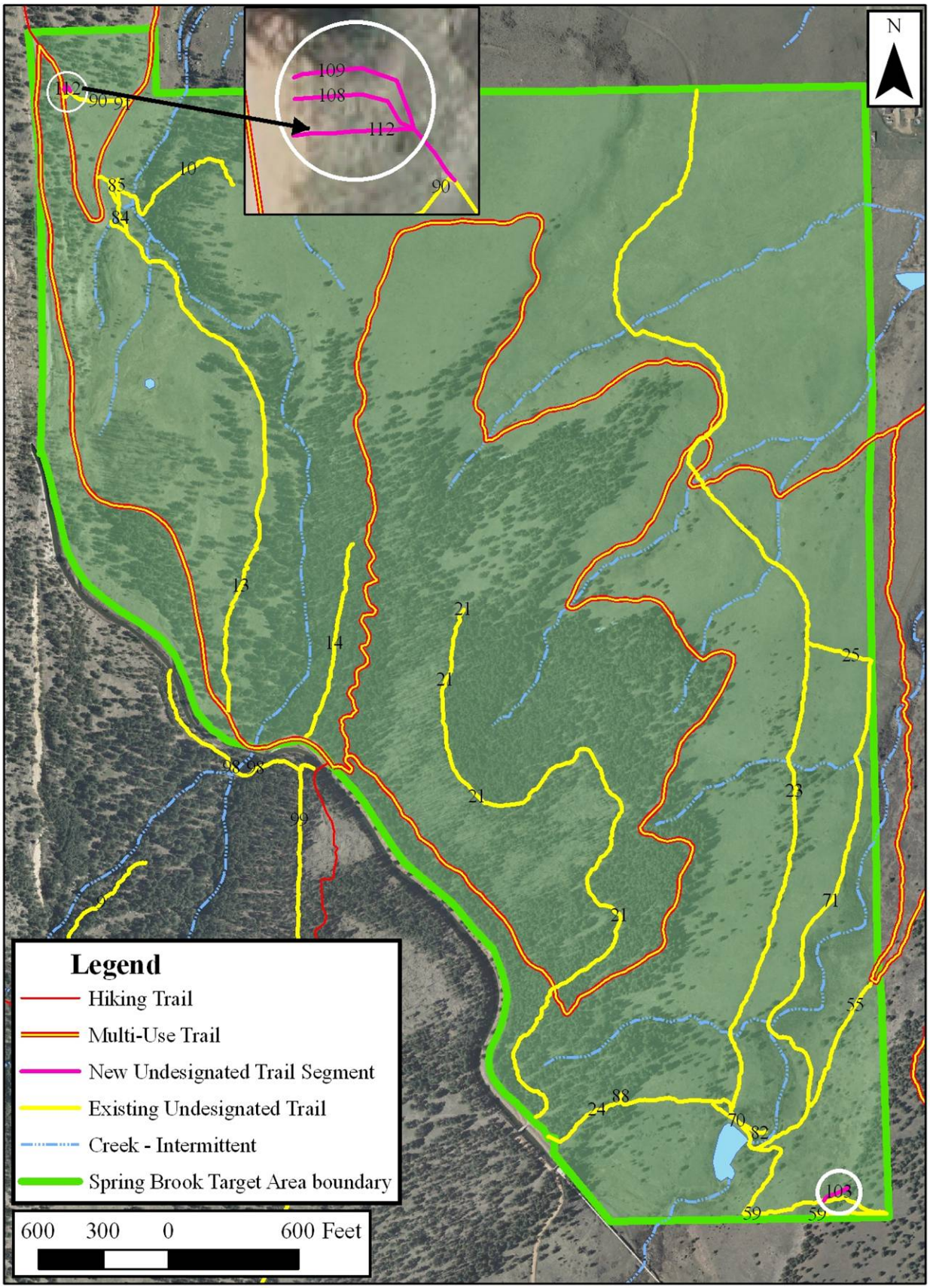
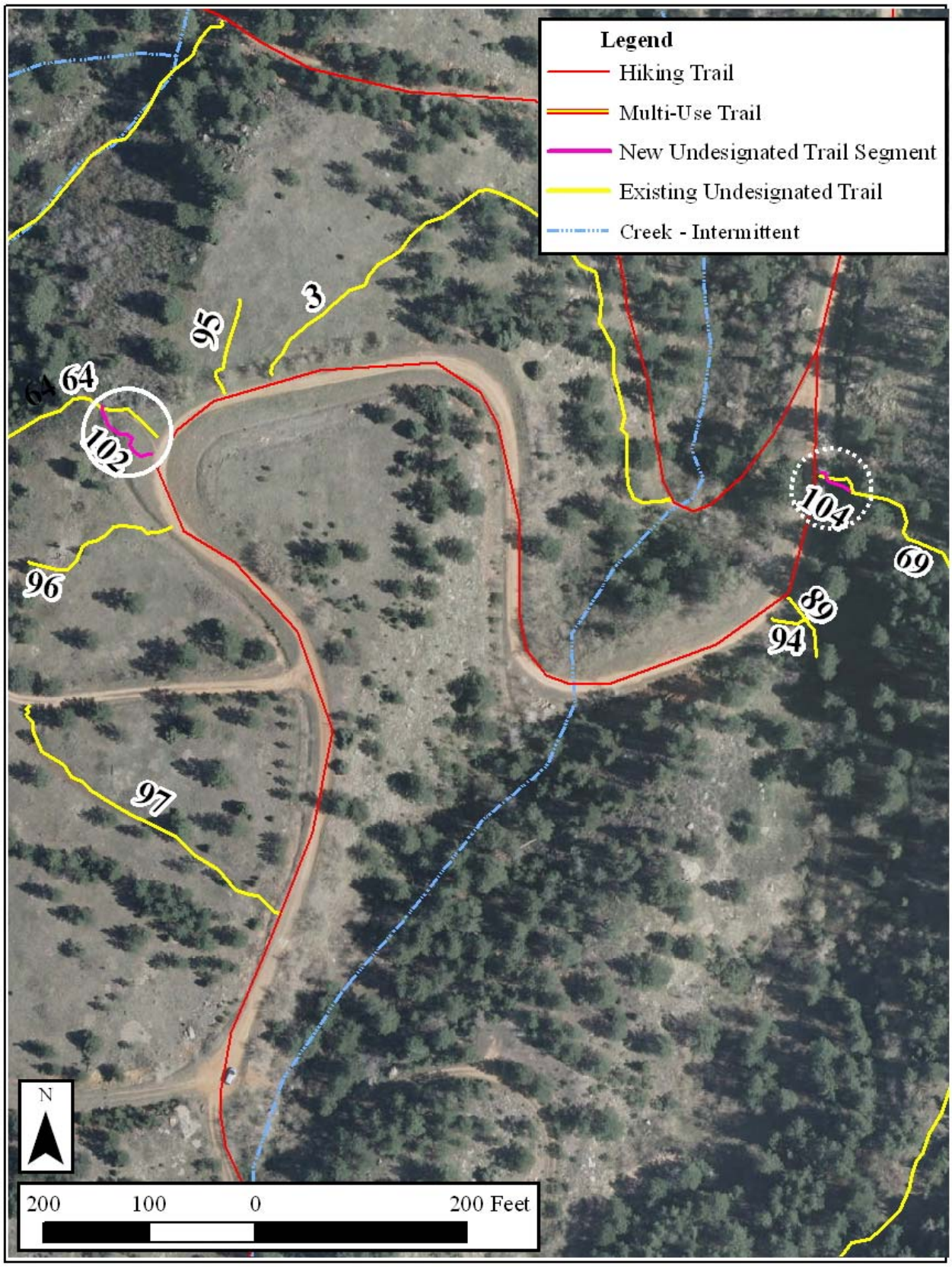


Figure L1. Photographs of new trails in the GRT vicinity and SB Target Area. A) Branching trails 108, 109, and 112 from UDT #90 to Fowler; B) UDT #104, providing slightly gentler access down from UDT#69 (on the ridge) to the Fowler Road; C) UDT#103, a branch from UDT#59 (in the Lindsay Pond vicinity) at its terminal end

Map 3. New undesignated trail segments (circled in white) mapped in 2010 in the Spring Brook Target Area. Numbers identify previously mapped undesignated trail IDs



Map 4. New undesignated trail segments (circled) in the GRT vicinity. Circles delineate an undesignated trail mapped only in 2009 (dotted white) and another mapped in both 2009 and 2010 (white). Numbers identify undesignated trail IDs.



Appendix M. Photographs and maps depicting condition classes of undesignated trails in the Spring Brook Target Area and the GRT Vicinity (2008-2010).

