CASPER MOUNTAIN PARKS TRAIL SYSTEM ASSESSMENT & CONCEPTUAL PLAN, 2014

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TABLE OF CONTENTS

Background 1
Issues 2
Opportunities 4
Trail Assessment
- **Bridle Trails** 6
- **Crimson Dawn Park** 10
- **Archery Range Park** 12
- **Braille Trail** 14
- **Casper Mountain Trail Center** 16

Conceptual Plan 19
- **Trail Specifications** 24
- **Bridle Trails** 27
- **Crimson Dawn Park** 29
- **Archery Range Park** 31
- **Braille Trail** 33
- **Casper Mountain Trail Center** 34
- **Ponderosa Park** 36
- **Connectivity** 38

Appendix A -- Trail Impacts: Literature Review
Appendix B -- Signage, Wayfinding, and Mapping Recommendation
Appendix C -- Use Conflicts: Keys To Successful Trail Management

BACKGROUND

Natrona County contracted with KLJ Engineering in April, 2014 to inventory and assess the recreational assets on County Parks located on Casper Mountain. KLJ sought the assistance of Kay-Linn Enterprises to inventory and assess the recreational trail system on these lands and provide a conceptual plan for improvements to the trails and interconnectivity between County properties. The objectives of the recreational trail assessment were to:

- Assess the physical sustainability of the existing recreational trail system, including the condition of the trail tread, relationship between current trail grades and observed maximum sustainable trail grades, current and potential erosion/deposition, and saturation by groundwater.

- Assess the social sustainability of the trail system, including the quality of the provided recreational experience for summer and winter recreation and the potential for conflicts.

- Assess the managerial sustainability of the trail system, including the maintenance needs and management of risk.

- Make recommendations for redevelopment of the trail system, based on the findings of the assessment and available opportunities.

The trail inventory and assessment was focused on the stand-alone Rotary Park and its Bridle Trail System, Archery Range Park, Crimson Dawn Park, and the interconnected campgrounds, parks and trails around the Casper Mountain Trail Center. Rotary, Archery Range, Ponderosa (closed after fire for risk management), and Crimson Dawn Parks are separated from the campground-based parks (Beartrap Meadow, Deer Haven, Elkhorn Springs, Skunk Hollow, and Tower Hill) and Casper Mountain Trail Center by large numbers of private properties. Hogadon Ski Area, owned by the City of Casper, is also relatively close to Archery Range and Rotary Parks. A number of State-owned parcels are located on the northern and eastern flanks of Casper Mountain. BLM parcels exist on the southern and western slopes of the mountain, with Muddy Mountain Recreation area across the valley to the south. Outside the County properties and Muddy Mountain Recreation Area, authorized trails open to the public do not exist on Casper Mountain.

Existing trails of the Bridle Trail System extend beyond the boundaries of Rotary Park onto private property, as do existing nordic ski trails at the Casper Mountain Trail Center. Connectivity between the parks will be dependent upon deeded access across private properties and roads on Casper Mountain, a concept that has created significant strife in the past on the Bridle Trail System and generally across Casper Mountain where private property postings are ubiquitous.

ISSUES

Small County Land Base
The various Natrona County Parks on Casper Mountain are relatively small for the development of significant natural surface trail systems. Only the Casper Mountain Trail Center is large enough for a multi-use trail system that can provide a recreational trail use opportunities of more than one-hour in duration. Other County Parks can certainly hold high-quality trails that cater more specifically to a certain use, such as family-focused, play-based trails in Crimson Dawn Park.

Private Property And Roads
The prevalence of both private properties and privately maintained roads on Casper Mountain creates significant challenges for recreational connectivity between County Parks. Access is almost rapidly prohibited with many property owners placing huge numbers of "No Trespassing- Private Property" signs, fences, gates, and warnings. Stories abound from recreational trail users of being threatened by private property owners, balanced by just as many accounts of trespassers causing property damage, littering, and other infringements on common courtesy. Adding to the property challenges is the fact that many roads that provide transportation connectivity around the mountain are also privately held and maintained. While this hurdle has been overcome for winter snowmobile access, similar arrangements have not been accomplished for summer use of some of these roads/properties. Further, the public or private nature of a number of roads that could provide access between public properties are in dispute.

