High Plains Visitor and Dog Compliance Project

Monitoring Report

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1.0 Introduction

The City of Boulder Open Space and Mountain Parks (OSMP) trail system offers approximately 140 miles of designated[1] recreational trails in four types of management areas. One management designation, "Habitat Conservation Area" (HCA), includes most of the OSMP land system's large blocks of wildlife habitat with low levels of human activity. HCAs are typically characterized by remote location, low road and trail densities, lower levels of visitation than other OSMP areas and greater habitat effectiveness[2]. OSMP's management emphasis in HCAs is upon resource protection (OSMPa:43 and OSMPb:33) through several strategies including visitor regulations.

The goal of HCA visitor regulations is to manage for high quality visitor experiences and ecological integrity by minimizing visitor and dog related impacts to natural, agricultural and cultural resources. Visitor regulations include an on-trail requirement for people and dogs and a leash requirement for dogs. Visitors in possession of an off-trail permit are allowed to travel off-trail in HCAs. Visitors with dogs and bicyclists are not eligible for off-trail permits.

This study investigated visitor compliance with these regulations along the High Plains Trail (HPT). The HPT is the first trail to be built within an HCA. OSMP managers were interested in learning more about the effectiveness of on-trail and dog on-leash regulations. The HPT Project measured the level of regulatory compliance. Wildlife and vegetation monitoring occurred concomitantly to measure trail effects. The HP Project was identified in the Marshall Mesa-Southern Grasslands Trail Study Area Plan (OSMPb:33). The objectives of this monitoring project were to:

1. Estimate the level of compliance with visitor on-trail regulation.
2. Estimate the level of compliance with HCA dog on-leash and on-trail regulation.
3. Photo-document baseline conditions of selected portions of the trail and the surrounding area.

The results of this monitoring will be used to inform decisions about the proposed Marshall Lake Trail. This report documents the monitoring results.

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[1] Designated Trail: Designated trails are marked with signs that include a trail name and are indicated on trail maps.

[2] Habitat effectiveness refers to a landscape's ability to provide wildlife needs including food, water, visual cover, thermal cover and nesting/denning areas.

1.1 Location

The HPT is located along the southern periphery of the Southern Grasslands HCA (Figure 1). This management area is the largest block of grassland habitat in the OSMP system. It is a complex of several types of prairie grassland communities with scattered ponds and wetlands and a riparian area along Coal Creek.
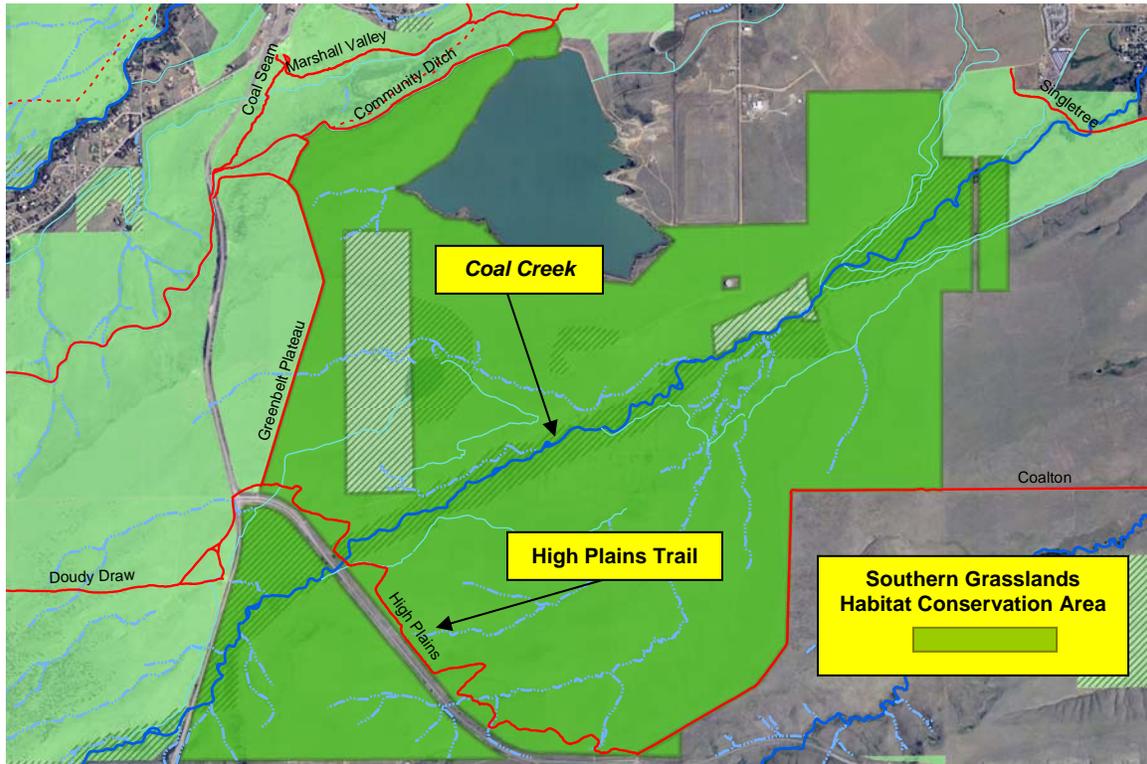

Figure 1: Southern Grasslands HCA and High Plains Trail

2.0 Methods

OSMP staff measured visitor compliance with on-trail and dog on-leash regulations in three areas along the HPT. The "visitor party[3]" was the sampling unit, and the results are reported as the percentage of visitor parties complying with the visitor regulations, and the percentage of dog-containing parties complying with both the visitor and dog regulations. Compliance was measured by counting:

- Visitors using the trail
- Visitors remaining on-trail
- Visitors who left the trail
- Dogs on and off-trail and
- Dogs on and off-leash.