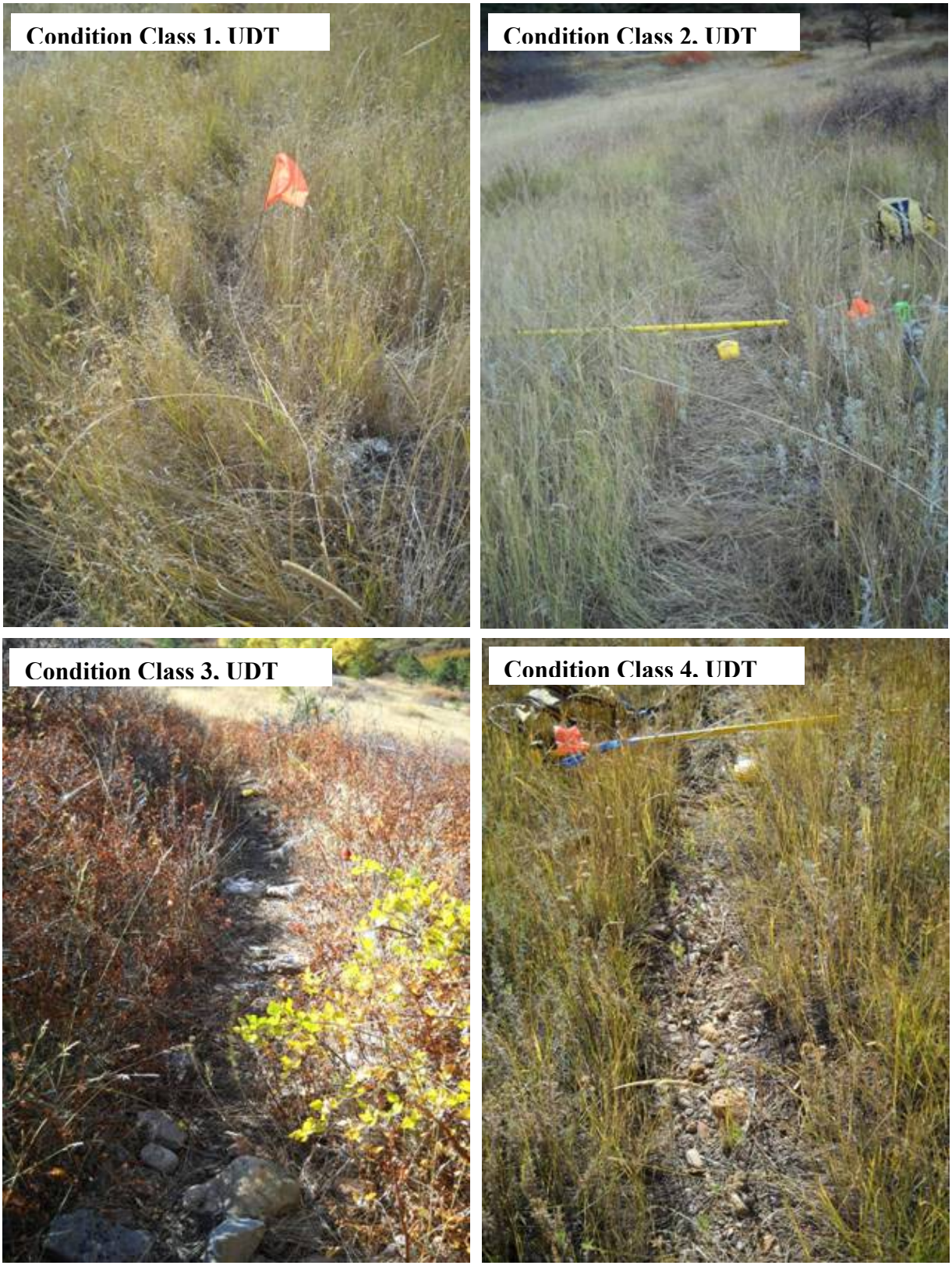
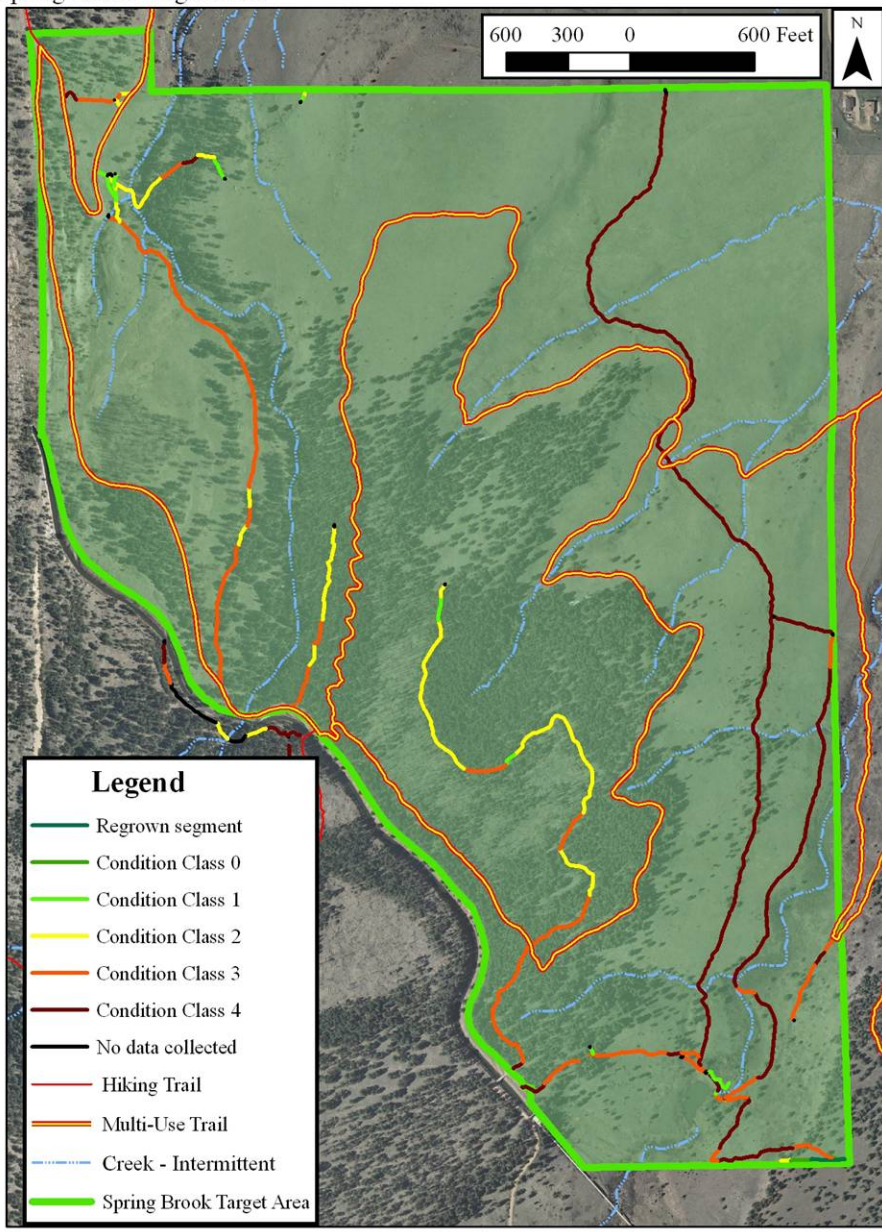
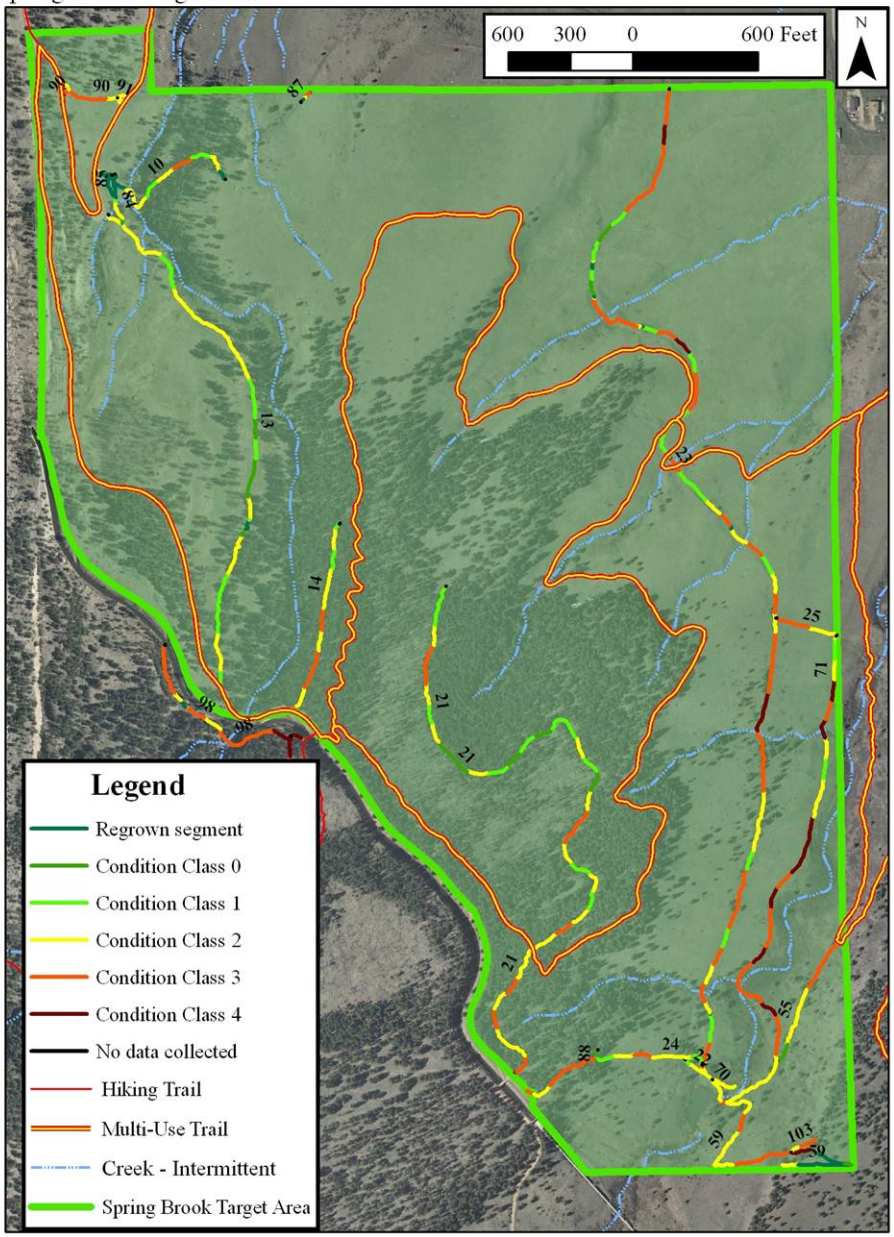


