Spring Brook Loop Trail
On-Trail and Dog Regulation Compliance
Summer 2009 and 2010

Monitoring Report

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Acknowledgments

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Sustainable Recreation Monitoring
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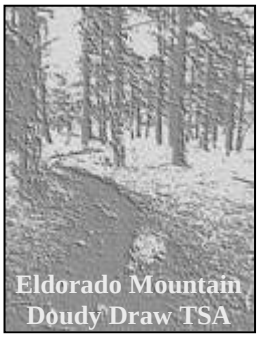

EXECUTIVE SUMMARY

In spring 2009, following the opening of the Spring Brook Loop Trail (SBL), and one year later (2010), the City of Boulder Open Space and Mountain Parks Department (OSMP) conducted observational monitoring to evaluate visitor compliance with on-trail and dog regulation requirements. Visitor compliance levels were compared to ranges of acceptability developed by OSMP with community input. After the first year of monitoring, OSMP met with community groups to discuss adaptive management responses for activities outside of acceptable ranges of compliance. Informational signs advising visitors of monitoring results and reiterating desired goals for compliance were posted as the preferred adaptive response. OSMP observed visitor parties on only a portion of the SBL, therefore compliance rates reported below refer only to compliance for a portion of the visitor party's trip.

Compliance Results

- On-trail compliance
  - Cyclists maintained an acceptable level of compliance (>95%) with on-trail travel requirements in both 2009 and 2010.
  - In both 2009 and 2010, the proportion of equestrian and "dog & guardian" parties fell below the acceptable range of 95-100% on-trail compliance.
- Dog-regulation compliance:
  - In both 2009 and 2010, compliance with on-leash requirements were below the 90-100% range of acceptability. Fewer than 60% of observed "dog & guardian" parties complied with requirements to keep dogs on leash and on trail.
  - In both years, compliance with regulations prohibiting dogs from a section of SBL was also below the 90-100% range of acceptability.

Other Results

- Observed visitor parties
  - In both 2009 and 2010, most observed visitor parties (nearly 70%) were cyclists.
  - Pedestrian parties (i.e., hikers and runners) accounted for about 30% of observed parties.
  - Equestrians represented fewer than 2% of observed parties.
- Pedestrian on-trail rates:
  Although no on-trail requirements existed for pedestrians, about 75-80% of pedestrian parties remained on-trail.
- Reasons for leaving the trail
  In general, the most commonly perceived reason for leaving the trail was yielding off trail to other visitors. Avoiding muddy or wet trail conditions was the second most common reason for cycling and running parties to travel off trail. Visitors, including dogs, leaving the trail to yield or avoid muddy conditions were never considered out of compliance with the on-trail requirement.

- Distances traveled off trail: Most (approximately 86%) off-trail visitor parties remained within 10 feet of the trail edge in both 2009 and 2010. Fewer than 70% of off-trail dog parties observed remained within 10 feet of the trail edge in both years. However, travel beyond 10 feet from the trail edge primarily occurred when off-trail dogs were also off leash.

Management Considerations and Recommendations

Staff developed the following recommendations to improve compliance with SBL on-trail and dog regulations:

On-trail compliance

General:

- Since the majority of off-trail observations were associated with travel required to responsibly share the trail, some degree of off-trail travel near the trail edge can be expected when single-track trails are constructed.

SBL Specific:

- Reduce evidence of past noncompliance (e.g., off-trail tracks, secondary trails) that may prompt additional off-trail travel. This could be accomplished by:
  - Maintaining well-drained trail conditions,
  - Closing trails when muddy, and
  - Restoring or at least concealing newly developing undesignated trails.
- Communicate persuasive messages to encourage on-trail travel by:
  - Integrating Front Country Leave No Trace principles[1] into signs and other educational materials,
  - Increasing awareness of the negative consequences of off-trail travel,
  - Appealing to a visitor's sense of social responsibility for stewardship of open space, and
  - Encouraging peer groups to promote on-trail travel as what is expected and normal.

Dog regulation compliance

General:

- Support research aimed at understanding and changing the underlying beliefs that form the basis of dog-guardians' noncompliant behaviors.
- Continue to educate visitors about the negative consequences of off-leash dog travel not only on natural resources but also on dog safety and the experiences of other visitors.

SBL Specific:

- Consider prohibiting dog travel on the SBL.
- Consider modifying external factors:
  - Increase fines for noncompliance;
  - Increase the potential for personal contact with
    - rangers,
    - volunteer stewards,
    - specially-trained peer group of dog-patrollers modeling behavior and communicating reasons to keep dogs in compliance with SBL rules
  - Develop persuasive messages about dog compliance using multiple message sources and types.

[1] Leave No Trace practices are available at: http://www.lnt.org/programs/principles.php

Importance of a system-wide approach to improving on-trail and dog regulation compliance on OSMP lands.

While the results in this report highlight the need for specific management responses at SBL, the results and responses may also be placed in the context of the larger OSMP land system, where off-leash dogs and off-trail travel can negatively affect visitor experiences, resource protection, and OSMP staff and financial resources (National Research Center, 2010). Thus, OSMP should consider which management actions aimed at improving compliance with dog-control and travel requirements at SBL are likely to be more efficiently and profitably implemented at the system-wide scale.

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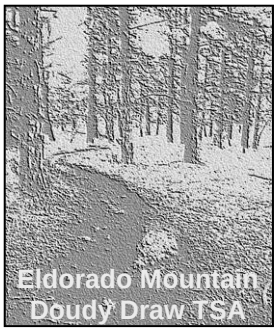

1.0 INTRODUCTION

1.1. Background

The Spring Brook Loop Trail (SBL) was opened in December 2008 as a shared-use trail designed to provide new recreational opportunities within the Eldorado Mountain/Doudy Draw (EM/DD) Trail Study Area (TSA). The EM/DD-TSA Plan describes a vision for the Doudy Draw/Spring Brook subarea as uniquely "wild". This vision emphasized protection of the area's exceptional ecological and cultural resources, while promoting sustainable trail development to improve shared-use access to this relatively remote place (City of Boulder, 2006, p. 13).

In keeping with this vision, the SBL loop and connector trails traverse varied topography in both grassland and forested habitats, while avoiding Spring Brook, Lindsay Pond, and mature forest patches (Figure 1). The on-trail travel[2] requirements on SBL for cyclists, equestrians, and dogs were established to help provide a quality visitor experience while minimizing ecological effects. While dogs must remain on-leash on the northern branch of the trail loop (SBL-north), the southern loop trail (SBL-south) was designated as a no-dog area to further protect wildlife and provide a new no-dog trail travel option for OSMP visitors.

Concern about unintended impacts to wildlife, native vegetation, and visitor experience associated with travel along the SBL prompted development of the EM/DD-TSA Monitoring Plan for the SBL area (City of Boulder, 2008, p. 13).

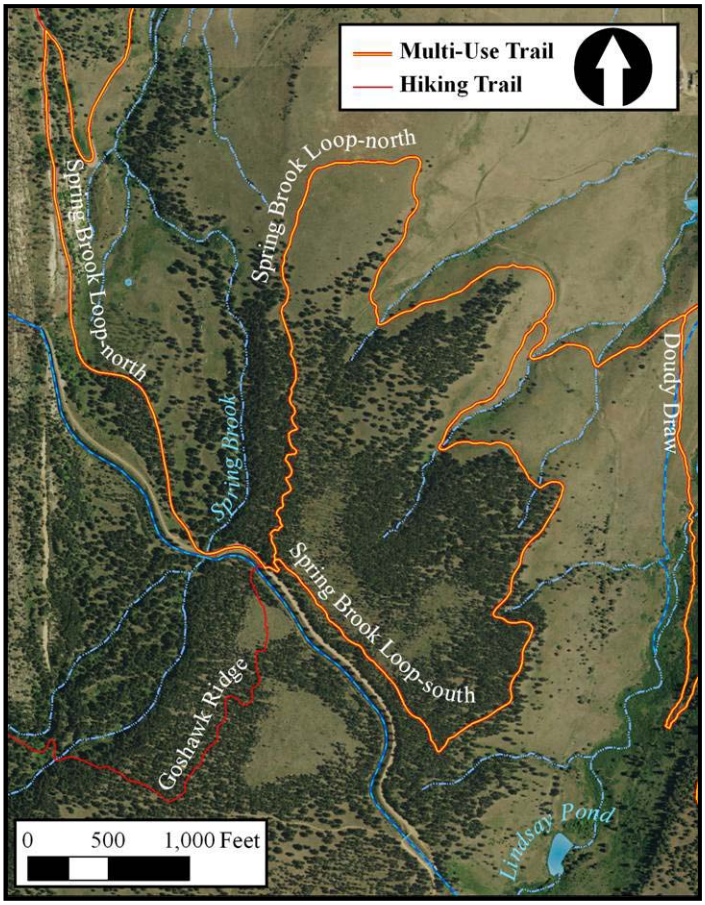

Figure 1. The Spring Brook Loop Trail in Eldorado Mountain/Doudy Draw TSA

[2] **On-trail travel** requires that at least a portion of one of a person's feet, horse's hooves, dog's feet or cyclist's tires remain on the trail tread at all times. The definition of **off-trail** (including exceptions to the definition) is given in the Section 2.4 of the SBL Monitoring Protocol (Lezberg, 2009).

The staff and Open Space Board of Trustees (OSBT) agreed that by measuring the compliance with on-trail and dog regulations on SBL, OSMP could gauge how well visitors were following the area-specific regulations and respond adaptively to conditions as monitored.

This report presents the rationale, objectives, and methods for compliance monitoring on SBL, summarizes monitoring results, discusses the results in the context of other studies, and lists potential strategies to achieve desired conditions for shared recreational use on the SBL.

1.2. Monitoring and adaptive management: Justification and history

The purpose of recreational use monitoring in the EM/DD-TSA is to inform OSMP's adaptive management responses so that recreational opportunities can be maintained in the manner intended while moving toward desired natural resource protection goals (City of Boulder, 2008, p.1).

OSMP has committed to monitor visitor compliance with travel and dog requirements and to use monitoring results to inform adaptive management (City of Boulder, 2005, pp. 59, 63; City of Boulder, 2006, p. 31; City of Boulder, 2007, p. 3). Development of the Visitor Master Plan (VMP) and the EM/DD-TSA Plan included public process. Both plans were accepted by the OSBT, and the VMP was approved by the Boulder City Council. The EM/DD- TSA Plan (City of Boulder, 2006, p. 31) states the obligation to monitor on-trail travel on SBL explicitly:

> "Visitor compliance with the on-trail requirements for this trail (bikes, horses, and dogs) will be monitored during the first two years after the trail is built. Changes to the type of allowed visitor uses will be considered during or after this period if compliance with on-trail requirements does not meet management goals."

Similar language in the EM/DD-TSA Plan establishes the need to evaluate compliance with dog prohibitions on SBL-south (p. 32) and with on-leash dog regulations on SBL-north (p.35).

The EM/DD-TSA Monitoring Plan (City of Boulder, 2008, pp. 11-12) states that on-trail travel and compliance with dog regulations on SBL will be monitored, and if measured levels are not acceptable (i.e., within publicly established ranges of acceptability), OSMP will take management actions to improve the situation. **Appendix A** presents potential management responses for various levels of measured compliance and the ranges of acceptability for each compliance indicator. Ranges of acceptability reflect standards mandated in the VMP and the EM/DD-TSA. The dog-compliance ranges of acceptability are also in line with the low tolerance found among OSMP visitors to specific off-leash dog behaviors (Vaske & Donnelly, 2007b). According to the EM/DD-TSA Monitoring Plan, disallowing specific activities would be considered only after less restrictive strategies were demonstrated to be ineffective at achieving targeted compliance rates (City of Boulder, 2008, pp. 2, 11-12). OSMP committed to work with community members and staff to implement strategies that allowed desired conditions to be maintained, and when possible, enhanced.

Abundant staff resources were committed to successful implementation of management strategies at SBL. To discourage off-trail hiking, OSMP closed previously identified social trails within sight of the SBL using fencing, tread camouflage and other restoration techniques. Starting shortly after the SBL opened in December 2008 and continuing daily for eight months, two seasonal rangers were dedicated to educational, enforcement, and monitoring patrols on the SBL. During numerous educational contacts, rangers clarified regulations and explained how compliance with the requirements enhanced resource protection and travel experiences on this shared-use trail. A high level of ranger presence and patrol in the SBL/Goshawk Ridge Trail (GRT) area was maintained through the 2010 monitoring period.

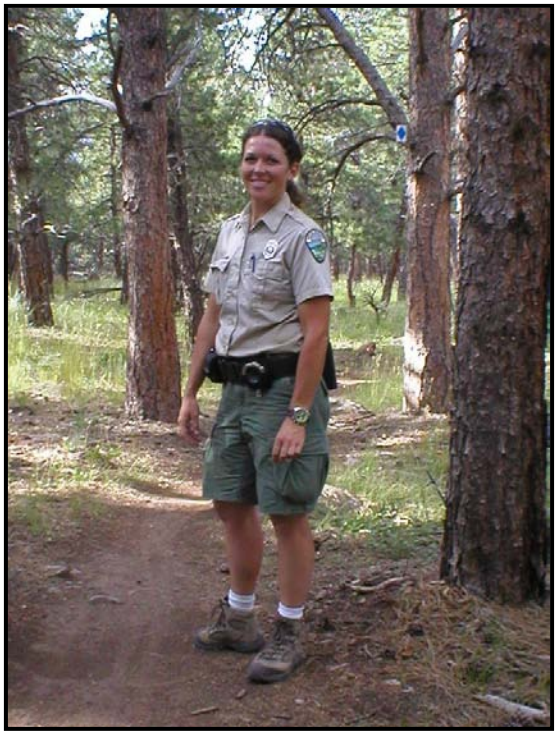

Figure 2. OSMP ranger patrols the SBL.

OSMP staff also met with the community and stakeholders before and after opening of the SBL to enhance their awareness and understanding of the SBL on-trail and dog-regulation requirements. Visitors to SBL had opportunities to learn about applicable requirements through regulatory signs and maps at trailhead kiosks as well as signs placed along the SBL corridor (**Appendix B1**). In addition, OSMP publicized these requirements during public meetings, in local newspaper advertisements, through education and outreach activities (e.g., staff-led interpretive hikes; trail-head outreach), in a site-specific brochure, and on the internet (e.g., email distribution, OSMP website). Some stakeholder groups networked among their members and employed peer-groups and volunteer bike patrols to encourage compliance with regulations when traveling along the SBL.

In spring 2009, approximately five months after the opening of the SBL, OSMP measured visitor compliance with the on-trail and dog-specific regulations. In response to the 2009 monitoring, OSMP hosted a community meeting to share the results[3]. The project team sought suggestions from the community, OSMP staff, and the OSBT for strategies to improve compliance. In late 2009 and early 2010, OSMP implemented agreed-upon management strategies including:

1. Installation of new signs explaining habitat sensitivity in the area while stressing recent low dog compliance levels and clearly warning visitors that continued dog use of SBL was contingent on acceptable levels of dog-regulation compliance (**Appendix B2**);
2. Additional outreach and education at trailheads servicing SBL;
3. Additional meetings with stakeholder groups; and
4. Trail improvements to more clearly delineate trail edges and minimize off-trail travel.

[3] Results presented at the community meeting and community feedback are summarized at http://www.bouldercolorado.gov/index.php?option=com_content&view=article&id=12045&Itemid=2593#sblm

In 2010, staff repeated the observational monitoring to gauge visitor compliance levels with on-trail and dog-specific regulations after these management responses were implemented.

1.3. Monitoring objectives

To determine if acceptable levels of visitor compliance on SBL were achieved in 2009 and 2010, OSMP developed two primary monitoring objectives:

1. Estimate the percentage of cyclist, equestrian and dog-guardian parties[4] that remain on-trail on observed trail segments of the SBL;
2. Estimate the percentage of dog-guardian parties on observed trail segments that are in compliance with area-specific regulations to keep dogs on leash and off sections of the SBL trail where dogs are prohibited.

Because OSMP staff observed visitor parties for only a small portion of their visit, compliance rates on observed trail segments could not be used to estimate compliance rates for an entire visit. Estimates of compliance (percentage in compliance) for each activity type (e.g., cycling; horse-back riding) and regulatory issue (on-trail, on-leash, off SBL-south) on observed trail segments were not estimates of overall compliance but rather used as "compliance indicators" on this shared-use trail.

Additional information was collected to better characterize visitors and visits to the SBL and provide the context for observed off-trail and noncompliant behaviors that could inform management of the SBL. Data recorded during these monitoring sessions were examined to determine:

1. The percentage of pedestrian visitor parties that remain on trail on observed trail segments;
2. The activities and behaviors of visitors traveling off trail on observed trail segments;
3. The distance from the trail edge visitors traveled off trail on observed trail segments; and
4. The activity distribution of observed visitor parties and visitors by year, day type (weekday versus weekend), and time of day.

2.0 METHODS

2.1. Study site

Monitoring took place along the SBL, a 4.0 mile shared-use trail opened for public use on December 2, 2008. The loop portion of the trail received roughly 28,000 visits during the first year it was opened and 30,000 visits during the second year[5]. The SBL is comprised of a loop and two connector-trails that traverse the rolling topography characteristic of the EM/DD TSA at elevations ranging from 5,950 to 6,200 feet (**Figure 1**). The EM/DD TSA lies south of the City of Boulder and includes open grass meadows, ponderosa pine forest and outwash mesa tops. These habitats exemplify the transition zone between the high plains prairies and the foothill forests of Colorado and support xeric tall-grass prairie, mature ponderosa pine forests and unique shrub communities. In addition to the high-value habitat supported in this area, rare native plant

[4] A party or a visitor party is one or more individuals traveling together along the SBL, and who, in the opinion of the observer, appears to be visiting OSMP as one unique group.

[5] Visits were estimated between December 2008 and December 2010 based on TrailMaster StatPak remote counters positioned along the trail.

communities and several threatened plant and animal species occupy the EM/DD-TSA (City of Boulder 2006, p.10).