Compliance with all regulations over the entire visitor trip was not measured, only whether the visitor party complied with regulations while in the observation area. Visitors who only stepped off the trail to avoid mud or to yield to or pass another visitor

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[3] A visitor party is defined as an individual or group of individuals who, in the opinion of the observer, appear to be visiting OSMP as one unique group.

and then returned to the trail were considered in compliance with the on-trail requirement.

OSMP staff conducted visitor and dog observation from May 21 through June 30, 2007. Monitoring was conducted during three-hour time periods on weekdays and weekends. A total of 52 observation periods occurred over the course of six weeks, for a total of approximately 150 observation hours.

Monitoring was conducted by staff every weekday and every other weekend (11 days of monitoring in May, 29 days in June). Weekdays were monitored daily for one or two three-hour monitoring periods. Weekends were monitored daily for two three-hour monitoring periods. The monitoring periods were from 9 AM-12 PM, 12-3 PM and 5-8 PM, as summarized in Table 1. Monitoring was scheduled to capture periods of highest visitor use based upon an analysis of trail monitor data collected during the 2004-2005 OSMP visitation study (Figure 2).

Table 1. Observation monitoring times

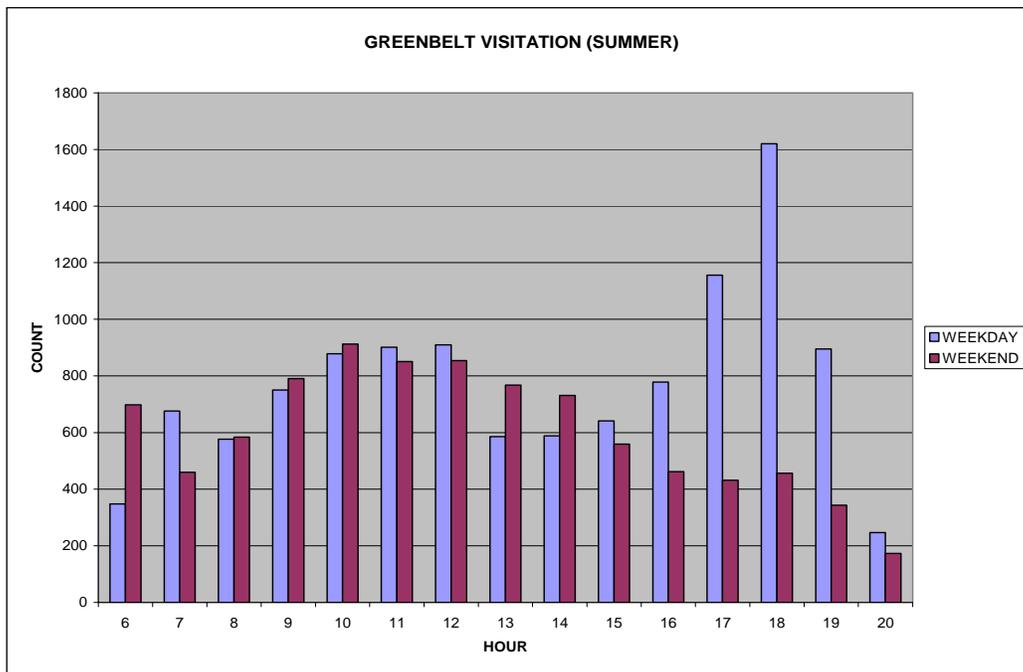|	AM	PM
Weekdays	9 AM-12 PM	5-8 PM
Weekends	9 AM-12 PM	12-3 PM

Figure 2: Greenbelt Plateau visitation summary by hour (April 1 - September 30)

Open Space and Mountain Parks rangers were informed of the monitoring schedule and asked to avoid the area during monitoring periods to eliminate the effect of their presence upon visitor behaviors.