Figure M1. Photographs illustrating Condition Classes 1 to 4 on undesignated trails in the Spring Brook Target Area and GRT vicinity

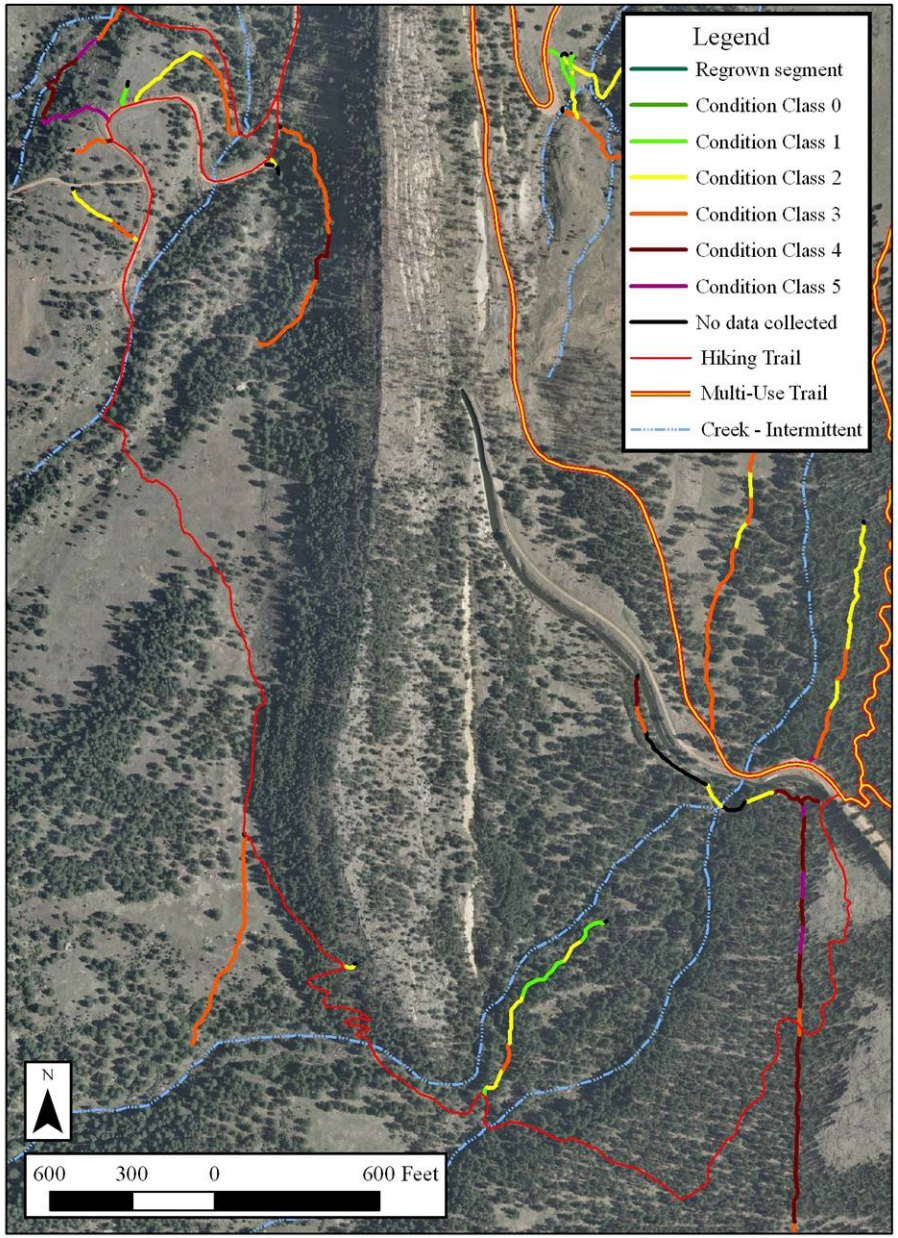
Map 5a. Condition classes for undesignated trail segments mapped in 2008 in the Spring Brook Target Area.