2.2 Observational approach

OSMP monitored visitor compliance on the SBL using systematic observations[6] by unobtrusive observers (More, 1984; VanderWoude, 2007; Veal, 2006). Using this method, observation sessions are chosen randomly to sample the population of visitor parties on a segment of the trail and direct observations are systematically recorded by a stationary, concealed[7] observer. Unobtrusive observations from a single to a few strategically located vantage points have been used in human dimensions and recreational ecology studies to understand off-trail travel patterns, visitor interactions, and visitor responses to interpretive and regulatory signs (Antos, Ehmke, Tsaros, & Weston, 2007; Hockett, Clark, Leung, Marion & Park, 2010; Kierle & Stephens, 2004; More, 1984; Turner & LaPage, 2001; Wood, Lawson, & Marion, 2006).

2.3. Season and duration of monitoring

Staff monitored visitor compliance for seven to eight weeks between late April and early June (*2009*: 20 April - 7 June; *2010*: 19 April - 3 June). This period is typically characterized by higher system-wide visitation levels compared to winter months (Vaske, Shelby & Donnelly, 2009). The delay between trail opening in December 2008 and initiation of observational monitoring in spring 2009 provided visitors with an opportunity to learn about regulations and become familiar with the trail routes. In 2010, an additional week of monitoring in June made up for observations cancelled due to frequent rain, high winds, and official closure of SBL during muddy trail conditions.

2.4. Monitoring schedule

Each monitoring session was limited to four hours to insure attentiveness of the observer. In both 2009 and 2010, 70 four-hour sessions were randomly chosen from a sample frame that included three time-slots per day (7:30 am to 11:30 am, 11:30 am to 3:30 pm, 3:30 pm to 7:30 pm) and all days during the April to June monitoring period, excepting Memorial Day. Due to staffing limitations, sessions were chosen so that no more than two observation sessions were scheduled on any given day. Rangers were asked to avoid regular patrols of the SBL area during these scheduled monitoring sessions to minimize the effects that uniformed staff might have upon visitor behavior during the time when observers were on site collecting data.

Sessions cancelled for unforeseen reasons (e.g., extreme weather, trail closure) were randomly rescheduled among remaining unscheduled time slots or added, if necessary, after the first seven weeks of monitoring. This sampling effort allowed OSMP staff to monitor for 221.5 and 252.2 hours, respectively in 2009 and 2010, accounting for 38.5 to 43.8%, respectively of all possible visitation hours between 7:30 am to 7:30 pm during the monitoring period. In both years, slightly less than one quarter of the monitoring hours occurred on weekend days. Additional

[6] Systematic observations gather formal predetermined measures (as compared to open-ended information) that can be quantitatively analyzed from probability samples across times and locations (Veal, 2006, p.173).

[7] Conditions along the trail prevented observers from being completely hidden from visitors, but observers concealed their identity as observers by appearing to look like other recreational visitors and by minimizing attention drawn to themselves and their activities.

information on the distribution of observation hours among time slots, day types, and locations is given in **Appendix C**.

2.5. Monitoring locations

Three trail segments and associated off-trail observer locations were selected for monitoring along the SBL (**Appendix D**). Segments were chosen to maximize observable distances along the trail tread, and where possible, provide relatively unobtrusive vantage points from which staff could observe visitor behavior. In addition, staff prioritized trail sections where visitors might leave the trail (e.g., near trail intersections where visitors tend to gather or wait, within view of existing undesignated trails or potential rest stops, and/or surrounded by relatively mild topography) or were at a decision point regarding posted dog regulations.

Targeted trail segments differed in length (623 to 2,457 feet), topographic setting, and surrounding vegetation, providing opportunities to observe visitors as they traveled through mesa-top and hill-slope grasslands, a prairie dog colony, dense ponderosa pine forest, open forest margins, and shrub-vegetated riparian corridors. Two trail segments included an intersection between SBL-south and SBL-north, where OSMP had posted regulatory signs (see **Appendix B**) prohibiting dogs on SBL-south and directing on-leash dogs to travel only on SBL-north. All observation sessions were randomly assigned one of the three possible trail segments for monitoring, with no attempt to have equal number of sessions among the observed trail segments. To avoid double counting of visitors that traveled past more than one of the three trail segments only one trail segment was scheduled for monitoring per time slot. Additionally, observers were attentive to visitors that may have already been counted during the current or previous four-hour session.

2.6. Field procedures and documentation

Observers scanned the trail segment and recorded separately, each visitor party entering the trail segment, the activity type of each party (**Table 1**) and the number of visitors and accompanying dogs per party on the form developed for this project (**Appendices E1** and **E2**). Once a visitor party left this observed trail segment or the off-trail area within the observer's field-of-view, they were not recounted again during that monitoring session, even if they passed through again on their return trip. Staff recorded whether a visitor party left the trail tread on the observed segment (i.e., went "off trail")[8] or allowed their dogs to go off trail[9] or off-leash during the observation session. Lastly, staff documented visitor compliance with the dog prohibition on SBL-south at SBL

Table 1. Visitor party activity codes

Code	Description
B	Biking
E	Horseback riding (equestrian)
OS	OSMP staff, volunteers, contractors
H	Hiking
R	Running

[8] For purposes of this monitoring "off-trail" is defined as when all of a person's feet, dog's feet, horse's hooves, or cyclist's tires are off the designated trail tread. However, in both 2009 and 2010, visitors traveling off-trail for reasons deemed exceptions (e.g., yielding, passing, avoiding mud) were considered to be in compliance with on-trail regulations. See Section 2.7 below and the SBL Monitoring Protocol for more details on exceptions to the "off-trail" definition used for monitoring.

[9] Observers recorded dogs as "off-trail" only if all four feet were off the trail tread and 1) more than 10 feet from the trail edge; or 2) less than 10 ft from the trail edge for a cumulative time of >30 seconds. This leeway allowed dog-guardians the time to bring their dogs back on trail.

north/south junctions where dog guardians and their dogs could be observed approaching or leaving SBL-south.

To better appreciate motivations for all off-trail travel and the relative frequency of off-trail trampling near versus far from the trail, additional data was recorded as follows. For any party observed traveling off trail from the observed trail segment (regardless of compliance status), the observer recorded the perceived activities or behaviors in which visitors and/or dogs engaged while traveling off trail, using predetermined codes (**Appendix E3**). Observers also recorded the number of visitors and/or dogs that were off trail in the near-trail zone (≤10 feet from trail edge) or the far-trail zone (>10 feet from trail edge).

Observers noted details of visitor party behavior, off-trail activities and off-trail locations. For a more detailed description of monitoring methods and quality assurance procedures, see the SBL monitoring protocol (Lezberg, 2009).

2.7. Analyses

Analyses of non-pedestrian visitor compliance

Analyses primarily focused on estimating the observed compliance levels relative to the applicable ranges of acceptability (**Appendix A**). Compliance was estimated separately for each of the five indicators:

1. On-trail compliance for cycling parties
2. On-trail compliance for equestrian parties,
3. On-trail compliance for dog & guardian parties
4. On-leash compliance
5. Compliance with dog prohibition on SBL-South

For these analyses, each visitor party recorded during monitoring was assumed to be an independent unit and those in compliance were summed across all monitoring sessions within a given year. Compliance percentages were calculated by dividing the total number of parties in compliance by all parties observed in that activity category over the year. Parties recorded during incomplete monitoring sessions (e.g., prematurely ended for bad weather) were also included in analyses of compliance estimates. Confidence intervals were calculated at 90% using equations for the exact confidence limits for proportions (Zar, 1984, p. 378). Compliance estimates for 2009 and 2010 were compared using a normal approximation test of differences among proportions (Zar, 1984, pp. 395-398; Systat® for Windows® Version 11, Systat Software, Inc., Chicago, IL).

Parties that traveled off trail for reasons deemed to be **exceptions** to the off-trail definition were considered to be in compliance with on-trail regulations. Exceptions included the following behaviors[10]:

- Cyclists dismounting from bikes or walking bikes while traveling off trail
- Equestrians dismounting and traveling on foot, leaving horses secured near the trail

[10] Exceptions listed are not inclusive, but are examples of expected behaviors that would be considered exceptions, for monitoring purposes, for going off-trail. When monitoring staff observed different behaviors or situations that did not fit into these categories, the situation was discussed with the monitoring team and a determination made.

- Equestrians or cyclists traveling off trail to yield, pass, or avoid poor trail conditions while on their horses or bicycles and that returned to the trail as soon as safely possible without shortcutting the trail
- Dogs traveling off trail with their guardians within 10 feet of the trail edge to yield or pass or move around muddy patches and returning immediately to the trail
- Dogs traveling into riparian areas exclusively to drink from a creek on hot days
- Dogs yielding to another visitor to get out of their way (when the guardian is still on the trail) provided they immediately returned to the trail
- Dogs that left the trail for less than 30 seconds and traveled no further than 10 feet from the trail
- Visitor parties (including parties with dogs) traveling off trail near the trail edge to get out of the way while engaged in trail side activities deemed incidental to the primary trail activity (at the observer's discretion) such as a dog guardian taking his/her leashed dog off trail to water the dog or pick up dog excrement, a party stepping off trail to adjust clothing or a cyclist moving off trail to repair a bike.

Estimates of on-trail rates for pedestrians

Because the SBL lies within a Natural Area, there are no regulations prohibiting pedestrians from traveling off trail. We used the on- and off-trail pedestrian data to gain insight into how often pedestrian parties followed the Leave No Trace recommendation of staying on trail in the absence of regulations. We were also interested in understanding the potential trampling impacts that would occur off the trail tread. To calculate the percentage of pedestrian visitor parties that remained on trail, we summed all observed pedestrian parties that remained on trail during observation sessions and divided this number by the total number of observed pedestrian parties. For this analysis, the number of off-trail pedestrian parties included all parties observed off trail, even if they were off trail only to yield, pass around obstacles, or engage in activities incidental to travel along the trail. Counting all off-trail travel provided a better representation of the frequency of off-trail trampling.

Analyses of off-trail reasons and relative off-trail distances traveled

To better appreciate and rank the reasons visitors and/or their dogs travel off-trail, we also calculated the percentage of all off-trail visitor parties (not just those out of compliance) in each activity group that went off trail to engage in various activities as perceived by observers. Because we were also interested in the frequency of trampling occurring near and far from the trail associated with off-trail visitor parties, we separately calculated the percentage of all off-trail visitor parties that were $\leq$10 feet or >10 feet from the trail edge.

Summarizing activity distribution on SBL.

To calculate the distribution of visitor parties and visitors by activity type in 2009 and 2010, we summed data across all monitoring sessions per year and calculated the percentages of all parties or visitors in each activity type. When calculating activity type distribution by time slot and weekday type, we standardized data to 4-hour sessions by summing visitors and parties in each year, time slot, and weekday type category and then dividing by the number of equivalent 4-hour sessions (i.e., summed observation hours for each category including observation hours for incomplete sessions divided by four).

3.0 RESULTS

During on-trail and dog regulation monitoring on SBL, monitoring staff observed 1,117 and 1,564 visitor parties over the 2009 and 2010 monitoring seasons, respectively. In both years, cyclists made up just less than 70% of the parties. Pedestrian parties made up about 30% of all visitor parties, and equestrian parties comprised the balance (just over 1%). Additional information on the distribution of observed visitors and visitor parties by year, week day type, time slot and activity can be found in **Appendix F**. The distribution of on-trail activities among visitor parties and among individual visitors differed by less than 3% for any activity among years (**Appendix F**). In nearly all cases, these observations provided a large enough sample size to evaluate the acceptability of OSMP's indicators of success for SBL visitor compliance.

3.1. On-trail compliance

Cyclists achieved and maintained an acceptable level of on-trail compliance in both years with greater than 99% of observed parties in compliance with the on-trail requirement on SBL (**Table 2**, **Figure 3**). The percentage of equestrian and dog guardian parties in compliance with on-trail requirements was below the acceptable range of 95-100% in both 2009 and 2010 (**Table 2**, **Figure 3**). However, for equestrians in 2010 the 90% confidence interval around the estimate extended into the range of acceptability (**Figure 3**). Statistical testing suggests there is an approximately 23% chance in 2010 that the true rate of compliance with on-trail requirements lies within the range of acceptability.

Table 2. Number and percentage of observed visitor parties in compliance with on-trail requirements on SBL in 2009 and 2010. Values shown in *red italics* fell outside acceptable ranges.

On-trail regulation compliance indicators	Acceptable range of compliance	Number of on-trail parties (*X*), total parties observed (n), and percentage on trail (%)					
		2009			2010		
		X	**n**	**%**	***X***	**n**	**%**
Cyclist parties on trail	95-100%	772	774	99.7	1046	1052	99.4
Equestrian parties on trail	95-100%	9	12	*75.0*	16	18	*88.9*
Parties with dogs on trail[11]	95-100%	37	49	*75.5*	53	63	*84.1*

Much of the off-trail travel observed was not counted as "off trail" when estimating compliance because the perceived motivations for leaving the trail (*summarized in **Section 3.4***) were considered unavoidable or the specific off-trail activity is expected or desired (e.g., yielding). Moreover, since off-trail pedestrian travel is allowed in the SBL area, equestrians and cyclists that dismounted were not considered out of compliance when traveling off trail on foot.

[11] Dogs observed off trail for less than 30 seconds and no further than 10 feet from trail edge were considered in compliance with on-trail regulations.

3.2. Dog compliance

In both 2009 and 2010, estimated compliance with requirements for dogs to be on-leash, on-trail, and off SBL-south fell below ranges of acceptability (**Table 3, Figure 4**). Among all five compliance indicators, compliance for on-leash dogs deviated most from the acceptable range, with less than 70% of dog guardian parties keeping dogs on leash on observed trail segments. Estimates of compliance with dog-travel restrictions on SBL-south fell below acceptable levels in both years, but given the small sample size, the 90% confidence interval around the estimate extended into the range of acceptability (**Figure 4**). Statistical testing suggests there is an approximately 35% chance in 2009 and 39% chance in 2010 that the true rate of compliance with travel restrictions on SBL-south lies within the range of acceptability.

Table 3. Number and percentage of observed dog-guardian parties in compliance with dog-specific requirements on SBL in 2009 and 2010. Values shown in *red italics* fell outside acceptable ranges.

Dog-specific regulation compliance indicators	**Acceptable range of compliance**	**Number (*X*) and percentage (%) of parties in compliance and total parties observed (n) parties**					
		2009			**2010**		
		X	**n**	**%**	***X***	**N**	**%**
Parties with on-leash dogs	90-100%	29	49	*59.2*	42	63	*66.7*
Parties with dogs on trail[12]	95-100%	37	49	*75.5*	53	63	*84.1*
Parties with dogs off SBL-south	90-100%	26	30	*86.7*	36	41	*87.8*

In both years, 50- 58% of all dog-guardian parties complied with both the requirement to remain on leash and on trail (51% compliance in 2009, 58% in 2010). Parties with off-leash dogs were more frequently observed out of compliance with the on-trail requirements than parties that kept their dogs on leash (**Figure 5**).

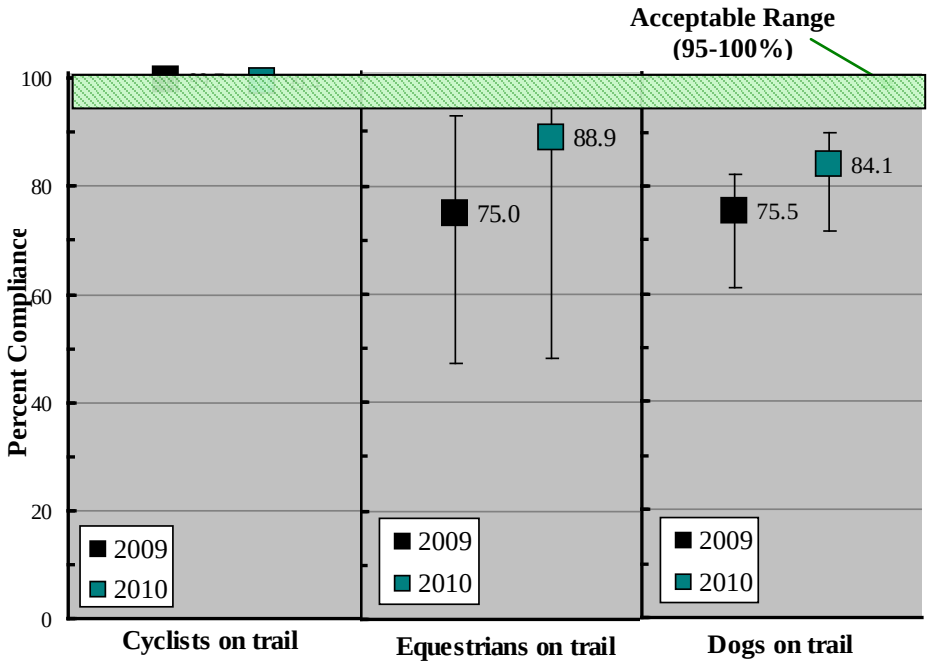

Figure 3. Percentage of observed visitor parties in compliance with on-trail requirements on SBL in 2009 and 2010. Numbers to the right of the squares give percentages for that year and indicator. Whiskers show the 90% confidence intervals above and below the compliance estimates.

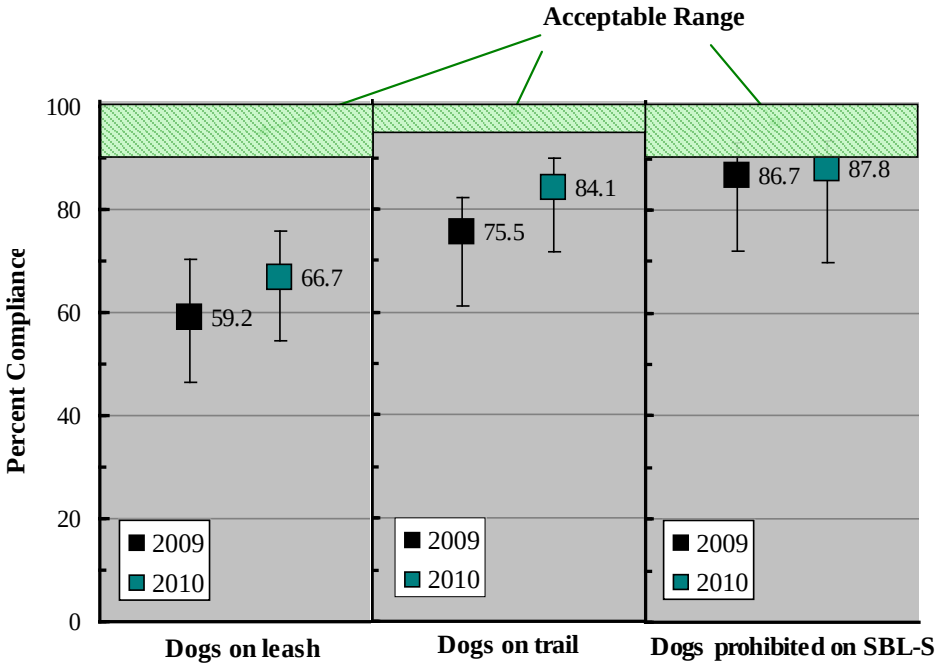

Figure 4. Percentage of observed dog-guardian parties in compliance with dog specific requirements on SBL in 2009 and 2010. Numbers to the right of the squares give percentages for that year and indicator. Whiskers show the 90% confidence intervals above and below the compliance estimates.