2.1 Study Site
There were three monitoring locations for the observation component of the HP Project along the HPT (Figure 3). Observation locations were selected to maximize observational distances along the trail and provide relatively unobtrusive locations for monitoring staff. In addition, staff prioritized sections of the trail that were most likely to attract visitors to leave the trail, such as the Coal Creek area and a prairie dog town. No observation areas were selected near the eastern end of the trail because there were no appropriate vantage points.
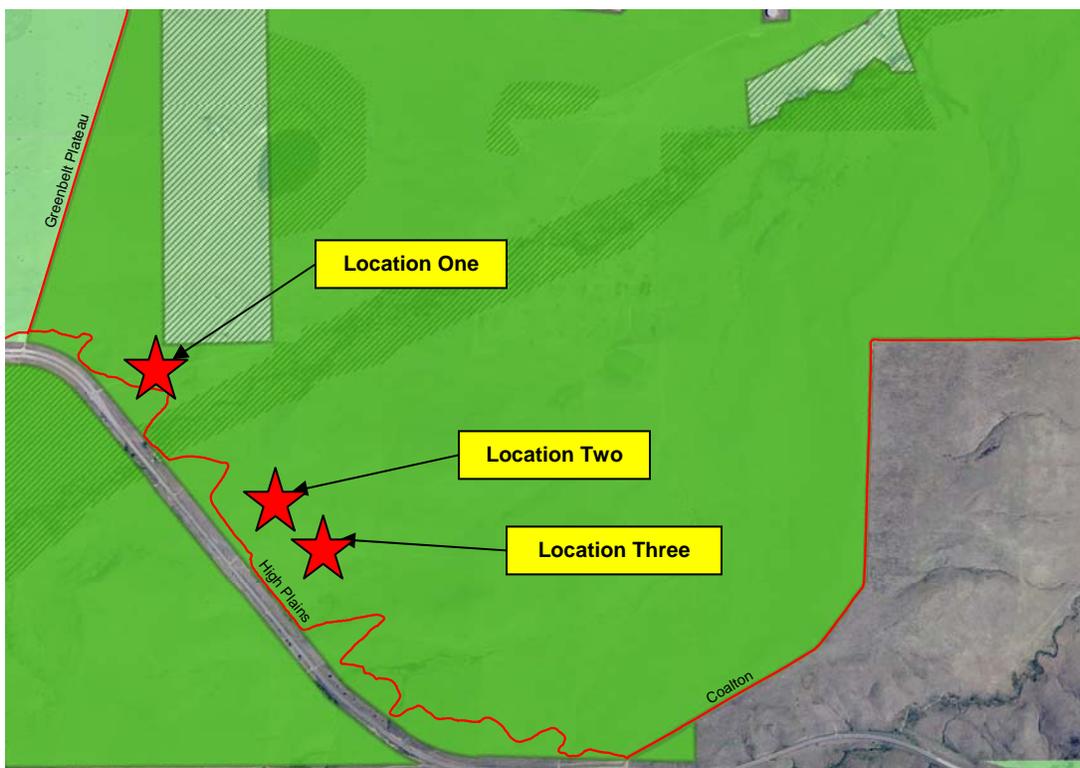
Figure 3: Map of observational monitoring locations

2.2 Sampling Schedule
Sampling locations were assigned to each monitoring period using a grid sampling design. Each sampling location had an equal chance for selection for any monitoring period. If monitoring did not occur as scheduled (e.g. because of illness or weather), the missed date was documented and a comparable make-up monitoring period was scheduled. The number of observations was evaluated at the end of June to determine if additional sampling was needed. It was not.

2.3 Photo Points
Four locations were selected for photo points (Figure 4). Photo points were selected where the potential for change in soil, vegetation and trail conditions was thought to be

greatest. Change was hypothesized to be greatest in areas of potential undesignated trail development, and near Coal Creek where water could be a likely attractant for both visitors and dogs. Photo points three and four were selected to represent baseline trail conditions for the eastern and western ends of the trail. Visitors and dogs congregate near access gates and informational signs. Baseline photos are included in **Appendix A**[4]. The photo points will be visited again in May of 2008 – one year post baseline.
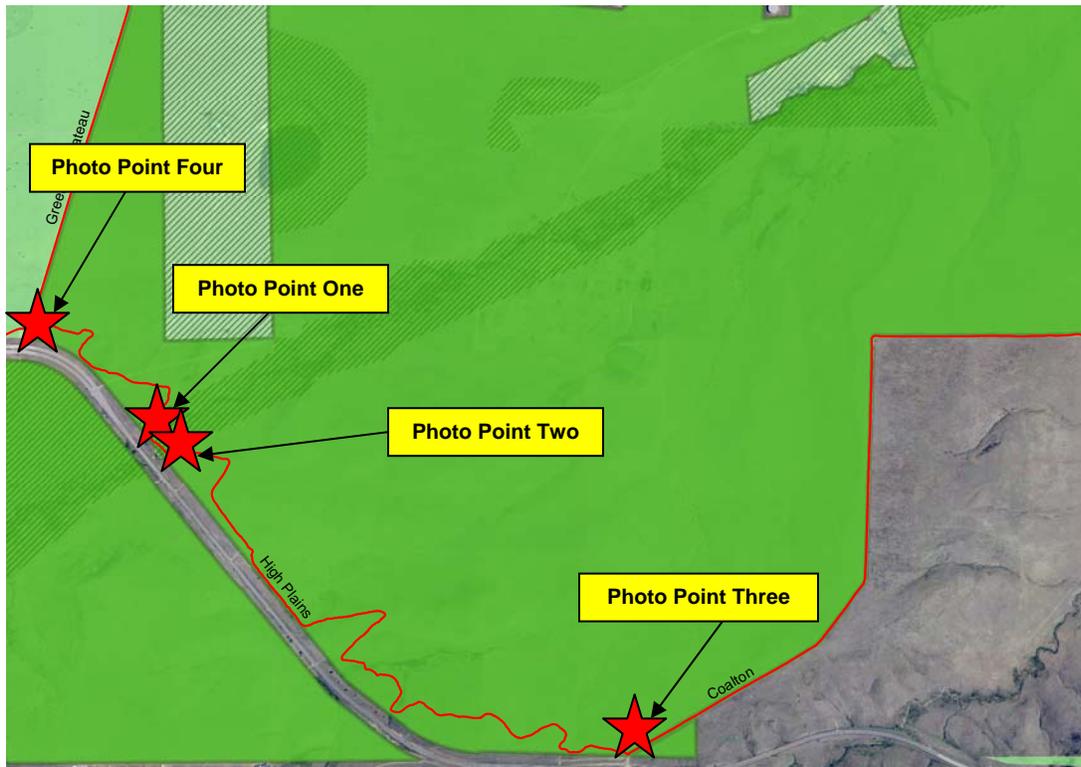
Figure 4: Map of photo points

2.4 Data Collection
The following attributes of each visitor party were recorded:
- Number of people in the party
- Number of dogs in the party
- Visitor activity (e.g. hiking, biking)
- Number of members of the visitor party who failed to comply with the "on-trail" or "on-leash" regulations and
- Sub-area[5] entered.