Small Summer Trail Use Community
For a community in close proximity to mountains, Casper has been relatively slow to push for four-season, trail-based recreation opportunities. Winter recreation at the Casper Mountain Trail Center nordic trails, Hogadon Ski Area, and snowmobile use are community staples. Camping, hunting, fishing, and events/festivals in non-winter seasons have been the predominant recreational uses of public lands.

Recently the City of Casper has developed a master plan for hard-surfaced transportation and recreation trails, whereas many Cities throughout the mountain west developed similar strategies a decade or two earlier. Natural surface trail development for mountain biking, trail running, hiking, and equestrian use is in its nascent stages in the Casper area. Until recently, the trail opportunities provided by the Bridle Trails seems to have satisfied the trail needs of Casper area residents. Related to the existing winter recreation and competition use of the Casper Mountain Trail Center nordic trails, the push for non-winter trail development has emerged from a competitive angle with the Fat Fish Racing mountain bike race promotion group leading the charge to develop new trails on various properties in the area. Meeting the demand for additional trails to improve race venues has caused some strife between land managers and trail users, as the trail development has not always been completed with complete authorization. Due to the narrow group of natural surface trail advocates (i.e. mountain bike racing and traditional users of the Bridle Trails) combined with limited trail opportunities, a groundswell of support has not yet developed in the Casper area.

ISSUES

Diverse Public Land Ownership
While the patchwork of private land ownership on Casper Mountain creates a large hurdle to recreational connectivity, similar challenges exist on more bureaucratic levels between multiple public land owners. At this time, a very low level of cooperation and collaboration is evident between City, County, State, and BLM land managers. While this may be primarily due to a lack of demand for cross-boundary activities, there are significant roots in differing missions. State Trust Lands do not explicitly allow for trail development and there is no basis for trail management in the stated mission for these properties and BLM planning and approval processes (i.e. Land Management Plans, NEPA approval, etc.) are typically longer term endeavors. So, while connectivity across a few publicly managed boundaries with larger acreages on Casper Mountain and between County properties further away (i.e. Alcova Lake) is certainly more attractive and expedient for high-quality trail development than negotiating with many, and potentially non-conducive, private landowners, this endeavor may also have significant and long-term challenges.

Lack Of Dedicated Capital Improvement Funding
County Commission approval for the development of an inventory and conceptual plan for recreation-related facilities on Casper Mountain is a very positive first step for high-quality, modern recreation. However, there is no currently identified source of funding for realizing the potential improvements. Small user fees have been introduced for nordic skiing at CMTC and camping/pavilion use. Festivals and events likely generate some revenue, but it is not apparent that those funds have been reinvested in the facilities and/or are not sufficient enough to accomplish more than status quo management. Looking to the future, it is not likely that user fees could produce enough funding to fully cover substantial improvements to recreation facilities. Because demand is not currently at a high level, it is difficult to justify the need to supply from an economic basis.

Synergy Development
As previously mentioned, County Commission approval for the development of a recreational facility inventory and conceptual plan is a very positive development. Recently completed improvements to facilities at Alcova Lake demonstrate the willingness to invest in modernizing Natrona County's recreational landscape. The long-term leadership of the Lions Club in the development and support of the Braille Trail indicates a level of civic dedication to recreation resources on Casper Mountain.

Ambitious master plans for Rotary Park and a competitive Biathlon Center that will broaden recreational opportunities and improve the quality of infrastructure demonstrates leadership on this County property that is being driven by non-profit organizations and local business and civic leaders. As these improvements are

OPPORTUNITIES

implemented, it will cement in the mind of residents and visitors that the community highly values its natural and recreational resources.

Platte River Pathways leadership in developing successful and highly utilized transportation and recreation hard-surfaced trails within the City of Casper, as well as the first Wyoming Trail Summit in 2013, demonstrate that community demand for improved recreation and quality of life is strong enough to drive significant changes to Casper infrastructure. Improvements along the Platte River, from environmental restoration and public golf course development to recreational boating improvements on the west side of the City demonstrate proof of concept for investment in recreation. Gaining momentum for improvements at Hogadon Ski Area, with an additional focus of developing four-season use of the facility, is yet another related and positive endeavor that supports the development of broader, better outdoor recreation.