3.3. Pedestrians on trail

Although no regulations require pedestrians to remain on trail, OSMP promotes a Leave No Trace approach[12], encouraging visitors to travel on trail, particularly in Natural Areas and HCAs. Of pedestrian parties observed on targeted trail segments, 80.4% (2009) and 75.7% (2010) remained on trail (**Table 4**). Runner parties were observed off trail in smaller proportions than hiker parties, with over 84% of runner parties remaining on trail in both years (**Table 4**).

The number of pedestrian parties traveling off-trail doubled from 65 off-trail parties in 2009 to 120 off-trail parties in 2010. These off-trail pedestrian parties accounted for 131 off-trail individuals in 2009 and 221 off-trail individuals in 2010.

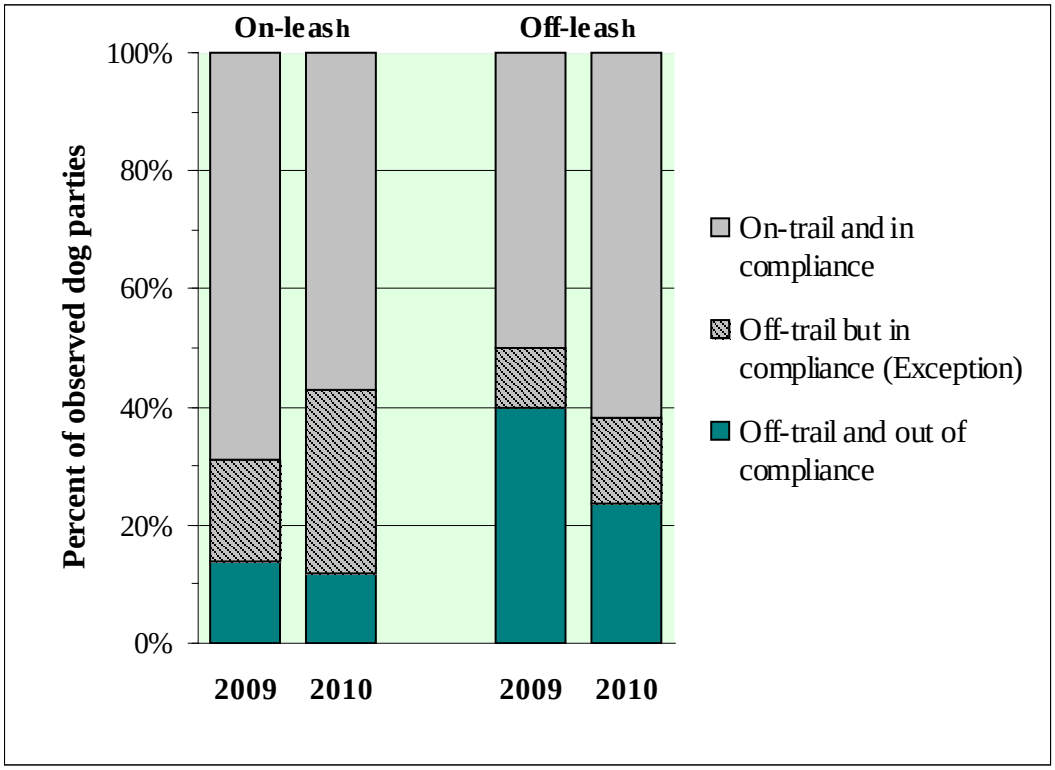

Figure 5. Percent of on- and off-leash dog guardian parties observed by their on-trail status in 2009 and 2010. Teal indicates dog-guardian parties off trail and out of compliance and grey indicates those in compliance with on-trail requirements. Hatched lines indicate those dog guardian parties that left the trail for reasons deemed to be exceptions and were therefore considered in compliance with on-trail regulations.

[12] Leave No Trace practices are listed at: http://www.lnt.org/programs/principles.php

Table 4. Percentage and number of pedestrian parties remaining on observed trail segments in 2009 and 2010. For the purpose of this summary, pedestrian parties leaving the observed trail segments were tallied as off trail, regardless of the perceived behaviors or motivations recorded for off-trail travel.

On-trail pedestrian parties	**Number of on-trail parties (*X*), total parties observed (n), and percentage on trail (%)**					
	2009			**2010**		
	X	**n**	**%**	***X***	**n**	**%**
Hiker Parties	131	185	70.8	171	255	67.1
Runner Parties	135	146	92.5	203	239	84.9
All Pedestrian Parties	266	331	**80.4**	374	494	**75.7**

Most off-trail pedestrian parties (73.8% in 2009, 72.5% in 2010) traveled off trail only to yield, pass, avoid muddy spots, or to get out of the way while engaged in trail side activities deemed incidental to the primary trail activity. These activities were considered exceptions to the off-trail definition when determining compliance indicators for cyclists, equestrians, and dog-guardian parties (*see* ***Section 3.4***.). In contrast, pedestrian parties engaged in such acceptable off-trail activities were not tallied as on trail in Table 4. Therefore, **Table 4** is not comparable to **Table 2** which includes such off-trail exceptions as "in compliance" with SBL requirements.

3.4. Visitors off trail: activities, behaviors, and relative location from trail edge

Off-trail people: behaviors and activities associated with off-trail travel

For all activity groups, yielding was the primary reason attributed to off-trail travel in 2009 (**Table 5**). In 2010, yielding was again the most frequently recorded motivation for off-trail hiking, running, and horseback riding. In contrast, the proportion of 2010 cycling parties observed traveling off trail to yield decreased by more than half (**Table 6**). Instead, trailside activities were the most frequent activity associated with cycling parties traveling off trail in 2010. Other common motivations recorded for leaving the trail included avoiding mud, resting or eating off trail, trailside incidental activities, and moving past other on-trail visitors (**Tables 5** and **6**). Avoiding muddy or wet trail conditions was the second most common reason for cycling and running parties to travel off trail.

Table 5. Percent of off-trail parties observed in 2009 in each activity group perceived to have left the trail for the reasons listed. If multiple reasons were listed for an off-trail party, additive percentages will exceed 100%.

	Activity Type **n**=number of off-trail parties observed[13]			
2009 Perceived reason for leaving the trail	**Hiker n=54**	**Runner n=11**	**Equestrian n=9**	**Cyclist n=50**
To accompany dog in off-trail dog activities	1.9	0.0	0.0	0.0
To travel around muddy or poor trail conditions	7.4	27.3	0.0	0.0
To observe wildlife, plants, or a scenic view	5.6	0.0	0.0	8.0
To move past visitors on the trail	0.0	0.0	11.1	2.0
To take a picture or be photographed	7.4	0.0	0.0	2.0
To rest or eat off trail beyond the trail edge	14.8	0.0	0.0	16.0
To travel side by side with an on-trail companion	3.7	0.0	33.3	0.0
To shortcut a trail	1.9	0.0	0.0	2.0
To get out of the way while engaging in trailside activities	Code not used in 2009			
To travel on a undesignated trail	0.0	0.0	0.0	0.0
To access water in a creek or in the DWB canal	0.0	0.0	0.0	6.0
To wait for a companion	3.7	0.0	0.0	6.0
To yield off trail to oncoming or opposing traffic	68.5	81.8	66.7	54.0
To fix a bike	0.0	0.0	0.0	14.0
To travel off trail for unknown or other codeless reasons[14]	3.7	0.0	0.0	4.0

[13] The number of off-trail parties includes parties observed off trail to participate in activities that were not counted when estimating compliance indicators (i.e. exceptions). As a result, a much larger number of parties traveled off trail than the number included in the calculation of compliance indicators. For example, parties off trail only to yield were not counted as out of compliance with on-trail requirements. All off-trail activities are included in this table to provide information to managers on the perceived motivations for traveling off trail.

[14] "Other" or "unknown" reasons for parties in each activity group traveling off trail are listed in **Appendix G1.**

Table 6. Percent of off-trail parties observed in 2010 in each activity group perceived to have left the trail for the reasons listed. If multiple reasons were listed for an off-trail party, additive percentages will exceed 100%.

	Activity Type **n**=number of off-trail parties observed[15]			
2010 Perceived reason for leaving the trail	**Hiker n=84**	**Runner n=36**	**Equestrian n=11**	**Cyclist n=99**
To accompany dog in off-trail dog activities	1.2	0	0	0
To travel around muddy or poor trail conditions	19.0	36.1	0	15.2
To observe wildlife, plants, or a scenic view	4.8	0	0	0
To move past visitors on the trail	2.4	13.9	9.1	16.2
To take a picture or be photographed	3.6	0	0	0
To rest or eat off trail beyond the trail edge	8.3	0	27.3	16.2
To travel side by side with an on-trail companion	8.3	5.6	0	0
To shortcut a trail	3.6	0	0	8.1
To get out of the way while engaging in trailside activities[16]	4.8	0	27.3	24.2
To travel on a undesignated trail	2.4	2.8	0	4.0
To access water in a creek or in the DWB canal	2.4	0.0	0	0
To wait for a companion	1.2	0	9.1	13.1
To yield off trail to oncoming or opposing traffic	56.0	47.2	45.5	21.2
To fix a bike	0	0	0	3.0
To travel off trail for unknown or other codeless reasons[17]	8.3	5.6	36.4	11.1

[15] The number of off-trail parties includes parties observed off trail to participate in activities that were not counted when estimating compliance indicators (i.e. exceptions).
[16] Specific trailside activities for each activity group are listed in Appendix G2.
[17] "Other" or "unknown" reasons for parties in each activity group traveling off-trail are listed in Appendix G1.

Off-trail dogs: behaviors and activities associated with off-trail travel

The most frequently tallied behaviors associated with off-trail dog travel were dog play and exploration, (52.6% of off-trail dog parties in 2009, 26.1 % in 2010) and yielding with guardians (47.4% in 2009, 46.2% in 2010). Dogs traveling off trail to engage in "dog activities" were observed running across the mesa, up and down grassy slopes, through riparian areas, and around a prairie dog area. Off-trail dogs were also observed swimming in the Denver Water Board canal, shortcutting trails, walking side-by-side guardians, tracking deer that had recently passed by, fetching sticks, sniffing around off trail, or accompanying dog guardians who were photographing or resting off trail.

Dogs that were considered exceptions to the on-trail requirements traveled off trail under their guardians control exclusively to yield, pass, avoid mud, or wait just off trail and out of the way while their guardians read signs or stepped off trail for incidental trailside activities (*see **Sections 2.6** and **2.7***). Dogs that traveled into drainages to drink during the hot days of August were also considered exceptions.

Human visitors: distance traveled off trail

For human visitors, off-trail travel most frequently occurred within 10 feet of the trail edge (**Figure 6**) with approximately 86% of off-trail visitor parties remaining within 10 feet of the trail in both years. Running and cycling parties rarely traveled greater than 10 feet from the trail edge, while equestrian parties more frequently went further off trail. Of off-trail pedestrian parties observed in 2009 and 2010, 90.8% (59 of 65 parties) and 85% (102 or 120 parties), respectively, remained within 10 feet of the trail.

Dogs: distance traveled off trail

In contrast to pedestrian off-trail travel patterns, less than 70% of off-trail dog parties observed remained within 10 feet of the trail edge in both 2009 and 2010. Dog-guardian parties with off-leash dogs were observed more frequently with their dogs greater than 10 feet from the trail tread than those with on-leash dogs (**Figure 7**).

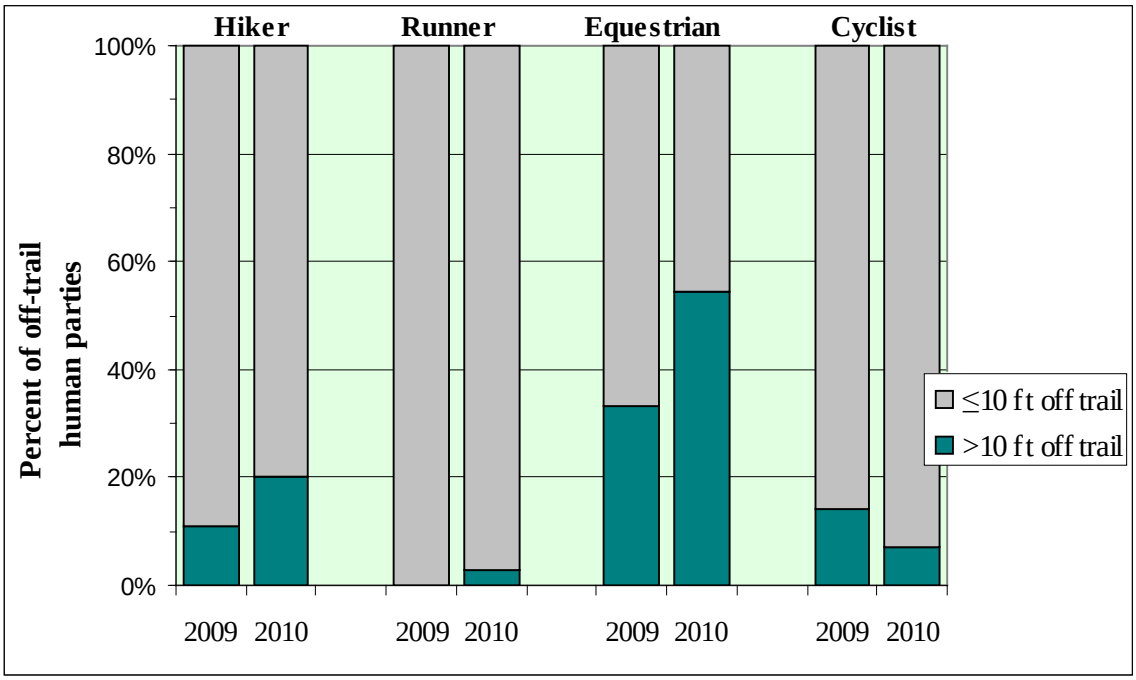

Figure 6. Percent of observed off-trail parties traveling ≤10 ft or >10 ft from the trail edge for each activity group in 2009 and 2010. Off-trail parties illustrated include parties off trail only to yield, pass, or avoid mud or otherwise considered an exception for compliance purposes.

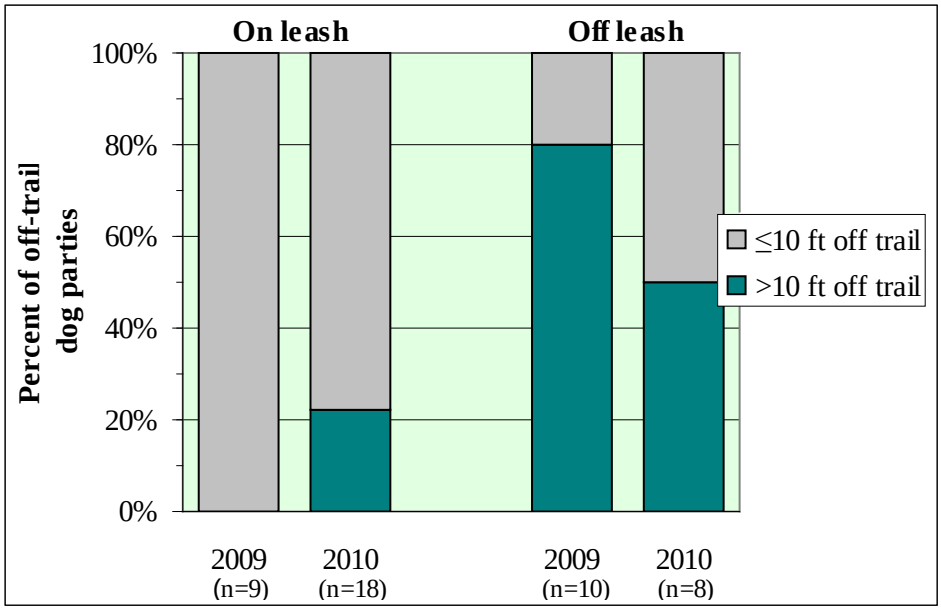

Figure 7. Percent of observed off-trail dog guardian parties with dogs traveling ≤10 ft or >10 ft from the trail edge for on-leash and off-leash dogs in 2009 and 2010. Off-trail dog-guardian parties illustrated include parties off trail only to yield, pass, or avoid mud or otherwise considered an exception for compliance purposes.

4.0 DISCUSSION

4.1. Status of compliance indicators

Observational monitoring of trail segments on the SBL showed that while most visitor parties remained on-trail and in compliance with dog regulations, four of five monitored indicators of compliance (on-trail requirements for equestrians and dogs, on-leash requirement for dogs, SBL-south prohibition for dogs) were outside OSMP's acceptable range in both 2009 and 2010.

Visitors were made aware of the area-specific requirements on SBL through increased educational and outreach efforts. Established ranges of acceptability for monitoring indicators were also communicated to the public through a community input process, website documents, and in 2010, the installation of additional signs reiterating the desired goals for compliance. Nonetheless, adaptive management following the first season of monitoring failed to bring compliance with these area-specific requirements into the established acceptable range.

Compliance levels estimated by OSMP's observational monitoring probably overestimate true compliance rates. First, these estimated compliance levels reflect only the compliance rate observed **along a small portion of the trail**. Monitoring observations along these trail segments measure only a fraction of a visitor's trip and would represent a compliance rate only if observed visitors in compliance with specific requirements remained in compliance for the rest of their trip.

In a study of on-trail compliance in the Potomac Gorge (Maryland, USA), visitors self-reported much lower rates of on-trail compliance for their entire trip (29.7% on-trail compliance) than rates directly observed (62.6 to 81.1% on-trail compliance) on a small section of trail (Hockett et al., 2010). One reason for this discrepancy could be the fact that there were more unobserved opportunities to travel off trail during the visitor's trip than could be measured by a stationary observer. During our monitoring sessions, observers noted visitor parties that remained in compliance while traveling on the official observation segment but that left the trail or allowed their dogs off leash before or after traveling on official observation segments, supporting the notion that on-trail travel and dog compliance is overestimated in this study. Furthermore, our estimates are more likely to overestimate compliance if the presence of observers, unable to remain completely obscured to visitors, improved visitor compliance as compared to behaviors exhibited when visitors believed they were out of view by others.