A copy of the field data sheet used during the study is provided in **Appendix B**.

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[4] A photo point log detailing date, location, photo point number and view number is located at: s:\osmp\plan\monitoring\high plains visitor compliance\pictures\high plains trail photo point log.doc.
[5] Habitat Conservation Areas are divided into sub-areas based upon area attributes for the purpose of administering off-trail permits.

For each visitor observed leaving the trail, the field observer documented the most likely reason. Table 2 is a list of reasons for departure documented during this study.

Table 2. Documented reasons for departing the trail

Y	Yielding to another visitor by stepping off the trail
P	Passing by leaving the trail to travel around another visitor
E	Excrement/Pick-up from the visitor's own dog
N	Nature observation
M	Avoiding mud
PD	Prairie dog interaction
W	Water access
O	Other

If the field observer was unable to determine the reason that a visitor left the trail, he or she recorded an "O" and described the situation in the "Notes" field. The observer also noted how far off the trail people and dogs traveled. Off-trail travel was either in the near trail zone (NTZ) if <u>less</u> than ten feet from the edge of the trail or the far trail zone (FTZ) if <u>more</u> than ten feet from the edge of the trail.

3.0 Results

OSMP staff spent approximately 150 hours in the field monitoring visitor behavior as part of the HPT Project. Monitoring occurred on all seven days of the week. One third of the observations were made on weekends during approximately 20% of the time in the field. Two thirds of the observations were made on weekdays during about 80% of the monitoring periods (Figures 5 and 6). Monitoring periods were distributed across the three study locations with each location being monitored 14 to 21 times (Figure 7).

Monitoring Periods

Weekend
21%
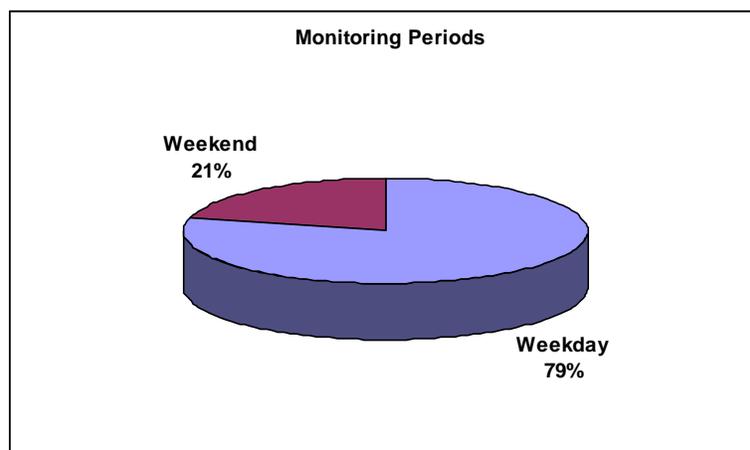
Weekday
79%

Figure 5: Distribution of monitoring periods between weekdays and weekends
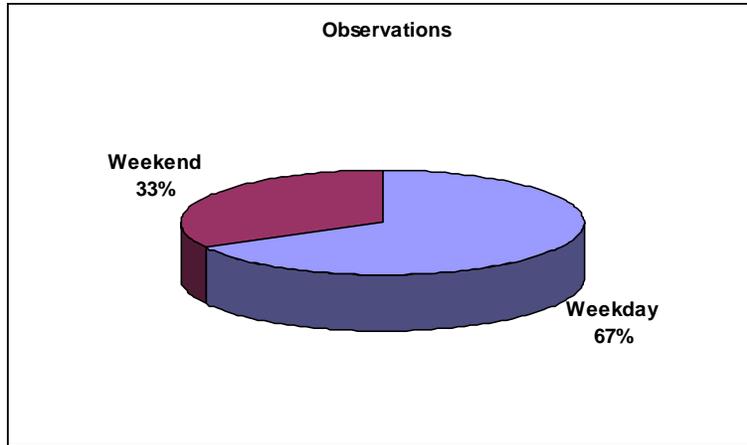
Figure 6: Distribution of observations between weekdays and weekends