Together, the development of synergy around recreation is incredibly positive and has the potential to help break down barriers and clear hurdles outlined in the previous section. With positive movement coming from so many different sectors, each with its own semi-distinct groups of contacts and spheres of influence, the opportunity exists for a much higher level of collaboration, momentum development, and cost/ implementation sharing.

Recreation Stewardship On Private Lands

While many of the most contentious issues related to recreation around Casper have centered on the legality of access across private lands, there are also very positive bases to promote this concept. Trail access across private lands at CMTC, with access to a private business and the development of a competitive biathlon center, are significant and positive precedents, as is the fact that much of the Bridle Trails are located on private property. Continued proactive management of these situations can only help to allay more concerns and open up more opportunities over time. Additionally, promotion of the fact that the County is a willing and able partner in helping to manage for positive, non-degrading use of its neighbors' property and good will is a message that needs to reach the community at-large. Without this positive messaging backing up proactive outreach and management, it is likely that negative messaging created by individual incidents or even hearsay will continue to dominate attitudes and expectations.

Opportunities also exist to forge relationships that provide recreational trail access across more non-traditional private lands. Quite a large number of camp properties exist between Hogadon Ski Area and CMTC, from Girl Scouts to numerous different churches. Added to this are properties held by the conservancies and private lodges that may benefit from recreational access directly from their properties. Such as precedent could be capitalized on by others, with family trusts or individuals who may see potential tax savings or revenue development in similar conservation or private enterprise development. The positive financial implications of

OPPORTUNITIES

recreational access from private property have been documented all over the United States, from standpoints of quality of life and property value increases to increased visitation and revenue at private enterprises.

Community-Focused Competition Ethic

In stark contrast to many competition-focused trail developments that are developed and intended for the top tier of competitors, the CMTC as well as the Fat Fish Racing events have a significantly broader community interest level. That is not to state that these groups will not produce world-class athletes, but with a primary focus on fun, active lifestyles, their reach seems to extend deeper into the Casper community than do many similar groups around the mountain west.

This is a significant opportunity to build upon with an improved, four-season trail system at CMTC, enhanced family-focused developments at Crimson Dawn and Archery Range, and interconnected trails throughout the County campgrounds on Casper Mountain. Changing behavior throughout the parks is as much about changing the user demographic as anything else, and enhancing the already-present positive attributes that focus on whole family and community-engaging activities is a natural extension of the positives that are already present.

BRIDLE TRAILS

HISTORY

The Bridle Trail was built in 1939 and 1940 by the Works Progress Administration, perhaps with assistance from the Civilian Conservation Corps, in part on property owned by the Rotary Club (purchased in 1932), as well as on nearby private properties. Some access easements were deeded and recorded for the trail, but full deeded access has not been documented. This issue has compounded in recent years as numerous private land owners along the trail route have been frustrated by inconsiderate public use of the trail, including the crossing of posted private property, vandalism, etc.

ACCESS

The main public trail access occurs from Rotary Park, off Rotary Park Road. Additional access occurs from some private properties/roads. Rotary Park currently provides parking for approximately 25 vehicles in designated parking areas and possibly another 15 vehicles through the picnic grounds. Rotary Park has recently completed a master plan that, when implemented, could substantially increase the parking capacity.

TRAILS

Three main trail areas exist in the Bridle Trail system, each focused on different natural features and developed facilities of the area. The first area is within the more highly developed portion of Rotary Park and includes the Picnic Loop, which runs from the restrooms north to the northern parking area, looping back utilizing the picnic sites' dirt access road. This trail provides access between developed facilities in Rotary Park and non-road access to the Waterfall Trail and other trail areas.

The second area is somewhat developed with bridges, large culverts, rest benches. This area contains the Cutoff and the Waterfall Trail, currently a destination trail to the base of the waterfall with connectivity construction in progress to the Lower Cutoff.

The third trail area consists of the least developed "backcountry" of the Bridle Trail and consists of trails named East and West Overlook, Upper Cutoff, Split Rock, and West Loop.