4.2. Comparison of results to on-trail rates and leashing compliance levels measured elsewhere

On-trail compliance for cyclists, equestrians, and dog guardians

Our estimates of on-trail compliance generally mirrored those found on the High Plains Trail during a similar observational study on OSMP land (VanderWoude, 2008). Compliance levels for cycling parties (99.7% in 2009; 99.4% in 2010) and equestrian parties (75% in 2009; 88.9% in 2010) observed during SBL monitoring were very similar to proportions of visitor parties observed on trail along portions of the High Plains Trail (98.8% for cyclists; 75% for equestrians). High trail fidelity among cyclists may reflect the suitability of a developed trail tread as compared to the surrounding landscape for faster and uninterrupted travel (VanderWoude, 2008), whereas equestrians may be more skilled at off-trail travel and more interested in off-trail activities such as grazing, resting or avoiding other visitors. Compliance

estimates for on-trail dog parties on SBL (75% in 2009; 84.1 % in 2010) were higher in both years than the 53.9% of dog parties reported on-trail along the High Plains Trail (VanderWoude, 2008), although both studies found relatively low compliance for dogs on trail as compared to other visitor activity types. Dogs, like horses, may be more at ease moving off the trail tread and more intent on exploring off trail.

On-leash compliance

There are relatively few studies, mostly unpublished, of on-leash compliance in natural areas or parks. Our estimated compliance with on-leash requirements on SBL was slightly lower or similar to estimates reported in other observational studies from the Boulder County area. On-leash compliance in 2009 (59.2% on-leash compliance) and 2010 (66.7% on-leash compliance) were similar or slightly lower than the 69.2% compliance rates observed by OSMP on portions of the High Plains Trail (VanderWoude, 2008). OSMP's on-leash compliance estimates on SBL were also lower than reported leash compliance rates estimated by Boulder County Parks and Open Space (BCPOS) across their system (77% in 1999; 82% in 2005) and on their foothills properties (76% in 1999; 77% in 2005) (T. Glowacki, personal communication, February 23, 2006). Both OSMP and BCPOS set the range of acceptability for compliance with leashing regulations at 90-100% yet failed to measure acceptable levels despite intensive outreach, enforcement and educational campaigns (T. Glowacki, personal communication, February 23, 2006; City of Boulder, 2009).

Other studies estimating leashing compliance in natural areas based on survey responses of dog - owners have reported levels of on-leash dog walking that are comparable to observations in this study. For example, sixty percent of dog owners reported on-leash compliance when characterizing their last 12 months of visitation to a North Carolina state park (Nesbitt, 2006). Similarly, 57% of dog owners reported that they never had let their dog off leash while hiking at Pima Canyon in Arizona (D. Urbinato & D. Juarez, personal communication, MS Powerpoint presentation sent by email, March 30, 2011).

Pedestrian off-trail travel rates

Although no on-trail requirements or acceptable ranges were established for pedestrians on SBL, observed rates of off-trail travel for pedestrian parties (22.2 % in 2009, 25.8 % in 2010) provided a way to gauge potential trampling concerns along the SBL corridor. Observed off-trail pedestrian travel reported in other studies varies widely with location and observation method. Less than 11% of observed visitors hiked off trail in the northern Wales countryside (Kierle & Stevens, 2004) and in Paradise Meadow, Mt. Rainer National Park (Johnson & Swearingen, 1992). Observational studies in the heavily visited Potomac Gorge area found that approximately 26% of individual hikers traveled off trail onto closed social trails (Hockett et al., 2010). Similarly, 30.9% of visitors hiked off trail where there were no signs directing them to stay on trail in Sequoia and Kings Canyon National Parks (Winter, 2006). Percentages of off-trail travel by pedestrian parties on observed SBL trail segments was less than off-trail percentages observed on segments of the High Plains trail (40.9 %) where on-trail travel is required (VanderWoude, 2008). Hiking parties in both studies traveled off trail more frequently than runners. Off-trail pedestrian travel rates can potentially be much higher than those observed on SBL with the proportion of visitors observed hiking off trail as high as 73.7% (Cadillac Mountain in Acadia National Park) (Park, Manning, Marion, Lawson & Jacobi, 2008) and 88.3

% (Camelot Island in St. Lawrence Islands National Park, Ontario) (Bradford & McIntyre, 2007). The latter two studies, however, were characterized by higher visitation rates, sampling that occurred exclusively during peak-use times, and dense networks of undesignated trails near the observation zone; conditions that do not currently exist at SBL.

4.3. What factors underlie visitor compliance?

An understanding of the beliefs and motivations underlying noncompliant behavior in outdoor environments is useful in developing successful and customized management strategies (Ham et al., 2009; Harding, Borrie, & Cole, 2000; Knopf & Andereck, 2004). Although SBL monitoring was not designed to measure the motivations for the observed off-trail travel or dog regulation compliance, supplemental information recorded for visitor parties during observational sessions and the insights and results gained from other observational studies and visitor surveys may suggest hypotheses for noncompliant behavior on the SBL.

A number of authors have developed frameworks to explain reasoning processes of visitors participating in outdoor recreation or have classified the motivations that underlie behavior in outdoor environments (Azjen & Driver, 1992; Harding et al., 2000; Hughes, Ham, & Brown, 2009; Stern, 2000). For example, the theory of "planned behavior" asserts that a combination of a person's attitudes and beliefs, their perceptions of external social pressures, and their perceived ability to perform the behavior will explain their behavioral intentions and ultimately actions (Azjen & Driver, 1992; Nesbitt, 2006). Inclusion of additional external forces (e.g., regulations, enforcement) and habitual acts as interacting causal variables in Stern's (2000) classification (below) makes his framework particularly useful in understanding noncompliance on the SBL:

1. **Attitudinal (internal) factors**: values, pre-existing beliefs about the behavior or the consequences of the behavior and personal norms that influence the behavior
2. **External or contextual forces**: the forces in the environment that increase behavioral awareness or sanction the behavior through various means including education, penalties, enforcement, incentives and social pressures
3. **Personal capabilities**: a person's literacy, knowledge, skills, experience, and resources that influence the ability to perform the behavior
4. **Habit**: the aspect of behavior conducted routinely, without deliberation

<u>Attitudinal factors for noncompliance</u>

Human dimensions research suggests that pre-established values and beliefs are an important explanatory factor driving visitor behavior in outdoor settings (Hughes et al., 2009; Marion & Reid, 2007; Williams, Weston, Henry & Maguire, 2009). These values may necessitate behavioral decisions when competing values promote conflicting behaviors, such as when strong pro-environmental values favoring low-impact, on-trail recreation compete with a person's value favoring off-trail exploration for themselves and their dogs. When making a decision about a behavior, a visitor's beliefs about the perceived personal costs of the behavior can be offset by the beneficial consequences associated with that behavior. Furthermore, a visitor may have predetermined values that lead them to consider a behavioral requirement (e.g., regulation) not applicable or irrelevant to their own actions in a natural setting.

Belief in positive consequences of behavior
A visitor's on-trail or dog-management behavior is guided by their belief in the beneficial outcomes of that behavior (Marion & Reid, 2007). For example, a visitor's beliefs in the necessity of on-trail travel to protect natural resources and minimize visitor conflict can influence their intention to stay on trail. Attitudes towards on-trail travel on OSMP lands are reflected in a recent survey of Boulder residents which found that most respondents (88%) felt that requiring visitors to stay on trail was a very appropriate or somewhat appropriate management strategy to address impacts to plants and wildlife (National Research Center, 2010). Similarly, 74% of respondents felt requiring dogs to be on or near the trail was a very appropriate or somewhat appropriate strategy to address conflict between visitors (National Research Center, 2010). Such visitor beliefs may reflect an underlying morality guided by socially responsible or altruistic behavior (Marion & Reid, 2007).

Similarly, strong beliefs in the positive consequences of leashing dogs may enhance leash compliance in natural areas. When queried about the advantages that could occur if dogs were kept on leash in an Australian national park, the majority (79%) of respondents in compliance with leash laws believed that dogs would be less of a nuisance to other people and dogs than their non-complying counterparts (12%) (Hughes et al., 2009). Similarly, a belief that their dogs would have negative consequences if unleashed was correlated with an obligation to leash dogs (William et al., 2009). OSMP's 2004 attitudinal survey showed that a majority of respondents (90% of dog-guardians and non-dog guardians combined) felt that leashing dogs in areas with a high wildlife-habitat value was very or somewhat appropriate management strategy (Public Information Cooperation, 2004).

Beliefs in personal costs of behavior
While on-trail travel and compliance with dog-leashing requirements may benefit natural resources and avoid visitor conflict, visitors may also respond to their perception of the personal costs (e.g., loss of freedom) associated with these behaviors. Visitors with a strong motivation for leaving the trail may do so even when they personally favor on-trail travel (Hockett et al., 2010). In cases where observational studies or surveys have tracked various perceived or self-reported motivations for off-trail travel, reaching a scenic vista or attraction, getting a better view, taking or posing for photographs, or exploring were among the primary motivations for off-trail travel (Hockett et al., 2010; Park et al., 2008; Winter, 2006). Furthermore, while most survey respondents visiting a particular trail in one study expressed high levels of commitment to stay on trail in order to protect off-trail resources, they were somewhat less willing to stay on trail if it meant giving up opportunities to explore off trail or to travel in some especially desirable areas (Hockett et al., 2010). At SBL only a small percentage of OSMP visitor parties were perceived to leave the trail in order to take or pose for photographs, get a better view, or explore off trail. The views visible from the mesa portion of the trail and the lack of crowding on the trail at most times may preclude the need to travel off trail to get to or photograph a scenic view.

A propensity to disobey leash requirements has been linked with a strong pre-held belief in the benefits of unleashed exercise for dogs (Ham et al., 2008; Hughes et al., 2009; Nesbitt, 2006; Williams et al., 2009), and a belief that dogs' experiences are compromised when they are leashed (Ham et al., 2008). A survey conducted from 1995 to 1996 among visitors to specific

Open Space locations (i.e., Mt. Sanitas, Chautauqua, Doudy Draw, and Bobolink) where dogs are not required to be on leash and City of Boulder areas requiring dog leashing (i.e., Colorado University campus and Pearl Street Mall) suggested a similar sentiment with the majority of respondents (89%) believing that their dog's experience would be diminished if their dog had to be on leash (Bekoff & Meaney, 1997). At SBL, the majority of dogs traveling off trail for reasons other than yielding seemed to be engaged in "dog activities" such as exploring or play. Dog guardians out of compliance with off-leash and off-trail requirements on SBL may believe that keeping their dog on-trail and on-leash stifles their dog's freedom to explore and exercise.

Other predetermined beliefs about the behavior

Research has indicated it is important for a visitor to not only accept the consequences of a behavior as real and significant, but also agree that their individual personal actions can contribute to negative impacts, and believe that they have the control to alter their behavior in a way that mitigates impacts (Bradford & McIntyre, 2007; Hockett et al., 2010; Widner-Ward & Roggenbuck, 2003). For example, those City of Boulder survey respondents that felt on-trail requirements were very or somewhat inappropriate for visitors (9%) or for dogs (19%) (National Research Center, 2010) may not believe that the regulations are appropriate, relevant to their personal behavior, or that the consequences are relatively minor relative to the benefits gained from off-trail travel. Likewise, visitors may acknowledge the ecological impacts from off-trail travel in general, but not believe that their individual actions cause a significant problem, despite numerous studies demonstrating that the greatest rate of physical impacts on social trails occur early in path formation, when initial trampling removes organic litter and vegetation (see review paper by Leung & Marion, 2000). Similarly, dog-guardians may acknowledge the negative social and ecological impacts of off-leash dogs, but rationalize their noncompliance under specific circumstances (e.g., not crowded, belief in their well-behaved dogs, belief that their dogs will not cause impacts) (Nesbitt, 2006).

Studies have demonstrated either a lack of awareness among dog guardians of the specific ways dogs may negatively impact wildlife and sensitive areas (Williams et al., 2009) or a lack of belief that the negative ecological impacts are real or important (Ham et. al., 2008). Even when dog owners acknowledge and support the importance of wildlife protection, they may place greater importance on the benefits of unleashed exercise for dogs (Williams et al., 2009). In fact, in an OSMP visitor survey on attitudes toward off-leash dogs, 44% of dog-guardians agreed and 24% of dog-guardians were neutral with the statement "I do not think that there are any real impacts from off-leash dogs at OSMP areas" (Vaske & Donnelly, 2007c). Furthermore, among OSMP visitors, only 10% of dog guardians responding to the 2007 Visitor Survey believed the behavior of off-leash dogs was a problem at OSMP (Vaske & Donnelly, 2007c).

Surveys suggest that a proportion of visitors will choose noncompliance with regulations or norms in natural areas based on their predetermined belief that off-trail walking is acceptable or "should be allowed" (Hockett et al., 2010; Park et al., 2008) or that "it is my choice how I walk my dog" or that "off-leash use should be allowed at any time" (Nesbitt, 2006). A variety of indirect management strategies (e.g., sanction, attribution, and educational signs, personal contacts) have been effective in significantly reducing, but not eliminating off-trail travel or off-leash dog walking among intentional violators (Bradford & McIntyre, 2007; Hockett et al., 2010; Park et al., 2008; Winter, 2006).

Contextual forces

A number of "external forces" likely influenced compliance with on-trail travel and dog management requirements on the SBL including:

- Existence and communication of on-trail and dog-control requirements
- Enforcement of requirements and potential for fines
- Presence of uniformed rangers
- Community expectations for high levels of compliance
- Perceived rewards for compliance such as retaining or gaining access elsewhere
- Social pressures favoring or disfavoring compliance.

Awareness of SBL regulations is one important factor favoring visitor compliance. Enhanced efforts were made to communicate the SBL regulations to the public through brochures, website notices, public meetings, ranger and volunteer contacts, and posted regulations. While a number of regulatory and interpretive signs were posted at the trailheads and along the trail (**Appendix B1** and **B2**), staff did not measure the frequency with which signs were read, internalized, or accepted. Other studies suggest that many visitors do not carefully read educational or regulatory signs posted along trails (Park et al., 2008; Turner & LaPage, 2002). Signs posted along SBL displayed a number of different persuasive message types including sanction messages (**Appendix B1**), interpretive messages (**Appendix B2**), and attribution messages (**Appendix B3**) that have been found to vary in relative effectiveness under different experimental conditions (Bradford & McIntyre, 2007; Johnson & Swearingen, 1992). Some authors, however, suggest that persuasive messages developed without knowledge of the salient beliefs driving specific non-compliant behavior are likely to be ineffective (Ham et al., 2009; Hughes et al., 2009). Because OSMP staff lacked knowledge of the significant underlying beliefs driving the non-compliant behavior at SBL, even their best efforts to deliver appropriate messages on signs based on the human dimensions in recreation research may have been ineffective at changing behavior of some visitors.

Other factors influencing compliance, such as acceptance of regulations, belief that the regulations will be enforced, and/or fear of penalties are likely to vary among visitors to SBL. A strong correlation between the propensity to disregard leashing requirements and a belief in one's ability to completely control their off-leash dog has been demonstrated through surveys of state park visitors (Nesbitt, 2006). Visitors that routinely use voice-and-sight control on OSMP trails may believe so strongly in the good behavior of their dog that they disregard other external forces favoring leash compliance. Although rangers avoided the SBL during scheduled monitoring sessions, their frequent patrols and contact with visitors on SBL at other times during the first two years after trail opening likely encouraged some increment of compliance. The degree of ranger presence on SBL over the first two years was disproportionately high relative to SBL visitation levels. However, communication of regulations and ranger presence may be ineffective if the visitor holds pre-existing beliefs that the regulation is irrelevant or should not apply, the rule is unlikely to be enforced, or the sanction is insignificant. For some visitors, the relatively low fine for noncompliance with dog regulations may not outweigh other factors encouraging noncompliance with SBL regulations.

Visitors traveling on SBL may have experienced a suite of interpersonal or social forces that encouraged compliance. OSMP intended to establish a social norm for high levels of compliance by setting relatively high ranges of acceptability for indicators and communicating these to the public prior to trail opening. Activity groups may have applied social pressures among their peers to meet these expectations hoping to retain their access or be rewarded with additional access elsewhere. Informal approvals (e.g., a verbal "thank you") or disapprovals (e.g., a contemptuous glance) from other visitors on the shared-use trail could also have reinforced compliance by triggering feelings of appreciation or embarrassment associated with the behavior (Heywood & Murdock, 2002). For example, volunteer mountain bike guides were observed educating other visitors and modeling appropriate behavior on the SBL. Social norms for leashing (i.e., the belief that other people generally expect dog-guardians to leash their dogs) have been shown to be relatively strongly related to a dog-guardian's sense of obligation to leash their dogs (Williams et al., 2009) or a dog guardian's observed compliance with leashing requirements (Ham et al., 2008). If such social norms exist, they are more likely to be manifested when other visitors are in the vicinity. However, the prevalence of off-leash dogs on SBL during this monitoring study generally paralleled the frequency of dog walkers with most off-leash dogs observed mid-day on weekends when visitation levels were relatively high.

Conversely, direct observation or indirect evidence of other visitors breaking rules or norms (e.g., presence of visitor tracks, social trails) in outdoor settings can promote noncompliance (Bradford & McIntyre, 2007; Hockett et al., 2010; Kernan & Drogan, 1995; Park et al., 2008; Vande Kamp, Johnson, & Swearingen, 1994). Off-trail tracks and braided trails evident in muddy spots on SBL (**Appendix H**) may have served as "releasor cues" that encouraged further off-trail travel. Anecdotal observations during monitoring suggest that visitors often followed others' paths as they tried to avoid wet or muddy spots on the designated trail. In contrast, effective recovery of historic social trails along the SBL probably minimized a releaser cue effect that would have been in place prior to undesignated trail closure.