Observations

Monitoring Periods
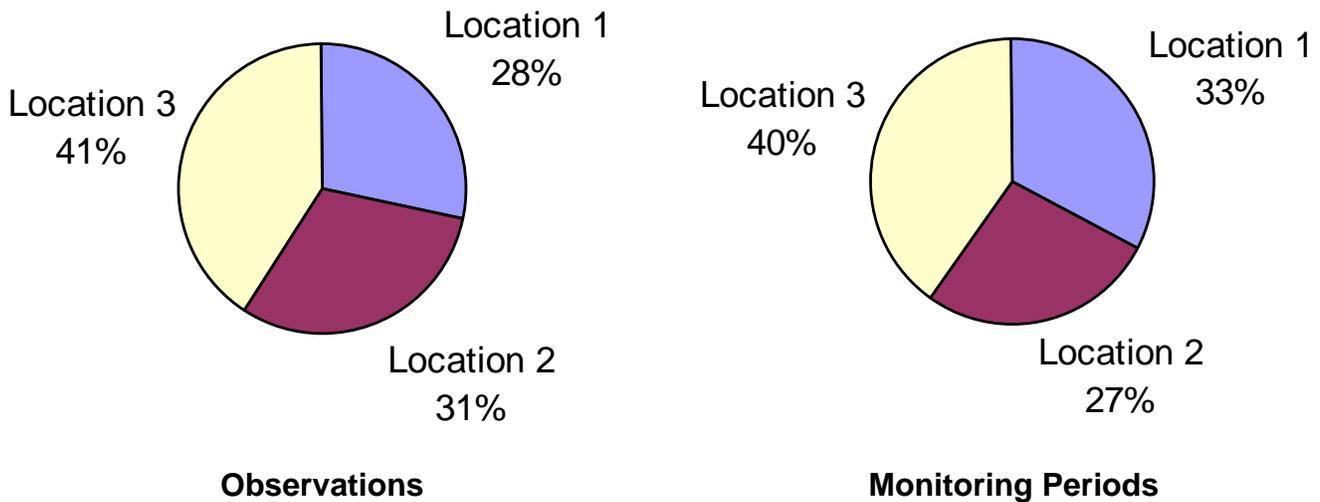
Figure 7: Distribution of monitoring periods and observations among study sites

OSMP staff observed 480 visitor parties; 13 were accompanied by dogs. Visitors were distributed among four documented uses: hiker, biker, runner and equestrian (Table 3). The number of dogs observed, with associated visitor activities, is summarized in Table 4.

Table 3. Summary of number of visitor parties and individuals observed by activity type		
Activity Type	**# Individuals Observed**	**# Parties Observed**
Biker	614	410
Runner	51	41
Hiker	41	25
Equestrian	7	4
Totals	**713**	**480**

Table 4. Summary of number of dogs observed with associated visitor activity type	
Activity Type	**# Dogs Observed**
Hiker	8
Biker	1
Runner	4
Totals	**13**

On-trail compliance levels varied by activity type (Table 5). Of the bikers observed almost all (99%) stayed on the trail. Of the sixteen visitor parties observed off-trail, only three parties, all of them hikers, traveled more than ten feet from the trail.

Notes related to observed off-trail activities are summarized in **Appendix C**.   A table presenting the observed on-trail compliance levels by activity type, with associated 90% confidence intervals, is included in **Appendix D**.

Table 5. Summary of visitor on-trail compliance levels by activity type

Activity Type	# Individuals Observed	# Parties Observed	# Parties Off-Trail	% Off-Trail	# Parties On-Trail	% On-Trail*
Biker	614	410	5	1.22%	405	98.78%
Runner	51	41	1	2.44%	40	97.56%
Hiker	41	25	9	36.00%	16	64.00%
Equestrian	7	4	1	25.00%	3	75.00%
Totals	**713**	**480**	**16**	**3.33%**	**464**	**96.67%**

* Visitors that only stepped off the trail to avoid mud or to yield to or pass another visitor and then returned to the trail were considered in compliance with the on-trail requirement.

For a summary of all off-trail activity, including visitors and/or dogs that only stepped off-trail to yield, pass or avoid mud, see **Appendix E**.   Dog on-leash compliance data is also included in **Appendix E**.

3.1 Off-Trail Permit Program
Hikers, runners and equestrians (without dogs) interested in traveling off-trail in OSMP HCAs can lawfully do so by obtaining a free off-trail permit prior to a visit. Visitors with dogs and bicyclists are not eligible for off-trail permits. Five of the sixteen visitor parties observed off-trail could have obtained an off-trail permit and been in compliance with HCA regulations while eleven of the observed off-trail parties (2.61% of total observations) could not have obtained a permit. However, no off-trail permits were issued for the Southern Grasslands HCA for the times and areas monitored during this study.

4.0 Discussion
OSMP developed on-leash and on-trail requirements based upon several assumptions:
1. Visitors and dogs have an impact on wildlife and vegetative resources;

2. Visitors and dogs remaining on-trail and dogs remaining on-leash will reduce these impacts; and

3. An on-trail requirement will reduce the potential for undesignated trail development and the adverse effects resulting from the establishment and use of such trails.

The HPT Project was designed to measure the compliance with on-trail and on-leash requirements. These requirements are difficult to enforce for various reasons including the HPT's lower visitation level (ranger time is prioritized to higher use areas) and remote location. Therefore, OSMP relies upon visitors to choose to remain on-trail with their dogs leashed. Visitors to the HPT have several opportunities to learn about the special HCA requirements. There are numerous signs along the HPT alignment. In addition, OSMP promoted these requirements through public service announcements on the city-sponsored television station, in the local newspapers and on the internet (email and the OSMP website).

HP monitoring data indicate that the on-trail and on-leash requirements were generally followed. Most visitors and the majority of dogs remained on-trail. Roughly two-thirds of dogs remained leashed (**Appendix D**). If OSMP's assumptions are correct, the levels of compliance suggest that OSMP has effectively minimized off-trail impacts resulting from the construction of the HPT.