BRIDLE TRAILS

Picnic Loop

- Originates from restroom area near the traffic circle, and runs along the sidehill between the parking area and upper picnic spots.
- 6' wide and slightly insloped in many locations.
- Vertical backslope beginning to slough in some areas.
- Surfaced with gravel mix, showing signs of larger material movement in areas greater than 12% trail.
- A few socially created trails from parking area to trail.
- Stormwater and/or spring creating wet trail conditions at north end of upper parking area.
- Each picnic area has an informal spur trail access to Garden Creek.

Recommendations:

- Pull back vertical backslopes and seed to stabilize.
- Blade outside critical edge to obtain positive cross slope and drainage.
- Rock armor wet area below northern edge of parking lot.
- Formalize creek access points with constructed trail at sustainable gradient and sitting rocks.
- Formalize a single crossing at downstream edge of property, near parking area to existing trail.

Waterfall Loop

- Originates from rotary on bridge with large culvert- some erosion at downslope edge of bridge from stormwater-based flow off hillslope and parking area.
- 6' wide, slightly insloped in many locations.
- Backslope sloughing severely in many locations, resulting in tread width reduction of 1-3'.
- Little chance of holding back future sloughing without retaining walls. Rock would be best, but much sloughing may be due to downhill, off-trail, pedestrian use, demonstrated by numerous vertical, social routes that connect legs of trail visual and below the Lower Trail.
- No water management (rolling grade dips) along course of trail.
- Benches at base of waterfall placed too close to pool- westernmost benchpost being buried by slough, easternmost benchpost being eroded by flow out of pool.
- Significant risk of high flow from pool running down trail and causing severe erosion.

Recommendations:

- Divert stormwater flow to upstream side of bridge.
- Create rolling grade dips at approximately 50-75' intervals, optimizing drainage management with features placed at top of steeper grades and/or where trail turns away from creek.
- Construct large, rough, rock retaining walls/sitting stones at sloughing locations and/or where social trails are connecting. Walls should allow for drainage and be optimized to pair with rolling grade dips to maximize efficiency. The locations of the drains may need to be further armored to prevent erosion.

BRIDLE TRAILS

Lower Cutoff Trail

- 2-6' variable width, eastern leg to stream crossing mostly steep (20-30%), old road cut with sloughed backslope bringing width to 4-6'. Western leg is narrower.
- Intense social trail development down to overlooks of falls.
- Considerable amount of intact, historic rock crib walls across entire loop.
- Dimensional lumber/t-stake/heavy gauge wire retaining walls and wooden steps installed much more recently than rock walls and in degraded condition or demonstrating signs of stress (bowed walls, exposed rebar)
- Generally steep trail grades with lots of up and down. Many extended sections with gradients between 15 and 30%.
- Little or no water management and definitive signs of channelization and erosion.
- A large number of spur trails enter private property and are "closed" with sign and deadfall. Few have been actively opened to facilitate use.
- No bridge at creek crossing and very steep grades into and out of crossing.

Recommendations:

- Significant formalization needed to provide a consistent experience befitting of the location of the trail and to deter continued social trail use.
- Water management structures at 50-75' intervals or where possible throughout entire trail, especially on steep western leg, and all areas where 15%+ grades continue for more than 50', focusing on water management at the upper edge of the steep gradient and where the trail turns into the hillslope.
- Remove lumber-based cribwalls and replace with rock to match WPA construction aesthetic.
- Add rock steps on all fall-line trail sections at grades of 15% and above to maintain narrow trail. Steps should not require more than a 12" rise to continue to provide maximum access to the trail.

BRIDLE TRAILS

- Garden Creek crossing should be bridged. Probably USFS-style log stringer bridge, set high enough for spring flood clearance.
- Trail closures should be much more complete, scarifying and planting, rather than simply piling deadfall and adding a sign.
- Waterfall overlooks should be developed and signed both along the trail and at a trailhead kiosk map.

Upper/"Backcountry" Trails

- Originally constructed 4- 6' wide trail, with backslope sloughing resulting in 2-4' active trail tread.
- Very limited presence of water management on entire system of trails.
- Some rolling contour sections with grades less than 10% have held up quite well.
- Moderate to heavy erosion throughout the majority of the trails, which has led to the removal of much of the fill material behind rock retaining walls and washed down to bedrock in many locations. Most of the trail has lost between 4" and 2' of tread material.
- For the most part, the original rock walls are still intact.
- Shortcutting of stacked switchbacks is occurring.
- Similar trail closure styles at private property junctions to Lower Cutoff.