<u>Personal capabilities and control factors</u>

Factors associated with personal capabilities that impinge on a visitor's abilities to remain on trail include trail characteristics and conditions and a visitor's skill in remaining on-trail when encountering other visitors or difficult trail conditions. Off-trail behavior associated with these control factors may be amenable to change through educational programs (e.g., cycling training) as well as actions that influence trail conditions. For example, limited space along a shared-use single track trail can challenge the ability of visitors to stay on trail. In both 2009 and 2010, avoiding other on-trail visitors by yielding or passing off trail was the most frequent motivation recorded by observers for off-trail travel by hikers, cyclists, runners and equestrians. While cyclists on SBL were often observed yielding on trail by forming a tripod with one foot on the trail (the so called "Fruita Lean"), pedestrians, dog-guardians, and equestrians may believe that there is no safe, comfortable, or convenient place to remain on a single-track trail when encountering crowding or faster-paced visitors. "Avoiding mud" was the second most frequently perceived reason for cycling and running parties to leave the trail, suggesting that much off-trail travel occurs during the limited periods when muddy conditions exist on the SBL. Although off-trail travel associated with yielding, passing, and avoiding mud is not considered in our estimates of noncompliance, addressing these common motivations for off-trail travel may help mitigate

the unavoidable impact that can be expected in the trail corridor whenever a shared-use trail is developed.

Personal capabilities influencing compliance with regulations to keep dogs on trail, on leash and off SBL-south are based on a guardian's ability or perceived ability to control and leash their dog. Dog guardians may have a more difficult time keeping their dogs on trail in the presence of other visitors, other dogs, or wildlife. Both the skill of the dog guardian and the behavior and characteristics of the dog influence this ability. On the SBL, off-leash dogs were more frequently observed off trail than on-leash dogs and were more likely to travel greater than 10 feet from the trail edge than dogs that remained on leash. Thus, the ability of dog guardians to keep their dog on trail or near the trail is improved when dog guardians comply with the leash requirement. No special skills are needed to keep a dog on leash.

Habitual behavior and noncompliance on SBL

Habitual behaviors are those actions that have become so entrenched through frequent repetition that reasoning does not play a role in behavioral decisions (Hughes et al., 2009). Visitors motivated by habit tend to be less amenable to educational or persuasive messages, possibly because they are less likely to read signs or have strong predetermined beliefs about the behavior (Ham et al., 2009).

Although SBL had been opened for less than a year at the time monitoring began, habits formed in the past or while traveling on other trails may have discouraged compliant behavior. For example, some current SBL visitors may have recreated in the SBL area prior to trail construction during which time they developed specific hiking or riding patterns or routines. These visitors may have also developed strong bonds with particular remote locations or with the experience of exploring off trail. Changing these patterns or routines, particularly ones with associated emotional bonds is very difficult.

Habitual behavior may also explain noncompliance with SBL leashing requirements. Noncompliance with leash requirements is thought to have a strong habitual component (Hughes et al., 2009) as suggested by the high levels of noncompliance among local dog walkers at a regional park in Australia who were frequent repeat visitors and also had a strong prior intention to walk their dogs off leash. Because SBL is further from densely-populated residential neighborhoods, a smaller proportion of dog guardians probably walk their dogs at SBL on a daily or even weekly basis than at other access points closer to neighborhoods. In fact, surveys administered at SBL within eight months of trail opening indicated that less than 20% of those reporting dog-walking as their primary activity visited SBL four or more times per month (D. VanderWoude, personal communication, February 11, 2011). However, visitors to SBL that frequently travel with their dogs under voice and sight control on other trails (such as along the nearby Doudy Draw trail) may have become accustomed to allowing their dogs off leash.

5.0 RECOMMENDATIONS and IMPLICATIONS FOR MANAGERS

Although most visitor parties complied with the area-specific regulations attempting to balance visitor experience and resource protection on SBL, four of five estimates of compliance with SBL-specific regulations fell outside the established ranges of acceptability, even after management strategies to improve compliance were implemented on the SBL.

Compliance levels with dog regulations, specifically with the on-trail and on-leash requirements, were lower than compliance levels for other visitor activity types. This suggests that improving compliance with dog regulations is the highest priority for management. Compliance with on-trail dog requirements would likely improve by addressing leashing compliance. Additional strategies to improve on-trail compliance for dogs and equestrians, along with an overall strategy to promote on-trail travel for all SBL visitors, should also be considered to minimize potential deterioration along the SBL trail corridor.

In synthesizing research on management of depreciative behavior in natural settings, Knopf and Andereck (2004) proposed 12 principles for effective intervention (**Appendix I**). Consideration of these principals, other literature on deterring depreciative behavior, and speculation on the underlying causes for noncompliance (**Section 4.2.4**) suggest a number of management strategies to consider for the SBL.

Consider prohibiting dog travel on the SBL.
In 2010, OSMP implemented a suite of management strategies for the SBL (additional education and outreach, changes in signs, stakeholder meetings) to address poor compliance with dog regulations after the first period of monitoring (**Appendix A2**, City of Boulder, 2008). OSMP also maintained frequent ranger patrols and enforcement in the SBL/GRT area. The EM/DD-TSA Monitoring Plan included a final strategy of disallowing dogs on SBL after less restrictive strategies were demonstrated to be ineffective at achieving targeted compliance rates (City of Boulder, 2008). Failure to follow through with this publicly-communicated strategy to meet EM/DD-TSA planning objectives may reduce public perception of agency accountability and OSMP's effectiveness in communicating regulations elsewhere in the OSMP system.

Prohibiting dog travel on SBL is an example of a direct management practice[18], a strategy that regulates visitor behavior while leaving little or no freedom for individual choice (Gramann, Christiansen & Vander Stoep, 1992; Hockett & Hall, 2007; Park et al., 2008). Prohibitions, rules, area closures, activity zoning, and formal sanctions to enforce these conditions are examples of direct management practices. Direct management practices, while effective in reducing depreciative behavior (Duncan & Martin, 1992; Johnson & Swearingen, 1992; Martin, 1992) are often considered inappropriate or undesirable by natural area managers and visitors (Hockett et al., 2010; Johnson, Rugh, Vande Kamp, & Swearingen, 1994; Park et al., 2008), with managers expressing concern for degrading visitor experiences, reducing visitor's flexibility and opportunities, and causing negative reactions by visitors to the management agency (Johnson et al., 1994; Martin, 1992; Vande Kamp et al., 1994) . Furthermore, because direct management using prohibitions may not engage the visitor in evaluating the merits of the requested behavior, the underlying values causing the behavior are not likely to change and the behavioral response is less likely to be long-term or transferable to other locations (Ham et al., 2009; Hockett & Hall, 2007; Manning, 2003).

The effectiveness of a "no dog" strategy for SBL may be enhanced when certain conditions are met. For example, to be effective in direct management, Knopf & Andereck (2004) believe that

[18] **Direct management** has been defined as "a strict enforcement of rules and regulations governing visitor actions, including the use of nonvoluntary limitations on visitor access (Gramman et al., 1992, pg. 253).

the agency must be able to impose severe enough sanctions to deter noncompliance, have the capacity to observe the noncompliant behavior, and have the authority and desire to uniformly enforce the regulation. OSMP would need to be able to convince the public that the management actions are appropriate and necessary to meet EM/DD-TSA objectives. By communicating a "no dog" regulation in a way that acknowledges the value placed on off-leash dog walking and by emphasizing a visitor's freedom to make choices (see Vande Kampe et al., 1994) by providing options for alternative off-leash dog walking sites (such as along the nearby Doudy Draw trail), OSMP may be better able gain acceptance of an SBL dog-prohibition. Alternatively, OSMP might consider building on efforts already implemented in 2009 and 2010, using the multiple educational and management approaches outlined below.

Strengthen external forces favoring compliance

Although OSMP has already put considerable resources into enforcement and communication of SBL regulations, a number of changes might be considered to strengthen the influence of external forces on visitor compliance. These include:

- Strengthening social norms favoring on-leash and on-trail compliance for dogs by training volunteer trail guides/stewards to model and communicate such behavior with their dogs.
- Working with community groups (e.g., mountain bike groups, equestrian groups) to promote social norms that discourage 1) use of the SBL when trails are generally wet and muddy; 2) off-trail travel when passing or avoiding mud and wet spots on the trail; 3) side-by-side travel, which encourages other visitors or a companion to move off trail.
- Increasing the penalty imposed on dog guardians out of compliance with leash requirements and dog-travel prohibitions system-wide[19]. There is the large discrepancy between fines issued for dog violations on parkland and open space lands as compared to other lands within the city limits.
- Minimizing evidence in the environment of past noncompliance prompting additional off-trail travel (off-trail tracks, secondary trails, undesignated trails) by early closure of SBL under muddy conditions and by promptly camouflaging or closing newly developed secondary or undesignated trails.
- Increasing or maintaining ranger presence, particularly during times when dog-guardian visitation is expected to be higher (mid-day, weekends). However, any increase in ranger patrol in the SBL area will likely tax OSMP's needs for rangers elsewhere in the system.
- Using other staff and volunteers (clearly identified as OSMP associates) to communicate the reasons for and requirements for on-leash and on-trail travel on SBL. Personal communication of an educational or regulatory message has been demonstrated to be very effective in reducing depreciative behavior in natural settings (Hockett et al., 2010; Kernan & Drogan, 1995; Widman Ward & Roggebuck, 2003).
- Consider installing a "dog must be on leash –violations will result in a summons" sanction sign at those access points where SBL visitors have the option to continue on SBL or to choose an alternative trail where dogs may travel under voice and site control. Installation of

[19] While only municipal judges may set penalties for violations, the standard maximum penalty for a 1st conviction for dogs running at large, not on leash in parklands or open space is $50 (Boulder Revised Code, 1981 [B.R.C. 6.1.16]). Violations of dogs prohibited rules on parkland and open space lands (B.R.C. 8.3.3) are also typically subject to a maximum fee of $50. In contrast, maximum penalties for violations of dogs running at large within the city limits but outside of park land or open space are typically $500 for a 1st or 2nd offense within 24 months.

additional signage needs to be weighed against the negative effect on visitor experience of multiple signs and enforcement messages.

Refine educational and persuasive tactics to alter personal beliefs about compliance
Indirect management techniques that encourage visitors to voluntarily adopt appropriate behavior have been found to be effective in deterring some, but not all noncompliance among visitors (reviewed by Gramann, Christiansen & Vander Stoep, 1992; Knopf & Andereck, 2004; Manning, 2003; see also Bradford & McIntyre, 2007; Ham et al., 2008; Hockett et al., 2010). Many indirect management strategies rely primarily on persuasive communication of a message through interpretation, signage or education (Gramann et al., 1992; Hockett & Hall, 2007). While these efforts may not alter the behavioral beliefs of those who willfully or accidentally violate rules, they may encourage appropriate behavior among visitors who are careless, unskilled, uninformed, or misinformed about regulations and their consequences (Gramann et al., 1992; Park et al., 2008). OSMP has already employed a number of strategies to educate and persuade the public that employ a range of message sources and content recommended in the literature (Bradford & McIntyre, 2007). These messages have communicated rules about desired behaviors, threatened sanctions of fines and loss of access privileges, provided information about the environmental impacts of off-leash and off-trail travel, presented interpretive information to empower individuals with a sense of caring for the SBL, and conveyed a sense of personal responsibility and ownership for improving behaviors on the SBL (i.e., an attribution message) (Appendix B1 through B3).

OSMP managers could consider a number of additional persuasive strategies to improve on-trail and on-leash compliance:

- Providing more specific information on the negative outcomes of off-leash or off-trail dog behavior. Current messaging focusing on the impacts of off-trail or off-leash travel to wildlife should be expanded to include negative effects on other visitors' experiences and threats to a dog's safety (See **Appendix J** for two examples) because research elsewhere suggests that visitors may care more about what others think and their own dog's experience than they do about ecological concerns (Ham et al., 2008; Williams et al., 2009).
- Developing messages that enhance a visitor's awareness of how travel on wet and muddy trails will negatively impact their experience and the condition of the trail and trail corridor. Sharing photos of mud covered bikes, statistics on the volume of soil that can stick to boots, and the costs of repairing braided trails could provide vivid examples during interpretive talks.
- Supporting "share-the-trail" education campaigns to not only minimize conflict on SBL, but also to train visitors in yielding and dog-control techniques that minimize off-trail travel.
- Enhancing "Leave No Trace" education across the system so that visitors that choose to go off trail (e.g., to observe nature, to graze or rest a horse, to experience time alone) will do so with the least amount of damage.
- Educating the public on the negative consequences of off-trail travel by developing an outreach/educational field campaign designed to show the impacts and proliferation of undesignated trails and demonstrate or teach the techniques and effort required to close and restore undesignated trails. This might provide the secondary benefit of recruiting volunteers to assist with upcoming undesignated trail closures.

- Working with local dog recreation groups and trained volunteer trail guides to promote on-trail and on-leash travel and to communicate reasons for doing so. Messages geared towards persuading dog-guardians to leash their dogs will likely prevent some degree of off-trail dog travel.

Support system-wide research designed to identify motivations for noncompliance
Research on influencing behavior in outdoor settings suggests that compliance can be improved by first identifying the beliefs of noncompliers amenable to persuasion and then developing persuasive messages that target those beliefs (Ham et. al., 2008; Hugh et. al., 2009; Nesbitt, 2006). Since dog-related issues frequently top the list as sources of conflict and management problems among OSMP survey respondents, research identifying the underlying beliefs and norms that lead some dog guardians to disobey dog-control requirements should be prioritized when OSMP is able to support an external research program. Similarly, it is important to understand visitor motivations for leaving the trail to tailor management strategies to the different reasons for off-trail travel.

Enhance visitor ability to comply by managing trail conditions and increasing visitor skills
For visitors that believe that off-trail travel is unavoidable, OSMP might also consider the following steps that could make the trail more amenable to on-trail travel and enhance a visitor's capabilities to stay on trail.

- Closing trails during times when muddy trails encourage off-trail travel (see photo examples, **Appendix H.**
- Maintaining trails to discourage water collection/mud along the trail.
- Training visitors in the tripod yield (i.e., the Fruita lean) and in Leave No Trace travel options (minimizing off-trail distances traveled, stepping on rocks)
- Providing step-off points where off-trail waiting, yielding, or resting are encouraged.

A system-wide approach
While the results in this report highlight the need for specific management responses at SBL, the results and responses may also be placed in the context of the larger OSMP system, where surveys, ranger encounters, and anecdotal information suggest that off-leash dogs and off-trail travel are also problems (National Research Center, 2010). Thus, managers should consider which management actions aimed at improving compliance with dog-control and travel requirements at SBL are likely to be more efficiently and profitably implemented at the system-wide scale.

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7.0 APPENDICES

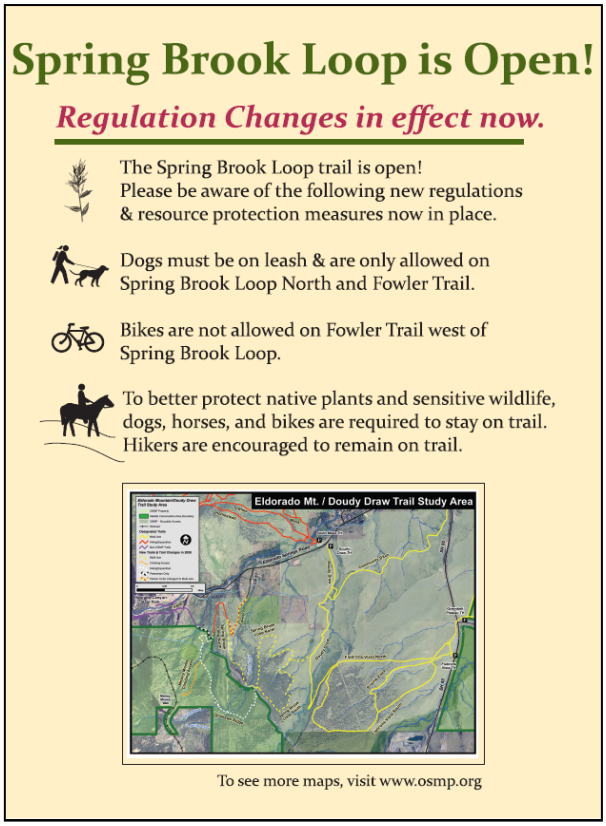
Appendix A1. Ranges of acceptability and potential management responses for on-trail compliance indicators on SBL (City of Boulder, 2008)

Ranges of Acceptability	Potential Management Responses
95 to 100% on-trail compliance of equestrian parties, cycling parties and parties with dogs	• Maintain or consider reducing existing levels of education, outreach and enforcement • Acknowledge/Thank visitors
<95% on-trail compliance of equestrian parties, cycling parties and parties with dogs	• Changes in 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 • Meet with stakeholders and implement strategies aimed at improving compliance • Seasonal or temporary access restrictions
OSMP will examine the rate of compliance and visitation levels observed from each activity, along with data from ranger patrols and undesignated trail monitoring to make determinations about prohibiting or restricting a particular activity Adopting regulations prohibiting specific activities would be considered after less restrictive strategies were demonstrated to be ineffective at achieving targeted compliance rates	• Prohibit off-trail travel by pedestrians • Disallow one or more activity groups on the Spring Brook Loop Trail

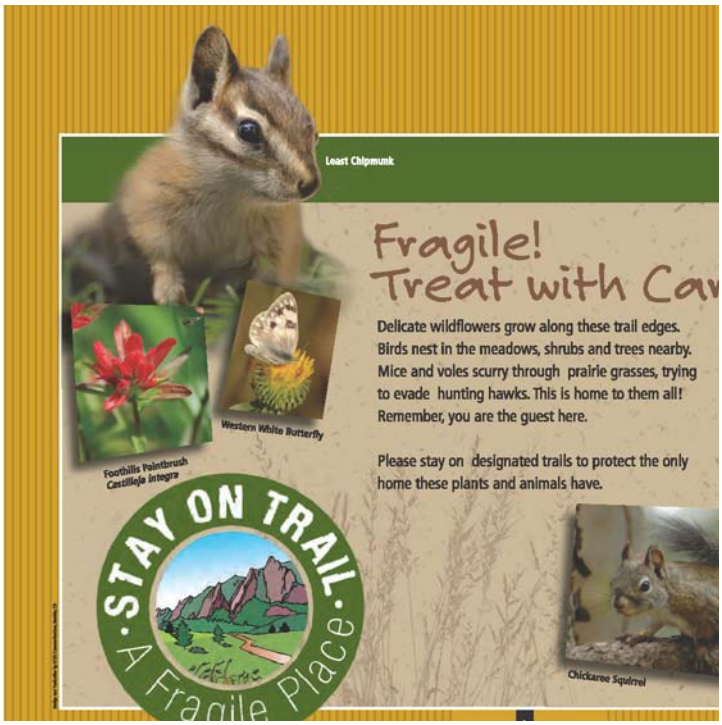
Appendix A. Ranges of acceptability and potential management responses for dog-regulation compliance indicators on SBL (City of Boulder, 2008)