4.1 Compliance Factors

The extent to which these monitoring results are applicable elsewhere is dependent upon a number of factors. The vast majority of observations were runners and bikers (94%) with a combined compliance level of approximately 98%. This high trail fidelity may be related to the nature of faster moving activities. Runners and bikers are often more focused (than hikers or equestrians) on moving along the trail and exercise. Hikers exhibited the lowest trail fidelity (64%). It should be noted that hikers represent a small portion of the sample (25 of 480 visitor parties). Conclusions about hikers, equestrians and runners should be tempered by an understanding that low use levels by these groups means a small sample size and less certainty of the true levels of compliance.

Another factor which may have affected compliance was vegetation. In 2007, trailside vegetation was tall and dominated by diffuse knapweed. This tall, prickly vegetation created a barrier for some visitors, discouraging them from leaving the trail. In drier years, or in areas where the trail is not lined with knapweed, visitors may be more able and thus more likely to leave the trail.

A third consideration is that the area surrounding the HPT offers few attractions to draw a visitor off-trail. There are no large rocks, trees or scenic overlooks. While the surrounding area is attractive, the absence of specific points of interest or attractions may support high levels of on-trail compliance. In a landscape with more destinations or off-trail attractions, trail fidelity is likely to be lower. For example, in a mountainous

environment, trail fidelity by bikers may be lower because of the large number of potentially attractive travel routes.

4.2 Strategies to Improve Hiker Compliance
The low levels of compliance by hikers suggest that hikers may benefit from additional education and/or enforcement efforts. Informing hikers about the availability of off-trail permits could lead to a greater percentage of off-trail hikers obtaining a permit and complying with regulations. More frequent trail signs displaying area regulations could also promote a higher degree of compliance from hikers because they tend to travel slower and are more likely to see and read signs. Additional examples of specific strategies are suggested in the following section.

4.3 Managing Visitor Behavior
Managing visitor behavior can be difficult. Current research shows that visitor behavior is concurrently affected by several factors. Some of the most important are:
- Experience level
- Expectation of recreation related impacts
- Perception of cause and effect
    - Inattention to effects (degraded conditions)
    - Inability to see relationship between cause and effect (especially when the cause is the visitor himself) and
    - Inability to perceive multi-step cause and effect relationships.

These factors interplay and can be additive in nature. For example, as experience level rises a visitor may develop an inattention to degraded conditions as his focus may be on the experience (activity) itself and not the place.

4.3.1 Experience Level
Visitors with higher experience levels are less likely to be persuaded by new information (Marion and Reid, 2007:21). These visitors are more likely to learn from social experiences with peers rather than from formal educational outreach mechanisms. However, knowledge about low impact recreation techniques gained through activities (e.g., through word-of-mouth) can be less accurate and potentially adverse to low impact behaviors. Therefore, messages targeting experienced visitors should provide more convincing rationales and should try to explain why a certain behavior is desirable and expected. Different user groups vary in their receptivity to information about low impact practices. An improved awareness of audience receptivity would allow OSMP to know when to use peer communication or partner with local user groups to provide information.

4.3.2 Expectation of Impacts
All OSMP visits in the study area are by day-use recreationists who are less likely than overnight visitors to notice resource impacts. Urban day-use trail visitors may commonly encounter recreation related impacts and are less likely to think that they are a problem (Cole, 2001:24).   OSMP could work on strategies to change visitor expectations about resource impacts.

4.3.3 *Perception of Cause and Effect*

Trail users often do not associate themselves with observed environmental impacts (Bradford and McIntyre, 2007:8). The failure to self-associate is more pronounced when the impact of a given behavior is not immediately apparent (O'Connor and Tindall, 1990:492). For example, OSMP visitors may not associate going off-trail with an observed influx of weeds in areas they frequent. Visitors are more likely to attribute environmental impact to the behaviors of others rather than accept full or partial personal responsibility. OSMP managers need to find ways to increase the likelihood that visitors will attribute resource damaging effects to their own actions (Bradford and McIntyre, 2007:7).

Most visitors do not seek to damage resources by traveling off-trail. The negative impacts of using a social trail are unlikely to be intentional; therefore, it is assumed that visitors are either unaware of the impact they cause or feel that their use of a social trail will have negligible impact (Bradford and McIntyre, 2007:3). Visitors typically are unwilling to view themselves as the cause of environmental impacts (e.g., trail braiding, vegetation damage and erosion). This may account for the lack of success in reducing the miles of undesignated trails within the OSMP system. This type of behavior could be amenable to change by providing information to enhance visitor understanding of appropriate behaviors through focused education and enforcement efforts.

Table 6 summarizes some potential management responses directed at improving visitor behavior with regard to off-trail travel.

Table 6. Summary of visitor behavior factors and potential management response

Factor	Visitor "Profile"	Management Response
Experience Level	As experience grows, more likely to learn from peers and like-minded users. Information from such sources is likely to be unreliable.	Partner with user groups to provide reliable information to members. Encourage members to "spread the word." Direct contact with uniformed personnel.
Expectation of Degraded Conditions	Expect degraded conditions and consider them to be normal for urban day use trails.	Explain what OSMP management standards are and pick some high profile places to improve conditions - demonstrating sincere commitment to improve the norm.
Inattentive to Effects	Adverse effects go un-noticed.	Illustrate or draw attention to degraded conditions.
Inattentive to Personal Contribution	Perceives the effects, however fails to perceive personal contribution to the situation.	Information and education about personal responsibility and contribution to the resource condition.
Lack of Understanding of Indirect Causes	Perceives only proximate causes and their effects.	Information and education about indirect effects.