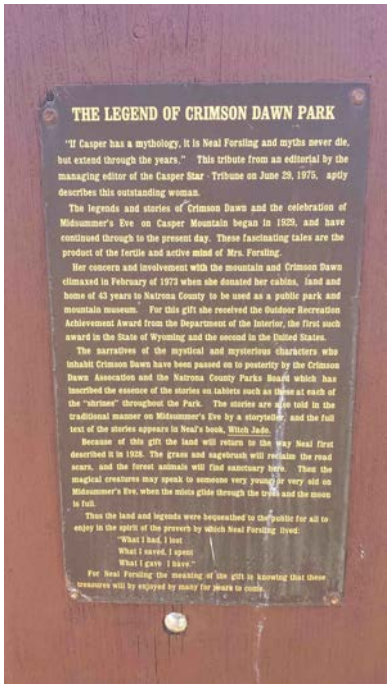
Recommendations:

- Significant formalization needed to provide a consistent experience befitting of the location of the trail and to deter continued social trail use.
- Water management structures at 50-75' intervals or where possible throughout entire trail and all areas where 15%+ grades continue for more than 50', focusing on water management at the upper edge of the steep gradient and where the trail turns into the hillslope.
- Remove lumber-based cribwalls and replace with rock to match WPA construction aesthetic.
- Refill material behind rock retaining walls and combine with rock steps to reconstruct and "save" this extensive, high-quality construction.

CRIMSON DAWN

HISTORY

The Crimson Dawn Park was originally the family property of Neal Forsling. Ms. Forsling wrote a book titled “Crimson Dawn” and created a number of shrines related to the book’s characters around the property. An annual Midsummer Festival, including a bonfire and night hike along the trail through the shrines, has been the main focus of the property. The Crimson Dawn Association operates a small museum in the historic Forsling home.



ACCESS

The park is accessed off East End Road, turning south at the Natrona County Parks sign on Crimson Dawn Road. Entrance to the park is on the south side of Crimson Dawn Road at a smaller entrance sign. Crimson Dawn Road continues past the park, eventually meeting Casper Mountain Road near Bear Trap Park. After passing through the entrance gate, an approximately 15-vehicle, gravel parking area is located just outside the pine forest, adjacent to the museum.

TRAILS

There are currently two trails on the Crimson Dawn Park property. A short loop trail from the parking area to the Forsling family cemetery/bonfire location and a trail between the existing shrines.

Cemetery Loop

- Begins in parking area with no sign.
- Descends and then ascends steeply through an ephemeral drainage, providing expedient access to the fenced cemetery area and the adjacent point of the annual bonfire.
- Rudimentary trail continues around the small hill, with a view of Muddy Mountain to the south. This section of trail does not naturally shed runoff with a sidehill, bench cut configuration and is too narrow for two-way traffic.
- Descends steeply into a swale and old cattle pond, connecting to an old farm road a few hundred feet east of the parking area at the woodland theatre location. On the opposite side of the theatre, connectivity is made with the woodland trail.

CRIMSON DAWN

Recommendations:

- Provide a small sign indicating the beginning, length, and features present along the trail.
- Relocate trail with reduced (less than 8%) gradient through drainage and swale areas on the east and west ends of the loop.
- Eliminate and restore vegetation on the fall-line portions of trail.
- For the portion of the trail with views toward Muddy Mountain, relocate approximately 30' downslope with a rolling contour, 4-6' wide, full bench cut trail that will handle two-way traffic and minimize erosion.
- Add a few rustic benches at eastern and western ends of the loop that provide optimized views of Muddy Mountain.

Woodland Trail

- Unsigned access to the Woodland Trail originates from the eastern and western ends of the parking area along the historic farm route that is now barely discernible.
- Access is also possible adjacent to the museum, again without signs.
- The trail is approximately 15' wide throughout its course through the shrines and to the woodland theatre, before connecting to the old farm route just outside the forest at the eastern and western ends of the loop.
- Trail grades are very mellow, less than 5%, over the entire loop.
- The tread surface is not improved and the edges of the trail are continually lined with logs, ostensibly to contain traffic during the busy Midsummer Festival.
- Rustic fences encircle each shrine and separate these areas from the trail.
- Each of the shrines has an interpretive description of its contents.
- Most of the shrines are in a degraded condition.