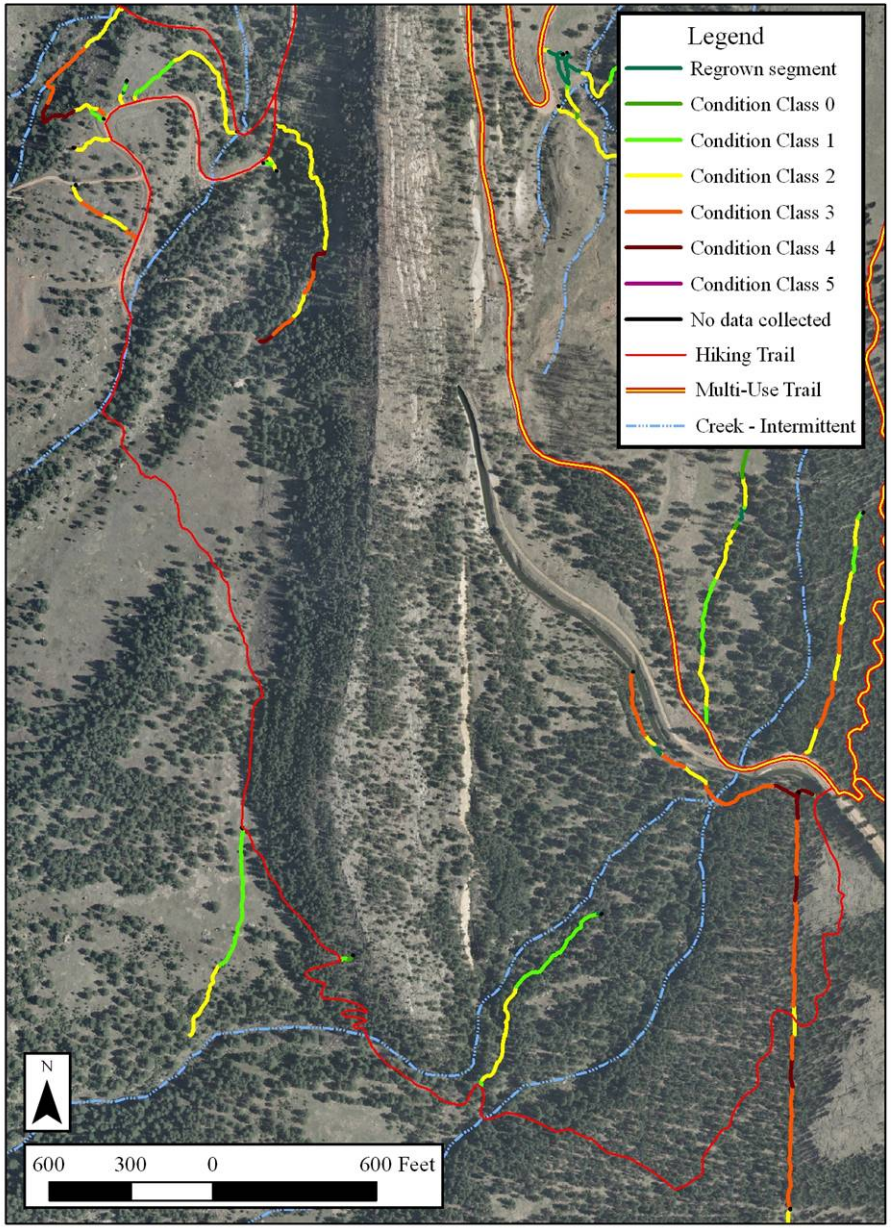
Map 5b. Condition classes for undesignated trail segments mapped in 2010 in the Spring Brook Target Area.