4.4 Case Study – St. Lawrence Islands National Park

In 2004 an observational study was conducted at St. Lawrence Islands National Park to assess the effects of signs on mitigating social trail use (1239 observations over 4 weeks). The study examined the effectiveness of message text and sign location in reducing the amount of social trail use. Signs included:

- An attribution message: "Your feet have trampled the vegetation on this island. Please stay on the main wood-chipped trail."

Or

- A plea message: "Please stay on the wood-chipped trails."

Signs were placed at either the trailhead or at the social trail juncture.

The attribution message, which placed responsibility with the visitor and offered a behavioral option to reduce impact, was significantly more effective than the plea message in discouraging social trail use. Signs placed at the social trail juncture were significantly more effective than signs placed at the trailhead (Figure 8).

No message: 88% went off-trail
Plea message at either location: 77% went off-trail
Attribution message at either location: 49% went off-trail

Either sign **at trailhead**: 86% went off-trail
Either sign **at social trail juncture**: 65% went off-trail

Figure 8: Summary of sign effects on visitor behavior

The most effective combination was an attribution message <u>at</u> the social trail juncture (44% went off-trail).

4.4.1 OSMP Applications

The main implication of the St. Lawrence Islands study is that managers might be able to achieve a significant drop in creation and use of social trails by using appropriate messages on signs. For the HPT, this could mean development of new signs incorporating an attribution message with a behavioral suggestion such as, "Your feet could disturb grassland wildlife and vegetation. Please stay on the designated High Plains Trail." Development and installation of this type of sign *before* the HPT begins to see social trail development would be a proactive way of eliciting preferred visitor behavior. The current signs read "Access behind sign requires permit, Travel on designated trail only", regulatory signs offering no reasoning for the preferred behavior option for the reader. Given that signs are the primary communication mechanism on the HPT, careful consideration should be given to their content.

A similar type of sign could be developed for the proposed Marshall Lake Trail, if built. This trail will likely have more off-trail attractions than the HPT and area signage could be a way to prompt preferred visitor behavior.

4.5 Effective Communication

Education and regulation information is best conveyed by uniformed personnel through direct contact (Marion and Reid, 2007:20). This is not practical for the HPT and OSMP must rely on signs and the regulation board for communicating area requirements. The HPT is easily accessible and likely will be used by repeat OSMP visitors.   Some of these visitors will have a high experience level and research has shown these visitors are less likely to be persuaded by new information (Marion and Reid, 2007:21).   If OSMP discovers that the hiker compliance level does not improve, or is not satisfied with compliance levels, managers could consider increasing the level of ranger presence in the area.

4.6 Marshall Lake Trail

When using the HPT Project data for guidance in whether or not to build the Marshall Lake Trail, OSMP managers should consider differences in the setting. The shoreline itself will be a major attractant and will likely draw visitors from the trail. It has already been determined that if built, the Marshall Lake Trail (MLT) will prohibit dogs. There may be a higher proportion of hikers, walkers and wildlife observers. These are activity types with lower documented trail fidelity.

4.7 Recommendations

We recommend that similar studies be conducted where the design (or at least use and setting) differ from the HPT. Compliance levels may fluctuate in different landscapes and additional monitoring could be conducted to understand the reasons for any variation. OSMP could then use the additional information to better understand visitor and dog behaviors within HCA boundaries.

We recommend that OSMP conduct a literature review of studies related to sign efficacy and other strategies for managing visitor behavior. Literature on this topic is widely available (e.g., Winter 2006, Bradford et al 2007, Winter et al 1998, Winter et al 2000, Marion et al 2007, McCool et al 2000, Winter 2005) and could be compiled within a White Paper and/or an annotated bibliography.

We also recommend that OSMP develop on-trail and on-leash compliance thresholds to guide on-the-ground management decisions.

5.0 Summary

OSMP implemented an on-trail and on-leash regulation in HCAs to balance visitor opportunities with ecological integrity. OSMP monitored the compliance with visitor and dog regulations. The sample size for bikers was high, and this group demonstrated trail fidelity. Sample sizes for hikers, runners and visitors with dogs were relatively low and conclusions about trail fidelity are less certain. Hikers and visitors with dogs may benefit from additional education regarding HCA requirements. Research suggests targeted education and direct contact with uniformed personnel are most effective in reaching experienced visitors such as many persons that frequent OSMP lands. When making decisions about building other trails in this HCA or trails elsewhere, OSMP should consider the range of factors likely to contribute to off-trail travel. These include

the mix of uses likely to develop on the trail, the presence of interesting features (such as water, large rocks or trees, riparian areas, historic buildings, scenic viewpoints, etc.), and the ease of moving from the trail in the surrounding landscape. Careful consideration should be given to sign development and message effectiveness. Additional monitoring could be conducted to better understand visitor and dog behavior in other HCAs. OSMP managers could also consider development of on-trail and on-leash compliance thresholds to guide on-the-ground management decisions.