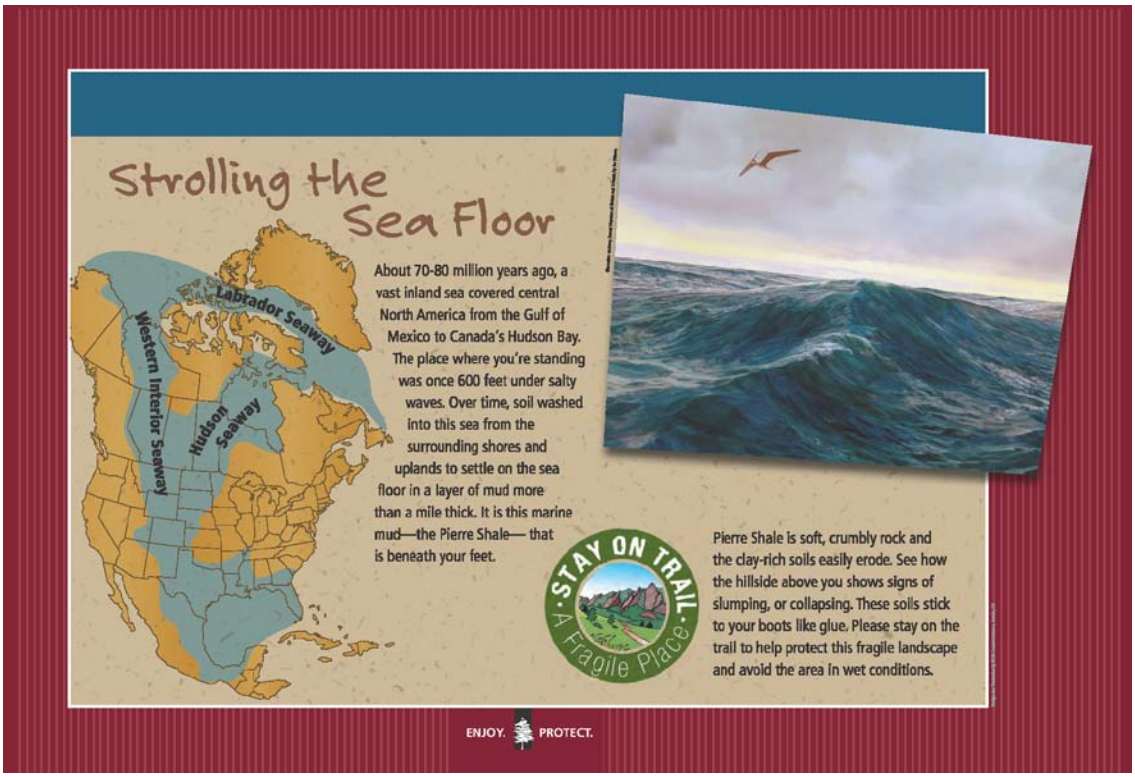
Ranges of Acceptability	Potential Management Responses
90 to 100% of parties comply with on-leash requirements and 90 to 100% of parties comply with dog prohibition on the southern Spring Brook Loop Trail	• Maintain or consider reducing existing levels of education, outreach and enforcement • Acknowledge/Thank visitors
<90% of parties comply with on-leash requirements; or <90% of parties comply with dog prohibition in southern Spring Brook Loop Trail	• Changes in education, outreach, signs, or enforcement • Meet with stakeholders and implement strategies aimed at improving compliance
OSMP would use values and trends of this indicator for on-leash compliance, along with levels of on-leash compliance measured during ranger patrols to make determinations about prohibiting dogs. To make determinations about compliance with dog prohibited on the southern Spring Brook Loop, OSMP would only use values and trends of this indicator. Adopting regulations prohibiting dogs would be considered after less restrictive strategies were demonstrated to be ineffective at achieving targeted compliance rates	• Disallow parties with dogs on the northern Spring Brook Loop Trail

Appendix B1. Regulatory signs placed on SBL before the trail opened in December 2008 communicated 1) the requirement for dogs to be on leash and on trail on SBL-north (top left, posted at the SBL-north/south intersections near the DWB road and at the intersection with the Doudy Draw trail); 2) the prohibition for dog travel on SBL-south (top right, posted at both SBL north/south intersections; 3) the threat of a summons for walking dogs on SBL-south (bottom left, posted at the beginning of SBL-south on the southern side); 4) Changes in on-trail and dog regulations (bottom right, posted at SBL trailheads during the initial months after SBL opened).



Appendix B2. Interpretive signs posted along SBL explaining different reasons to stay on trail





Appendix B3. Signs posted on SBL in response to first year monitoring conveyed a sense of personal responsibility for improving behaviors on the SBL (e.g., "Do your part, Keep Dogs on Leash")

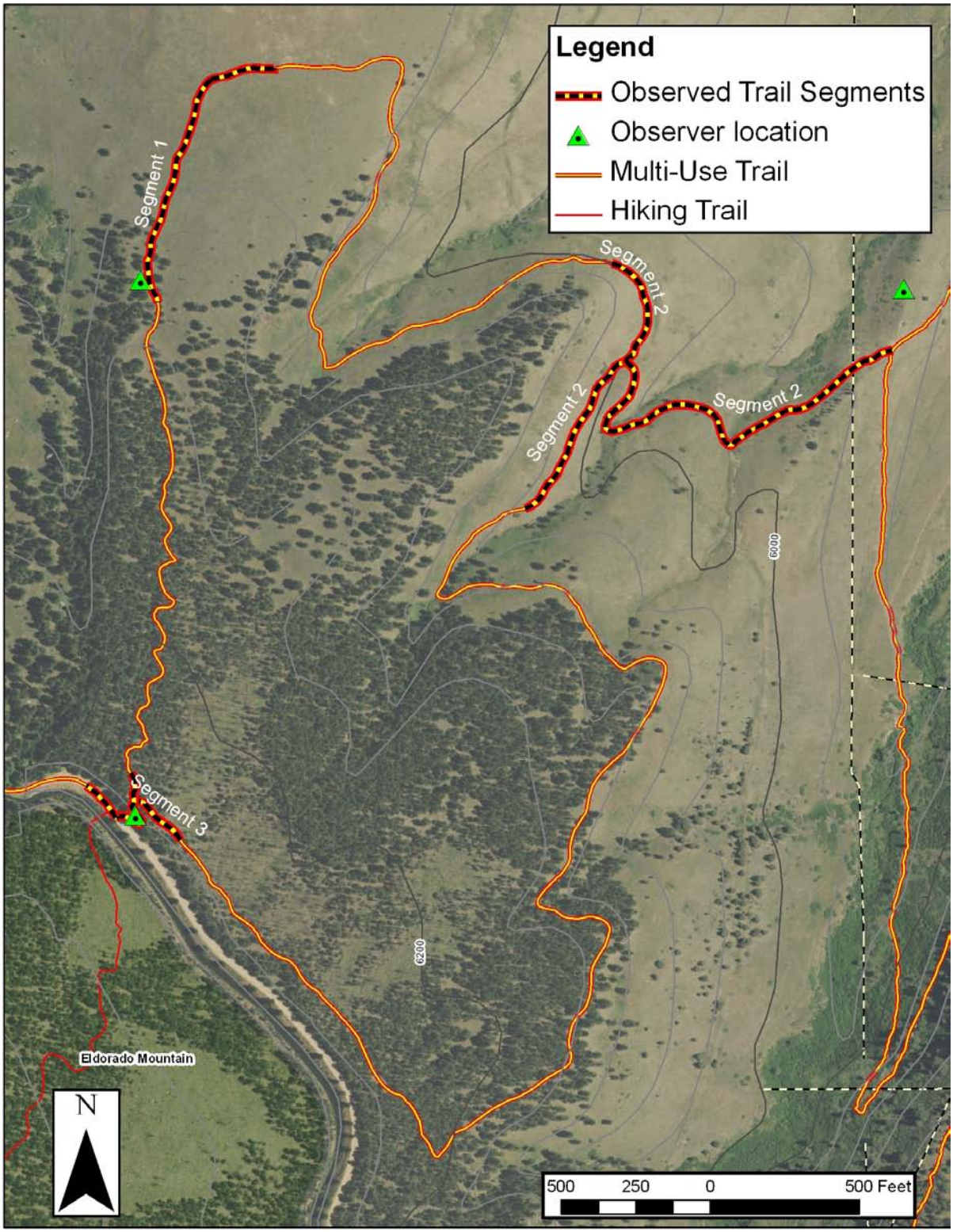
Appendix C1. Distribution of monitoring hours and sessions by type and time of day

Session Type		2009		2010	
Day type	**Timeslot**	**Hours**	**%**	**Hours**	**%**
Mon-Fri	am	59.7	26.9	65.9	26.1
Mon-Fri	mid	63.4	28.6	74.4	29.5
Mon-Fri	pm	51.7	23.3	51.6	20.4
Mon-Fri	**Total**	**174.8**	**78.9**	**191.8**	**76.1**
Weekend	am	16.0	7.2	19.0	7.5
Weekend	mid	18.9	8.5	16.0	6.3
Weekend	pm	11.8	5.3	25.3	10.0
Weekend	**Total**	**46.8**	**21.1**	**60.3**	**23.9**
All days	**All times**	**221.5**	**100.0**	**252.2**	**100.0**

Appendix C2. Distribution of monitoring hours and sessions by monitoring location and day type

Session Type		2009		2010	
Location	**Day Type**	**Hours**	**%**	**Hours**	**%**
Mesa	Week day	71.7	32.4	55.9	22.2
Mesa	Week end	12.0	5.4	17.0	6.7
Mesa Total	**All days**	**83.7**	**37.8**	**72.9**	**28.9**
SBL Stem	Week day	56.0	25.3	57.1	22.6
SBL Stem	Week end	14.1	6.7	23.3	9.3
SBL Stem Total	**All days**	**70.1**	**32.0**	**80.4**	**31.9**
Ramp	Week day	47.1	21.3	78.8	31.3
Ramp	Week end	19.8	9.0	20.0	7.9
Ramp Total	**All days**	**66.9**	**30.2**	**98.8**	**39.2**

Appendix D. Map of trail segments on the SBL monitored for visitor compliance



Appendix E1. SBL compliance monitoring instructions

City of Boulder Open Space and Mountain Parks
Visitor Master Plan
Eldorado Mountain/Doudy Draw
April 14, 2010

Spring Brook Loop Trail On-Trail Travel & Dog Regulation Monitoring
Instruction Sheet for Trail Segment Observation Monitoring[20]
DRAFT

Purpose: To estimate the proportion of observed visitor parties[21] that go off-trail or are out of compliance with dog regulations (i.e., on-leash, on-trail, prohibited on SBL-south) while traveling on observed trail segments and to gather information on visitor travel and activity types on the new Spring Brook Loop Trail (SBL).

Description: Observers will tally visitor parties and visitors by activity type, on- or off-trail status, and compliance with dog regulations on predetermined segments of the SBL. Observers will map the estimated location where parties are observed off-trail. Observers will be inconspicuous, observing from a predetermined off-trail vantage point.

Where: Observations will be conducted on one trail segment per session, randomly chosen from three possible trail segments on the SBL (Map 1). End points of all trail segments are marked by wood stakes or permanent features on the landscape. Short portions of the trail that are obscured have been marked by stakes to insure consistency of observers.

When: Beginning on April 19th and continuing through June 6th (initially for 7 weeks). Each observation session of 4 hours is randomly chosen from morning (7:30 – 11:30 am), mid (11:30 to 3:30 pm) and pm (3:30 to 7:30 pm) time slots. All days of the week are sampled with one or two sessions per day. Additional monitoring may be required if sample sizes are too small to determine if indicators are within our standards. If necessary, we will continue to monitor from June 7 to June 20th.

Who is counted: Applies to all SBL visitors and their dogs traveling under their own volition (children being carried by pack or bike seat are not tallied). Volunteers and staff conducting official OSMP business are recorded for our information but not analyzed when calculating compliance.

Return trip and non-target observations: Noncompliance with dog-related or on-trail regulations observed outside of the "observed target segment" or when a party is

[20] Detailed monitoring methods, background, definitions, and proposed management standards can be found in the protocol at S:\OSMP\PLAN\MONITORING\TSA\EMDD\SBL_StationaryObservationMonitoring\Protocol

[21] An individual or group of individuals observed along the SBL, who, in the opinion of the observer, appear to be visiting OSMP as one unique group.

observed during a 2nd observation on the target segment for a "return trip" or "2nd loop" is not tallied but should be recorded in the Party Notes for that party.

General issues related to monitoring:

What to bring to your monitoring session:

- □ Extra **field forms** available from Ann's office or at: S:\OSMP\PLAN\MONITORING\TSA\EMDD\SBL_StationaryObservationMonitoring\Fieldforms\EMDD_OnTrail_DogReg_datasheet.xls)
- □ SBL **base map** with trail segments delineated, available from Ann's office or at:
- □ S:\OSMP\PLAN\MONITORING\TSA\EMDD\SBL_StationaryObservationMonitoring\Instructions_logistics\maps\Target_segmentx_mappingform.jpg)
- □ **List of codes** for "leaving trail reasons"
- □ Instructions for monitoring
- □ Monitoring protocol
- □ Lindsay gate key and Gas card
- □ First aid kit from vehicle
- □ List of phone contacts and on-duty ranger list (available from Ann)
- □ Clipboard, clips and rubber bands (holding papers on windy days)
- □ Pencils and sharpies/grease pencils to write on maps
- □ Binoculars
- □ Stopwatch, timer on cell phone, or other timing device (for timing dogs off-trail)
- □ Cell phone
- □ OSMP business cards/Steve Armstead business cards
- □ OSMP identification (hat, business card, etc.,) to substantiate your employment should you encounter a visitor requesting such identification
- □ Field guide, book, etc. to mask your role as an observer.
- □ Sunscreen, sunglasses, extra clothing for end of day and wind, snacks, water, something to sit on (optional), and a day pack to hold it all.

Getting to/leaving observation site:

- Park vehicles out of site (Doudy Draw or Mesa Trailhead for "SBL stem"); allow extra time to park on Denver Water Board (DWB) road if parking lot fills on weekends, likely after 10 am.
- For "SBL ramp" or "SBL north sites", go through Lindsay Gate on CR 67 and park on the DWB road near the 2nd bridge. You will need the "Lindsay Gate Key" to open the gate and drive through.
- Allow ~ 25 minutes to hike from Doudy Draw trail head to SBL stem. From DWB bridge, allow ~ 10 minutes to SBL ramp; ~ 25 minutes to SBL north/mesa.
- Be at site 10 minutes early to fill in field sheet and get ready
- Allow time as needed to fill gas in car at the Yards (on Old Pearl Rd). This can add ~ 45 minutes to your work day.

Be prepared for environmental conditions:

- Be prepared for wind on the hill near the SBL stem. Bring clips or rubber bands to keep field sheets from flapping in the wind.
- Be prepared to stand still and be cold! Bring extra warm clothes.
- Segment 2 observers will be looking directly into the sun as it sets in the evenings making it difficult to see a portion of the trail. Bring sunglasses and a visor and record any problems with accuracy that you feel may result.

Observer logistics:

- Only count parties that enter your trail segment after you start the session. Ignore those already on the trail segment. If your time slot ends before a party completes travel through the segment, continue to observe them until all parties have left the observation segment.
- Observers may walk around or vary their observation position somewhat as long as they are consistently able to see the same trail segment.
- Observers should make an effort to be inconspicuous by covering clipboards, reflective surfaces, and backpacks, appearing to be engaged in typical OSMP activities like bird observation, plant ID, waiting for someone, or resting.
- Avoid getting into long conversations with visitors.

What is tallied as off-trail?:

- Both runner's or hiker's feet are off the trail tread
- All cycle tires are off the trail tread when the cyclists is on the bike
- All four dog's feet are off the trail tread for >30 sec cumulatively over the observed trail segment OR all four dog's feet >10 ft from trail margin
- All horses hooves are off the trail tread

Observers will use the above guideline to tally visitors and visitor parties for the purpose of this monitoring project. However, observers will also systematically note the perceived behaviors, activities, and reasons visitors leave the trail. Based on these notes and coded reasons, monitoring staff will consider parties as exceptions to the off-trail definition above and not include these parties when calculating "compliance indicators". For example, any off-trail party noted as "yielding" will not be included when calculating non-compliance with the off-trail regulations.

Responding to visitors:

- If visitors inquire about what you are doing, respond honestly but with no more detail than necessary. Note our interest in learning more about travel on SBL given the newness of the trail, the mix of uses, and the new regulations.

- If visitors request more details or rationale for monitoring, we can refer them to the Trail Study Area Implementation, Spring Brook Loop On-Trail and Dog Regulation Compliance Monitoring Page on the OSMP website (www.osmp.org, URL also on the business cards) where they can find more details on Natural Resources and Sustainable

Recreation Monitoring. Visitors with issues to discuss can be referred to Steve Armstead, Visitor Master Plan coordinator (give them one of his business cards).

Cancellation Policy:

- Call Ann if you need to cancel and have more than 3 hours advance notice
- You should cancel or end a session prematurely when conditions are unsafe (e.g., lightning, extreme wind)
- Use your best judgment to cancel for rain or snow. If it is sprinkling at the office, you may need to go to SBL to determine the local conditions
- If you cancel or end a session prematurely, please fill out the following Header Information on the field form: Date, Start time: (scheduled start time), Recorder, and Trail segment on SBL. Indicate in the Notes section at the bottom of the form that session was "Not Done" or "Incomplete" and why it was not done (e.g., Cancelled D/T rain; Cancelled D/T observer illness).

Recording Information on SBL Trail Segment Observation Forms

Header information (top of form)

Date: Enter date (mm/dd/yyyy) of the patrol.

Start/End Time: Enter beginning and ending time of patrol (24 hr notation hh:mm). If you start the session late, record the actual start time and monitor for 4 hours from the start time.

Recorder: Enter complete first and last names. A second recorder can also be entered.