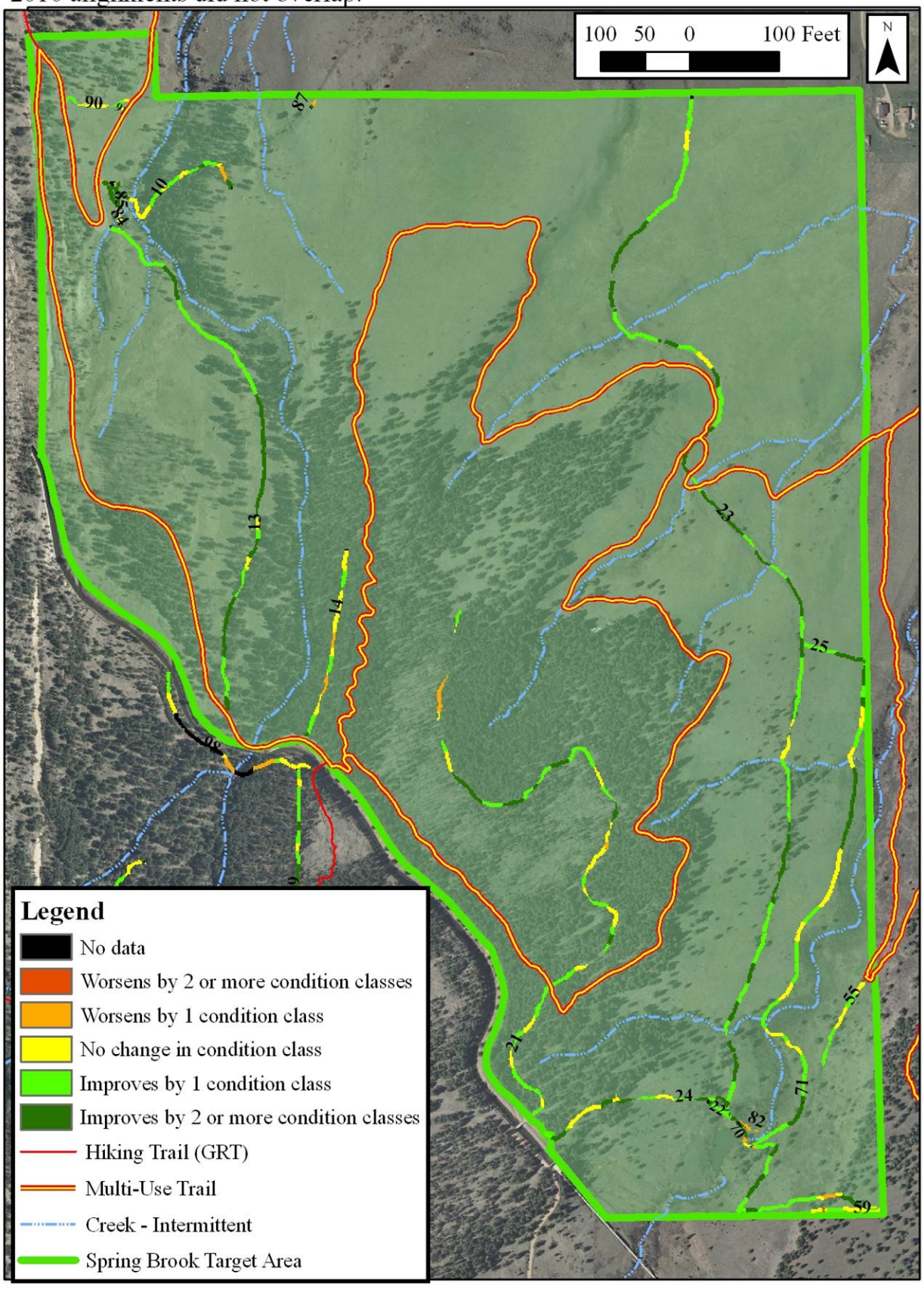
Map 6a. Condition classes for undesignated trail segments mapped in 2008 in the GRT vicinity.