6.0 Literature Cited

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Appendices A-E

Appendix A – Baseline photo points

Photo Point One - Coal Creek bridge crossing

Photo Point Two – First switchback east of Coal Creek bridge

Photo Point Three – Eastern end of High Plains Trail at junction with Coalton Trail

Photo Point Four – Western end of High Plains Trail at junction with Greenbelt Plateau Trail

Appendix B – Data sheet used for observational monitoring

High Plains Visitor and Dog Compliance Project Monitoring Data Sheet (Component 1 and 2 - Observational study)													
Date (mm/dd/yy):						Weather:					# of people permitted:		
Time (24-hour):						Location:							Observer:
	Visitor data					Off-trail use						Zone of off-trail use	
Obs. #	People (0-n)	Visitor Activity	Dogs (0-n)	Leashed thru entire area (0-n)	Unleashed dogs (0-n)	People off trail (0-n)	Leashed dog off trail (0-n)	Unleashed dog off trail (0-n)	Sub-area Entered	Why visitor left trail	Why dog left trail	<10 ft. from trail tread	>10 ft. from trail tread

Notes:

Visitor Activity Codes
R=Running
H=Hiking
B=Biking
D=Dog Walking
E=Horseback Riding (Equestrian)

Why Left Trail Codes
P=Passing
E=Excrement/Pick-up
N=Nature Observation
M=Avoiding Mud
Y=Yielding
PD=Prairie Dog Interaction
W=Water Access
O=Other

Appendix C – Field technician notes summary by activity type (B=biker, D= dog walker, E=Equestrian, H=Hiker and R=Runner)

ACTIVITY	NOTES
B	Dog running around off-trail many times, more than 10 feet off-trail.
B	Yielded to horse and other biker, off-trail twice.
B	Also went off-trail to avoid mud, but went farther off to yield to horse.
B	Rider plus one horse off-trail to yield.
B	Went off-trail to shake mud from bike/self on east side of east gate at Coal Creek bridge crossing.
B	Observation #2 stepped off-trail 1 foot to yield to observation #3 party.
B	The person and leashed dog in observation #6 went off trail when yielding to other users to train the dog how to sit/stay.
B	Fixing bike chain, had to step off-trail to have look at it.
D	Dog running around off-trail many times on an approximate eight-foot leash.
D	Dog roaming on leash. People and dog left trail twice to yield to bikers.
D	Dog roaming around.
D	Off-leash dog came up to me barking and showing teeth, owner called many times before dog returned to trail.
E	Horse off trail in observation #3 was a little skittish, perhaps young. Would shy away from noises and back off trail.
H	One man walking around taking pictures of wildflowers.
H	Went off-trail three times to yield to two biker parties and one runner.
H	Went off-trail several times to yield, once to avoid mud.
H	Yielded twice.
H	Went off-trail to view wildflower.
H	Went off-trail several times to observe nature and do some type of body movement exercise.
H	Two adults, two children off-trail many times looking at nature and picking wildflowers.
H	These 2 were walking along the power lines for at least 3/4-1 mile. Employees of some utility company perhaps.
H	One adult and one child looking at wildflowers.
R	As far as I could tell, the leashed dog in observation #3 stayed on trail except when yielding to 2 bikers.
R	Stepped off trail to take a break, drink water, walked around a little before heading back.
R	Dog was unleashed the whole time but followed directly behind owner on trail.
R	The dog in observation #8 was unleashed and remained on trail the whole time following behind owner.

Appendix D – Confidence intervals around on-trail compliance levels

Table D1. On-trail compliance levels with 90% confidence interval

Activity Type	# Groups Observed	Percent of Total	On-Trail Compliance Estimate*	90% Confidence Interval Around Estimate
Biker	410	85.4%	98.78%	(97.45%, 99.52%)
Runner	41	8.5%	97.56%	(88.94%, 99.87%)
Hiker	25	5.2%	64.00%	(45.61%, 79.76%)
Equestrian	4	<1%	75%	(24.86%, 98.73%)
Totals	**480**	**100%**	**96.47%**	**(94.75%, 97.74%)**

* Visitors that only stepped off the trail to avoid mud or to yield to or pass another visitor and then returned to the trail were considered in compliance with the on-trail requirement.

Confidence intervals were based upon each activity's sample size and observed compliance and were calculated using SAS® 9.1.

Appendix E – Visitor and dog on-trail and dog on-leash compliance summaries

Table E1. All observed off-trail use summary (includes visitors who stepped off-trail only to yield, pass or avoid mud)

Activity Type	Total # People Observed	Total # Groups Observed	# Groups Off-Trail	Off-Trail	# Groups On-Trail	On-Trail
Hiker	41	25	17	68.00%	8	32.00%
Runner	51	41	10	24.39%	31	75.61%
Biker	614	410	68	16.59%	342	83.41%
Equestrian	7	4	3	75.00%	1	25.00%
Totals	**713**	**480**	**98**	**20.42%**	**382**	**79.58%**

Table E2. Dog on-trail and on-leash compliance by visitor activity type (13 dog-parties with exactly 1 dog each)

Activity Type	Number Dog Parties Observed	#Dogs Off-Trail	Off-Trail	#Dogs On-Trail	On-Trail	#Dogs Off-Leash	#Dogs On-Leash	# Dog Parties in Full Compliance	% Dog Parties in Full Compliance
Hiker	8	4	50.00%	4	50.00%	1	7	4	50%
Biker	1	1	100.00%	0	0.00%	1	0	0	0%
Runner	4	1	25.00%	3	75.00%	2	2	1	25%
Totals	**13**	**6***	**46.15%**	**7**	**53.85%**	**4**	**9**	**5**	**38%**

*Two dogs were observed more than 10 feet off-trail (FTZ), both off-leash, one with a biker and one with a hiker guardian