Page ___ of ___: Number pages consecutively during each patrol. Indicate total number of pages at end of patrol.

Weather check boxes: Check the Sky, Wind , and Precipitation (Ppt) conditions that dominate at the start of your patrol. Changes in any weather condition during the observation session should be described in the notes. Indicate the temperature to the nearest 10° F.

Trail tread conditions: Check all trail tread conditions observed on the target trail segment.

Information on each party (gray and white rows)

Party ID#: Assign a consecutive integer (1-n) to each party on or off the trail in the order observed. When a party is observed on their return trip as well, count them ***only for the first observation until they leave the target segment***. If a party retraces their steps before they leave your target segment, they are still considered part of your 1st observation. If a party **leaves your target segment** and then returns to your target segment (even if they travel on a part of the segment they weren't on before), they are not tallied again. If they show new behavior on a return trip (e.g., let dog off-leash), do not change the recorded tally. However, please add a note if any party seen again on their

return trip travels off-trail or allows their dogs off-leash or off –trail. Be explicit in your comment so we know that the observed behavior did not occur on your 1st observation. You will need to find a way to remember/track parties so you don't count them twice.

Total Visitor Count:

No. of People: Record number of visitors per party.

Activity of People : Record the activity code that best represents the activity of the party. Always describe the **Other** category in more detail in the Party Notes column. If visitors are on foot but also bird watching, record as hikers and characterize them as bird watchers in the Party Notes column.

Activity Codes: B=Bicycling (includes tricycles and unicycles), **E**=Equestrian (horseback riding), **H**=Hiking/walking, **R**=Running, **OS**=OSMP worker or volunteer on OSMP business, **O**=Other.

No. of On-leash/Off-leash Dogs: Record the number of dogs in the party that are On-leash and Off-leash. **Always record a "0" if no dogs are in the party**.

Off-Trail Visitor Counts:

No. of People <10 ft/>10 ft: Record the number of visitors per party in the Near Trail Zone (<10 ft from trail edge) or in the Far Trail Zone (>10 ft from trail edge). Recalibrate your 10 ft estimates with a tape measure on occasion.

No. of Dogs On-leash <10 ft/>10 ft: Record number of leashed dogs per party <10 ft or >10 ft from the trail edge. Dogs must be observed off-trail for at least 30 seconds (cumulative). If a dog is observed off-trail for <30 seconds, do not tally, but enter a note for that party describing the dogs behavior. Occasionally calibrate your estimate of 30 seconds using a stopwatch or the timer on your cell phone.

No. of Dogs Off-leash <10 ft/>10 ft: Record number of unleashed dogs per party <10 ft or >10 ft from the trail edge. Dogs must be observed off-trail for at least 30 seconds (cumulative). If a dog is observed off-trail for <30 seconds, do not tally, but enter a note for that party.

Off-Trail Information:

Reasons off-trail, People/Dogs[22]: Indicate the most likely reason(s) perceived by the observer for both the people in the party and the dogs being off-trail. Use codes below if appropriate or indicate '**O**' for 'Other' and give a longer explanation in the Notes column. If reason is unknown use code '**UN**' and describe the behavior you observe. More than one reason may be recorded if necessary. **These codes and your notes help us determine which parties are exceptions to the basic off-trail definition. Your notes are crucial in making unambiguous decisions!**

Leaving Trail Codes: BR=Bike repair, **D**=Dog activity/play, **E**=Excrement pickup/drop, **M**=Mud/puddle avoidance, **N**=Nature observation, **O**=Other (please specify), **OS**= OSMP work by staff/volunteers, contractors, **P**=Passing, **Ph**=Photography, **R**= Rest or snack stop

[22] See one page code list (attached) for longer explanations of these codes.

off trail, **S**=Side by side travel, **Sh**=Shortcutting trails, **TO**=Trail obscured (e.g., by snow), **TS**=Trailside incidental activities at side of trail; **UN**=Unknown/Undetermined, **UT**=Undesignated trail travel, **W**=Water access, **WA**=Waiting for party, **WI**=Wildlife interaction (includes prairie dogs), **WH**=Winter hazard avoidance, **Y**=Yielding

For **bikers**, please note what the visitor did with their bike while off-trail (rode bike off-trail, straddled bike, walked bike, left bike somewhere, carried bike, etc.). **Bikers** that dismount bikes and become pedestrians are only off-trail if both their feet are off-trail (even if they left their bike off-trail); if they leave their bike off-trail and travel only on-trail, they are not considered off-trail. For **dogs**, please note details of dog activities/behaviors even if you have given the dog appropriate codes.

Mapping off-trail parties:

- When visitor parties and/or dogs are observed off-trail, map their approximate location on a **target segment base map** using a marker or grease pencil
- Fill in the date, start time, and session observer on the **target segment base map**
- Identify locations of parties with their Party ID#. If there are multiple visitors or locations per party use the Party ID# and a letter (e.g., 13A, 13B) and explain what the letters mean in the notes
- Do not map off-trail parties that are off-trail <10 ft from the trail edge to yield or pass, stepping out of the way to tie a shoe, fix a bike, or standing just to the side of the trail while adjusting clothing, drinking, or snacking

Trail Junction:

Enter/exit SBL-S: Record the number of dogs per party leaving or entering SBL-south with their guardian. An off-leash dog that momentarily runs away from its guardian and onto the prohibited SBL-south will not be counted if the guardian doesn't also choose to travel on this trail. Leave blank if no dogs per party or if the intersection is not observed.

Passes N/S Jct: Record the number of dogs per party that pass the junction between SBL-north and SBL-south with their guardian. This count includes those that enter or leave SBL-south. Leave blank if no dogs per party. Please note if a party on Target Segment 2 or Target Segment 3 retraced their steps before getting to the junction and thus never passed the junction during your observation.

"On Loop" Check off: Note if the party was on the loop portion of SBL (Y) or (N) during your observation. The places where we can observe a party "not on the loop" are from the ramp looking out towards the road (Fowler Extension) and from the hill by Doudy Draw looking at the SBL stem. Please describe with a note (e.g., "Party traveled Fowler to GRT without getting on loop")

Party Notes column : Use this column for specific notes related to individual parties. Use the bottom or back of the field sheet to expand the Party Notes when more room is required, listing each comment by Party ID#. Some items that should be noted:

- More details on party behavior helpful in understanding tally codes

- Explanations of the "Other" category for leaving-trail reasons
- Notes to explain anything observed that doesn't fit our categories or tallying schemes
- Notes indicating any inability you have to see if the visitor/dog was off the trail tread
- Behavior observed of an off-leash dog
- Notes about dogs off-trail < 30 sec
- Notes about the number of times a dog went off-trail during the observation and what they were doing
- Further explanations of off-trail activities
- Notes describing behavior not tallied for 2nd trips of the same party
- Notes about off-trail parties or off-leash dogs observed out of compliance outside of the observed trail segment
- Descriptions to help you identify return parties (not for data entry)

Notes (at bottom of field form): Use this space to continue Party Notes and to provide general notes. General notes should include the following:

- Always indicate if the session was **"Incomplete"** or **"Not Done"** and indicate why.
- Always indicate if **"No visitors"** were observed during the entire session.
- If a ranger vehicle or a staff vehicle was parked in sight of visitors during the session. Indicate if rangers were on the trail or in the vicinity during the session.
- If you are uncertain whether a party was already counted once don't count this party but describe the party briefly and note that you may have missed counting this party
- Problems or suggestions related to monitoring methods
- Concerns/explanations for missing visitor tallies (e.g., during high visitation times, if observer left station for a break)
- Time spent during session interacting with visitors and feedback from visitors related to understanding visitor experiences, impacts, and compliance
- Questions or concerns related to our monitoring expressed by visitors

Managing SBL Trail Segment Observation Forms

Field Review: SBL Trail Segment Observation Forms should be checked for completeness, legibility, and correct coding before leaving the field. **Please be certain that your notes and tallies can be read by others (e.g., proofreaders)**

- As part of the field review, note any deviations from the methods or problems related to the observation session while still fresh in your mind.
- Was time entered in 24 hour time?
- Were weather changes noted? If the weather conditions changed notably during the 4 hours, the following guidelines should be followed: Sky (enter predominant condition); Temp (enter predominant condition); Wind (enter most extreme condition); precipitation (if it rained during the session, this should be checked); In all cases, variation in weather should be noted in the notes session.
- Are parties in the "Other" category described in the notes and entered appropriately.

- Are parties doing sanctioned work supporting OSMP's mission (contractors, DWB people) consistently entered as 'OS' for activity type and, if off-trail, is the reason given as 'OS'? Volunteers should be included here if they doing official OSMP work (are they wearing a hat?). If not sure, count them in the appropriate category (e.g., hiker)
- Was the number of dogs entered as zero if no dogs present?
- Was at least one off-trail reason given for a dog or person tallied as off-trail?
- If dogs were observed on trail segment 2 or 3, were the "Trail Junction" columns filled out or was their a note indicating that the party turned around before passing the trail junction
- Was the on-loop column filled out?
- If no visitors were observed, put a note across the field sheet "No visitors"
- Were parties mapped if they went off-trail and is the appropriate party number indicated on the map?
- Before leaving the field site, elaborate on any party (Party Notes) that you had no time to fill out earlier in the session. Be sure you given Party ID# for each note that correspond to the correct party
- Be sure you have also included notes on the bottom of the field sheet as requested in the Notes section above.

Storing Forms: Filled in observation forms should be place in the "Data Input Needed" folder in Ann's office.

Data Input and Proofing

Enter data daily (or soon after monitoring) into the prepared MS Access ® database: (S:\OSMP\PLAN\MONITORING\TSA\EMDD\SBL_StationaryObservationMonitoring\Data\SBL_Stationary_Observer.mdb) according to guidelines provided. Observers will enter their own data and proof the data of other observers. Dates of data entry and proofing and your initials should be recorded on the field forms and in the database to verify data quality and status. The edit and proof dates and your initials should also be noted on the field forms and entered into the MS Access database when these activities have been completed. Unresolved data problems are noted on stickies on the field forms and in the data problem description field of the MS Access database.

Appendix E2: SBL compliance field form

Date:	Start time:	End time:	Recorder:	Pg___of____

Sky		Temp (°F)	Wind	Ppt	Trail segment on SBL:		Trail Tread Conditions on segment	
❑ Sunny ❑ Partly sunny	❑ Overcast		❑ <20 mph ❑ ≥20 mph	❑ Snow ❑ Rain	❑ T1) North Mesa ❑ T3) Lower SBL N&S Int.	❑ T2) Upper SBL N&S Int.	❑ Dry ❑ Muddy	❑ Wet, hard ❑ Snow/slush/ice

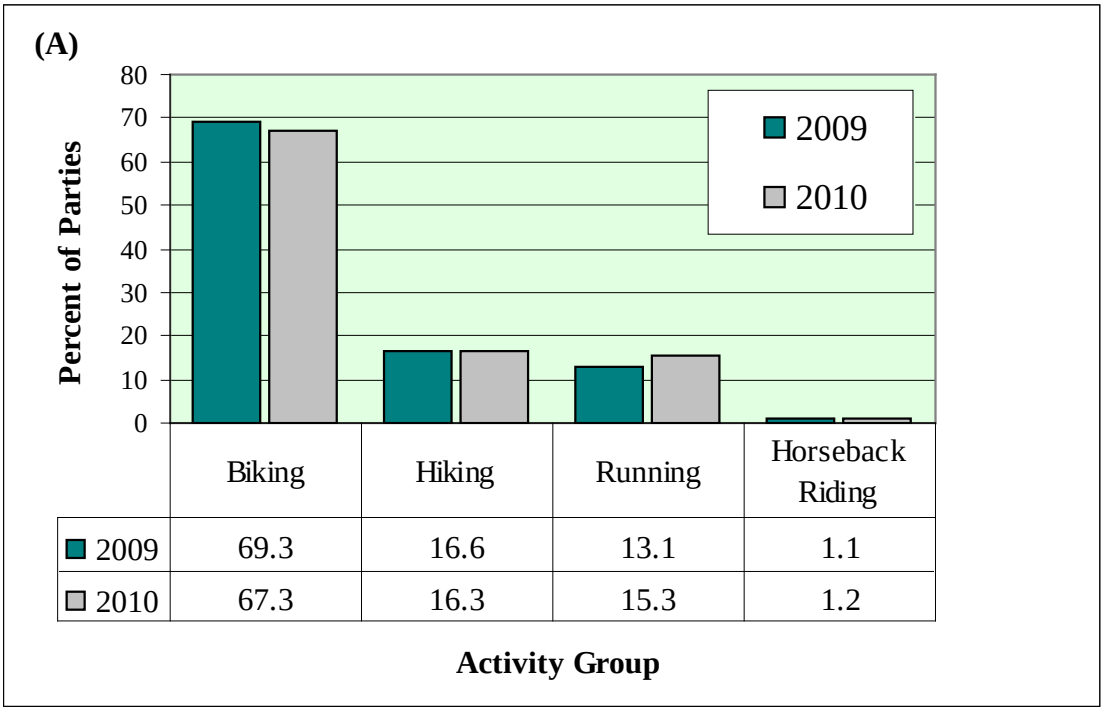
	Total Visitor Count (0-n)				Off-Trail Visitor Count (0-n)						Off-Trail Info.		Trail Junction		
	People		Dogs by Leash Status		People		Dogs **On-leash**		Dogs **Off-leash**		Reasons off-trail (see codes)		Enter/exit SBL-S	Passes N/S Jct.	Enter additional notes at bottom of form
Party ID	**No.**	**Activity**	**On-L**	**Off-L**	**<10 ft**	**>10 ft**	**<10 ft**	**>10 ft**	**<10 ft**	**>10 ft**	**People**	**Dogs**	**No of dogs/party**		**Party Notes**

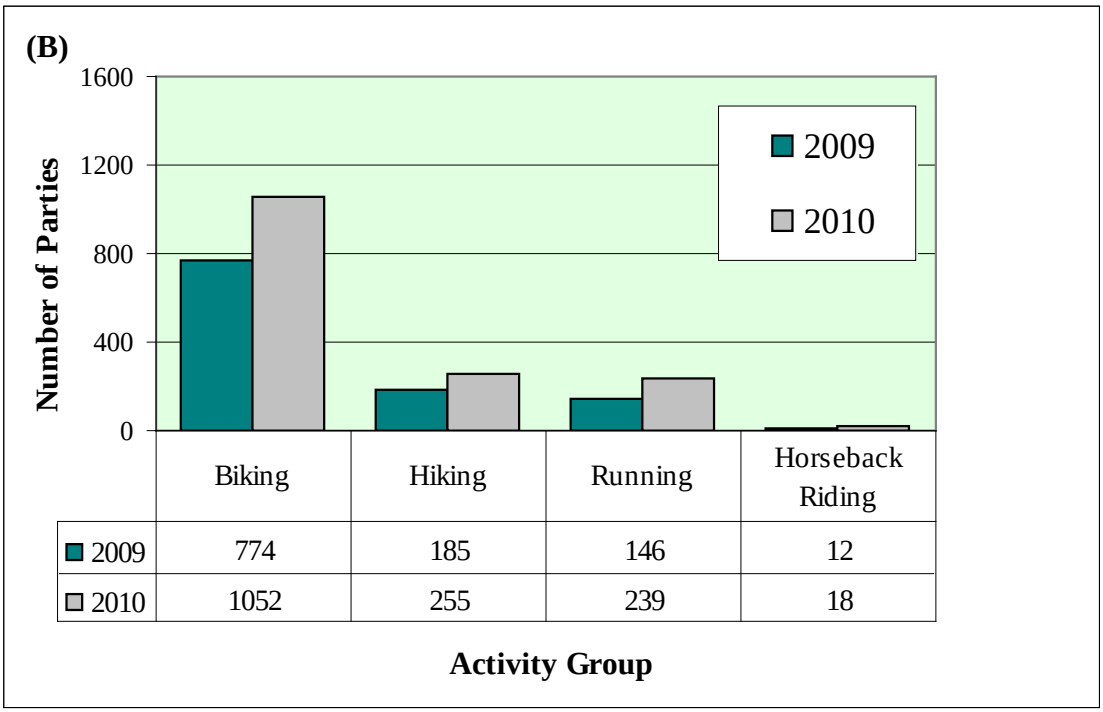
Notes:

Appendix E3. Coded behaviors of off-trail visitor parties as perceived by observers

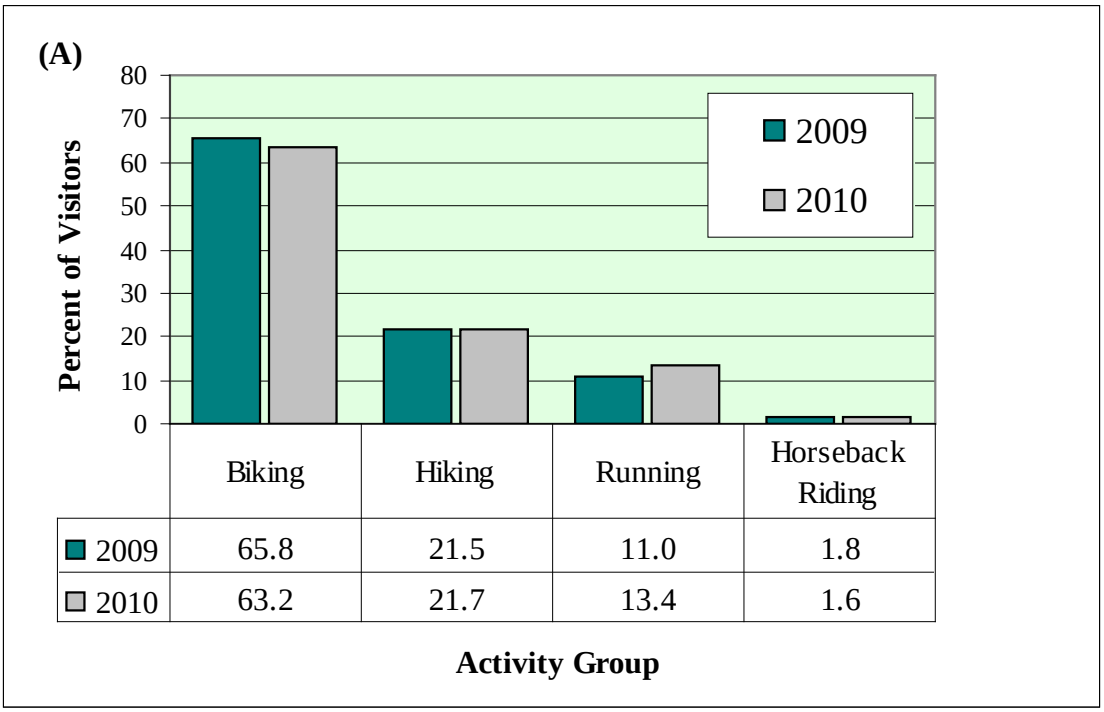
Off-trail codes	
Code	**Description**
BR	Bike repair
D	Dog play/activity
E	Excrement pickup
M	Mud/puddle avoidance
N	Nature observation (includes looking at scenic view)
O	Other/please specify
OS	OSMP business (including volunteers/contractors)
P	Passing (leaving the trail tread to go around other visitors)
Ph	Photography (or being photographed)
Pmt	Officially "permitted" off-trail activities (e.g., fire training)
R	Rest stop/snack stop off trail
S	Side by side travel
Sh	Shortcutting a trail
TS	Moving "out of the way" while engaging in trailside activities such as drinking or adjusting clothing
U	Unknown/undetermined
UT	Undesignated trail travel
W	Water access
WA	Waiting for other visitors
WI	Wildlife interaction (e.g., chasing/feeding prairie dogs)
Y	Yielding (leaving the trail tread to let others go by)