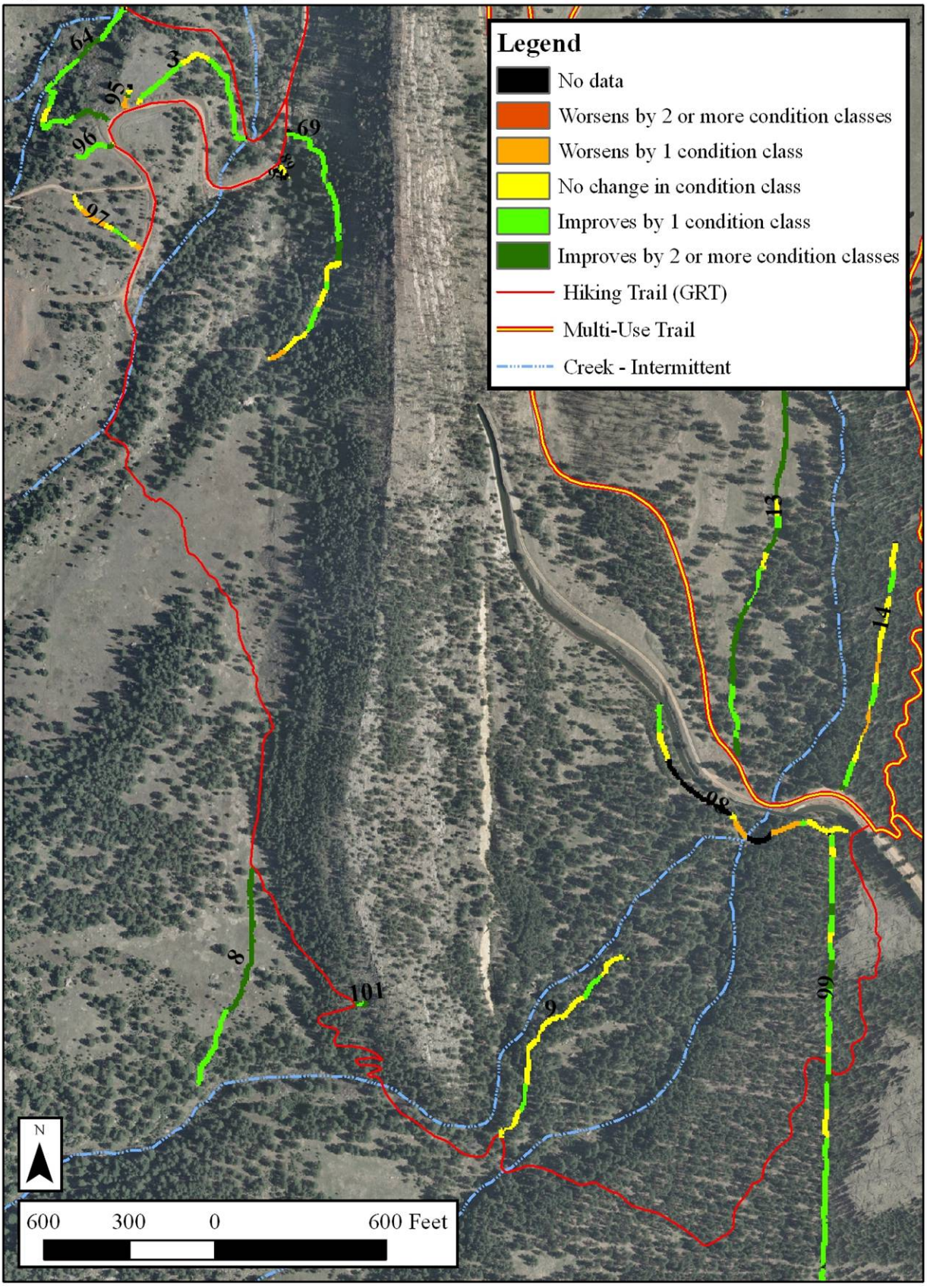
Map 6b. Condition classes for undesignated trail segments mapped in 2010 in the GRT vicinity.



Map 7. Change in condition classes between 2008 and 2010 in the Spring Brook Target Area. Gaps along trail alignments (no color) are segments where 2008 and 2010 alignments did not overlap.



Map 8. Change in condition classes between 2008 and 2010 in the GRT vicinity. Gaps along trail alignments (no color) are segments where 2008 and 2010 alignments did not overlap.



Appendix N. Range of thresholds and responses for monitored indicators presented in the 2008 EM/DD-TSA Monitoring Plan.

Threshold	Response
Reduction in the extent of pre-existing undesignated trails and Conditions of pre-existing trails are less severe and No new undesignated trails detected	• Close and restore any remaining undesignated trails • Maintain or consider reducing levels of education, outreach and patrol • Acknowledge/Thank visitors
No reduction in the extent or condition of pre-existing undesignated trails or Conditions of pre-existing trails more severe or New undesignated trails detected	• Close and restore undesignated trails • Change education, outreach, signs, or enforcement • Address maintenance concern(s) on designated trail that have resulted in off-trail travel • Create physical barriers to keep people on trail • Include minor reroutes or spur trails to popular overlooks or resting spots • Meet with stakeholders and implement strategies aimed at improving compliance • Seasonal or temporary access restrictions
OSMP would use values and trends of this indicator, along with those from trail segment observation and ranger patrols to make determinations about prohibiting a particular activity Adopting regulations prohibiting specific activities would be considered after the use of less restrictive strategies and clear indication of off-trail travel by a particular activity	• Prohibit off-trail travel by pedestrians • Disallow one or more activity groups on the Spring Brook Loop Trail /GRT