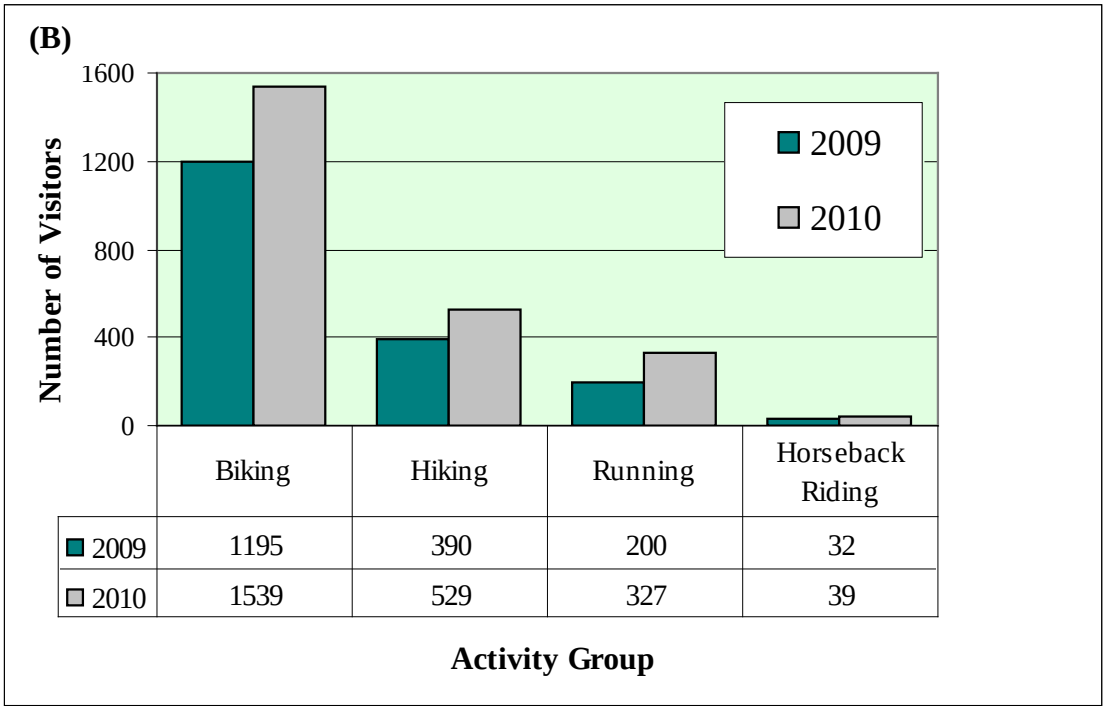
Appendix F. Activity, party, and visitor distribution by year, time slot, and week day type
Appendix F1. Observed activity distribution for visitor parties by percentage (A) and number of parties (B) on the Spring Brook Loop trail in 2009 and 2010 over all monitoring sessions.



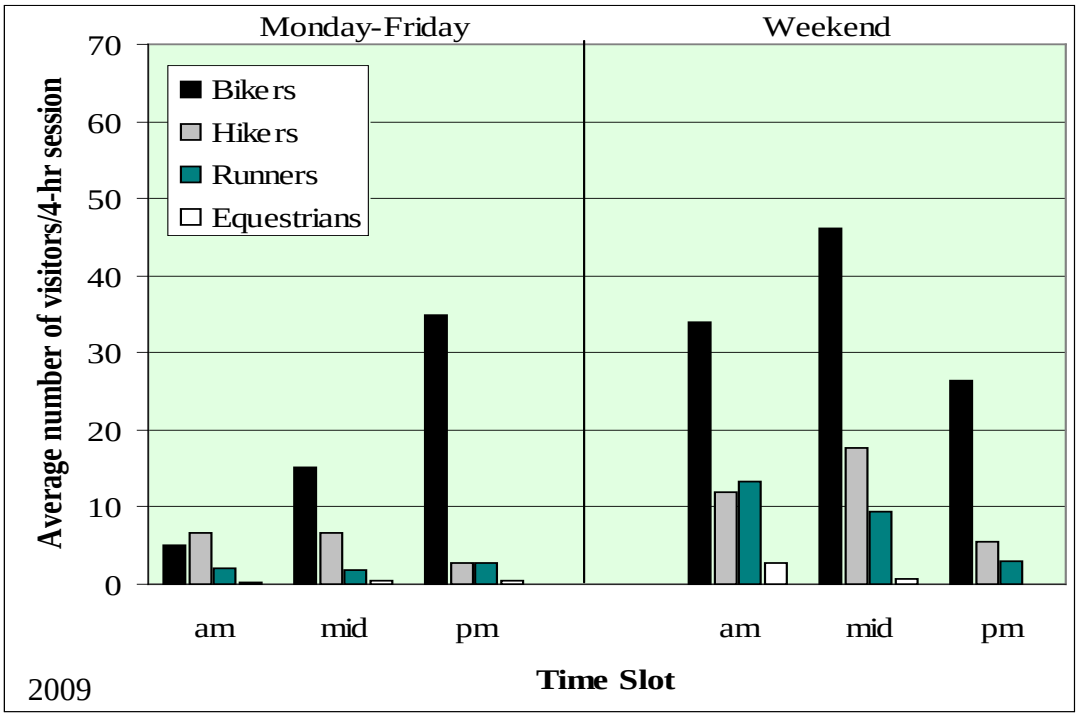


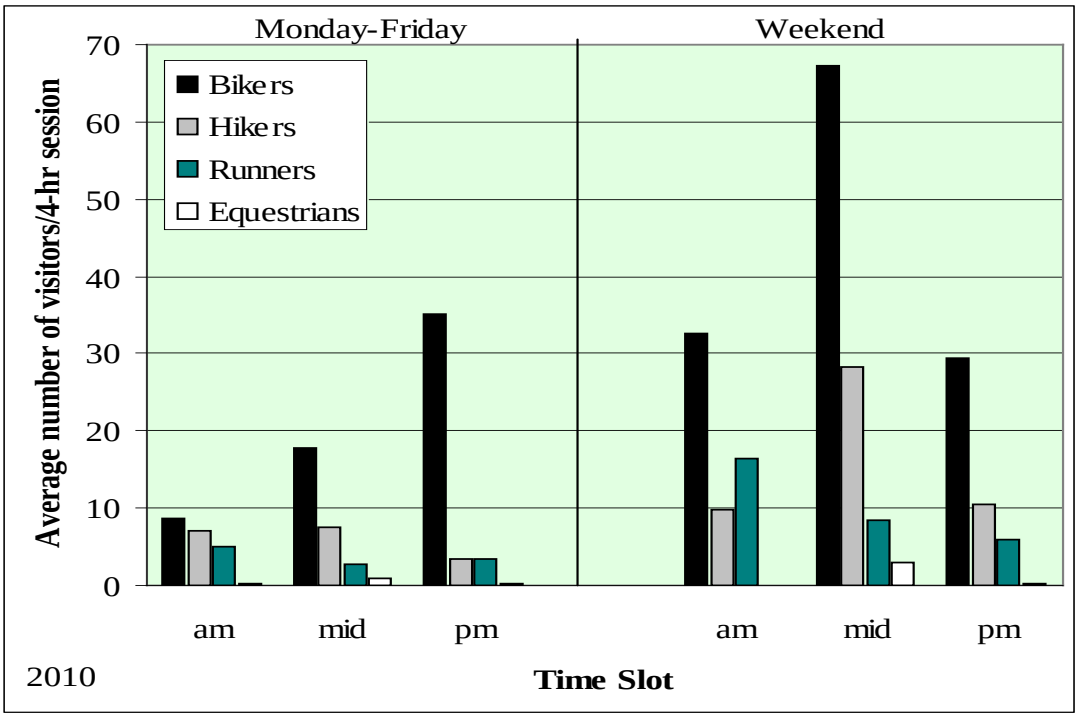
Appendix F2. Observed activity distribution of individual visitors by percentage of total visitors (A) and number of visitors (B) on the Spring Brook Loop trail in 2009 and 2010 tallied over all monitoring sessions.





Appendix F3. Distribution of visitors by activity, time slot, and week day type.
In both 2009 and 2010, the number of visitors observed on weekends was more than twice the number observed on weekdays when standardized per four-hour observation session. On weekdays, on average, there were 25.6 visitors/4-hr (2009) and 29.9 visitors/4-hr (2010) as compared to weekends, with 59.9 visitors/4-hr (2009) and 66.3 visitors/4-hr (2010). When separated by activity, the highest average number of bikers and hikers per 4-hr session was observed between 11:30 am and 3:30 pm on weekend days. The highest average number of runners per 4-hr session was observed between 7:30 am and 11:30 am on weekend days.





Appendix G1. Observer-reported comments describing perceived behaviors of visitor parties traveling off trail when the reason coded was "other" or "unknown" reasons

Year	Activity type	Observed behavior or activity
2009	hiker	chatting with OSMP staff by the side of the trail
2009	hiker	hiking up a hill with stake flags for unknown reasons
2009	biker	bathroom break
2009	biker	putting bikes off trail to travel on foot
2009	biker	overshooting intersection
2009	biker	walking up and back down hill, appearing to be looking for something
2009	equestrian	spooked horse
2009	equestrian	skittish horse
2010	hiker	helping a child that fell off a bike
2010	hiker	playing off trail
2010	hiker	seeking cover from rain
2010	hiker	cross-country travel during bad weather
2010	hiker	hiking up a hill and out of site for unknown reasons
2010	bikers	bathroom breaks
2010	bikers	setting down bikes off-trail
2010	biker	walking off trail while wheeling a bike up a steep trail segment
2010	biker	riding a bike off trail to turn around
2010	biker	losing control and falling off trail
2010	runner	examining visitor monitor
2010	runner	bathroom break
2010	equestrian	losing control of a spooked horse
2010	equestrian	moving off trail to adjust horse's reins and bit
2010	equestrian	riding or walking horses off trail to allow horses to graze

Appendix G2. Observer-reported comments describing perceived behaviors of visitor parties traveling off trail when the reason coded was "moving out of the way to engage in trailside activities"

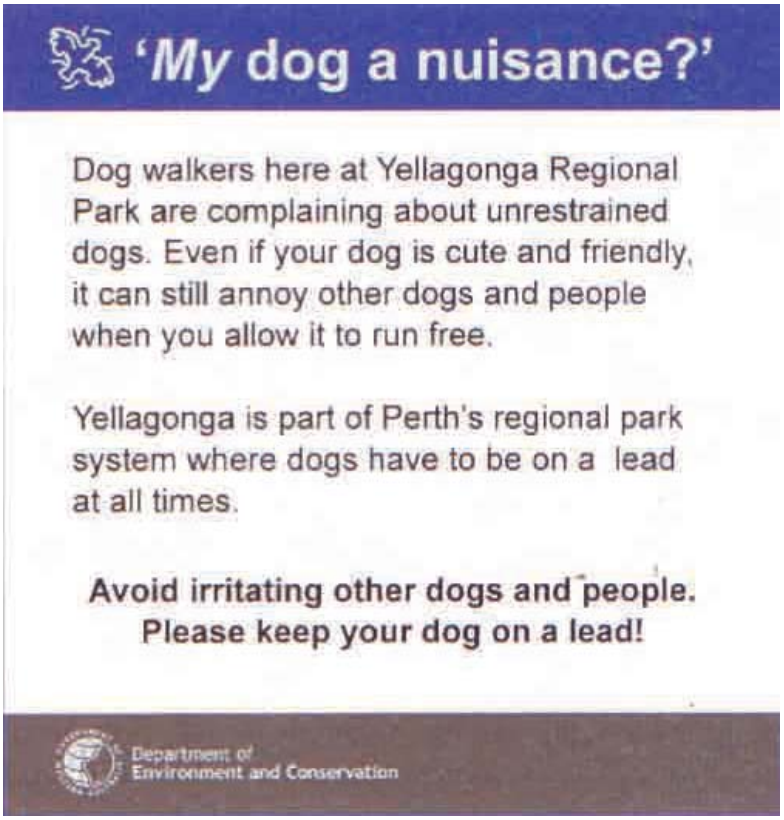
Year	Activity type	Observed behavior or activity
2010	hiker	adjusting clothing or shoes
2010	hiker	removing items from a pack
2010	hiker	stepping or sitting just off trail to chat
2010	hiker	stepping or sitting just off trail to rest in the shade
2010	hiker	stepping or sitting just off trail to have a drink or snack
2010	bikers	storing or retrieving bikes off trail
2010	bikers	resting near the trail edge
2010	biker	drinking or retrieving water from a pack
2010	biker	adjusting clothing, helmet or shoes
2010	biker	looking at a map
2010	biker	chatting off trail
2010	biker	using cell phones
2010	biker	looking at signs
2010	equestrian	dismounting and resting or drinking by trail edge
2010	equestrian	feeding or grazing a horse near the trail edge

Appendix H. Photographs taken along the SBL showing evidence of muddy spots in the middle of the trail and associated off-trail widening, braiding, or parallel trail formation.

Appendix I. 12 principals for managing depreciative behavior (from Knopf & Andereck, 2004)

1. Focus on the causes of depreciative behavior, not the perpetrator.
2. Eliminate environmental prompts.
3. Manage social norms.
4. Communicate rules clearly and coherently.
5. Provide information about consequences.
6. Deflect the behavior into reasonable options
7. Use positive overtones rather than negative overtones.
8. Favor personal communication over impersonal communication.
9. Juxtapose communication with place and time of noncompliance.
10. Use uniformed personnel at high risk areas.
11. Institute appropriate reward structures.
12. Use direct coercion as a last, but effective, resort.

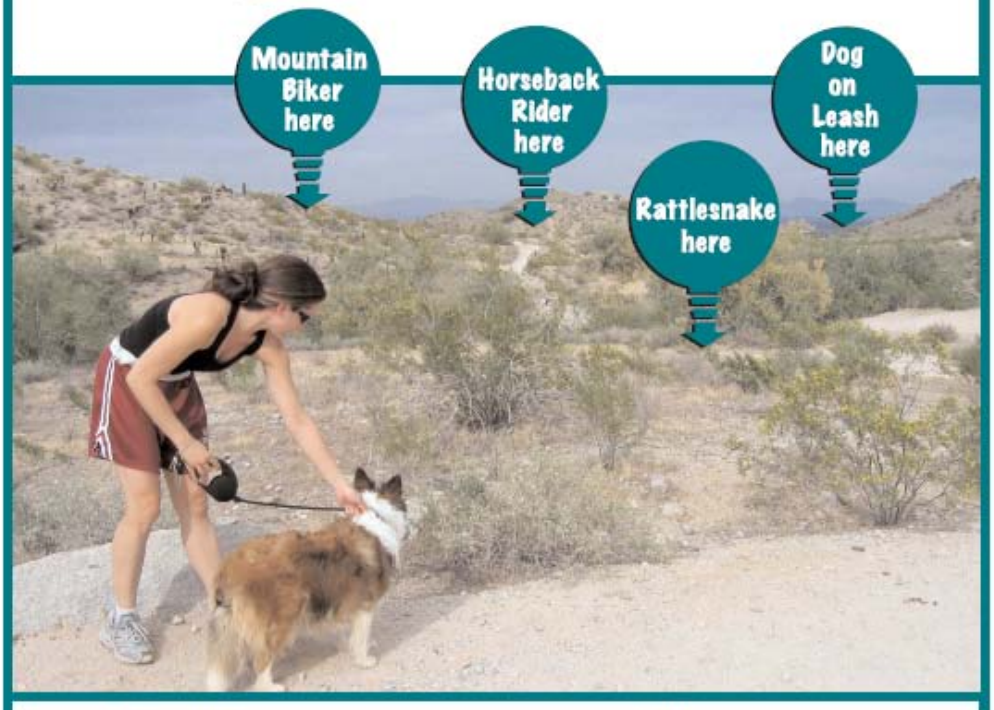
Appendix J1. Persuasive message sign developed in the Yellagonga Regional Park, Perth, Australia to persuade dog walkers to leash their dogs (Ham et al., 2008).



Appendix J2. Persuasive message developed to persuade hikers at Pima Canyon, Arizona to keep dogs on leash (D. Urbinato, personal communication sent by email, March 30, 2011)

City of Phoenix
PARKS AND RECREATION DEPARTMENT

TEMPTED TO LET YOUR dog OFF THE leash?



Today the preserves are more crowded than ever, and **complaints about off-leash dogs are on the rise.** People on horseback, mountain bikers, hikers with leashed dogs – these are just some of the users at risk from an off-leash dog, even a friendly one. Remember that even when the trails look empty, there's always someone around the next bend. Be a good neighbor – keep your dog leashed at all times while hiking in the Preserves."

There are lots of other good reasons to keep your dog leashed:

- **It's the law.** The city's leash law applies to all Phoenix parks and desert/mountain preserves.
- An unleashed dog can chase or harass wildlife or damage fragile desert vegetation.
- The desert is full of potential hazards -- an unleashed dog can more easily end up with a rattlesnake bite or a paw full of cactus quills.

Check out the list of city of Phoenix dog parks at phoenix.gov/parks.