Recommendations:

- Develop Trailhead kiosk with thematic map.
- Consider reconstruction of the existing trail route, creating 6'-wide, aggregate surfaced trail that meets accessibility guidelines.
- Continue with the existing, mandated (by Crimson Dawn Society) theme in park, but make modern upgrades to interpretation.
- Add a narrow, natural surface loop trail of approximately 1-mile to the north of the existing infrastructure and connecting to the Cemetery Trail to broaden the recreational opportunities.

ARCHERY RANGE

HISTORY

The Robert L. Adams Memorial Archery Range Park is located on the southwest side of Casper Mountain. The range has been in existence since the 1950s. In partnership with the Lost Arrow Archers, a number of improvements have been made to the park, including target upgrades, an animal range, pavilion and rest rooms.

ACCESS

The park is accessed from County Road 504 near Hogadon Ski Area. Turning south on Micro Road just before the ski area, the Archery Range Road continues south approximately 1.75 miles to the Archery Range parking area.

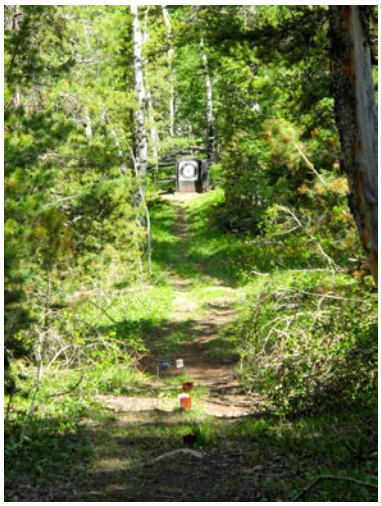
TRAILS

There are currently two, twenty-eight target field archery course trails as well as a target range on the property. A target field course is located just west of the practice target range, contained in a forested drainage with a western aspect. The animal course is accessed just southeast of the restroom and is bounded by the entrance road in the west.

Practice Range and Parking Facilities

- Signage directing visitors to Park is of dissimilar size and visibility, hindering navigation from County Road 504 to Micro Road and Archery Range road and the park.
- Safety berms and signage present along entrance road, but main safety sign is heavily degraded and is the only readily apparent safety-related messaging.
- A kiosk exists behind the covered pavilion explaining the history of the archery-focused park.
- No trail/range map exists.
- Small signs indicate entrances to Target and Animal Range trails.
- Mobility-impaired access at main facility is adequate, but could be improved, especially for access to the practice range.

ARCHERY RANGE



Target Range

- Stormwater runoff from parking area drains down main trail to target range, causing significant erosion on the trail to the first target as well as the cutoff trail to target twenty eight.
- The course is well-marked, with distance markers intact and targets in good working order.
- Each hole has a rest/wait bench that are aging but not yet degraded.
- Shooting corridors are quite narrow with some branches intruding into the shooting corridor.
- Some trails between targets are oriented on the fall line of the hillslope and are showing minor signs of degradation, which would worsen with increased use.
- Targets do not have earthen berms to contain arrow flight, nor is vegetation cleared behind targets to facilitate arrow recovery. However, with such a tight course this situation provides some measure of safety.

Animal Range

- Trails between targets on the animal range are less developed and sometimes difficult to follow. Often, there are small green arrow directional signs near the ground to assist in navigation. The inconspicuous nature of these signs helps to maintain a natural feel to the course, but some areas of multiple route development indicates that the signs may be too difficult to see and follow.
- Some vegetation intrusion into the shooting corridor is present.

RECOMMENDATIONS

- Improve size and quality of navigation signage along roads.
- Institute a comprehensive safety signage program at park entrance and parking area.
- Develop course map signage in kiosk and paper forms. Paper maps could also include scoring tabs.
- Improve accessibility at the trailhead and practice range area.
- Develop an additional, 14-target course in the southwest portion of the property that focuses on children and newcomers to the sport with instructional interpretation, shorter target distances, and larger targets.
- Better manage stormwater flows from parking area.
- Add rolling grade dips at 50-75’ intervals on entrance trail to target range.

BRAILLE TRAIL

HISTORY

The Lee McCune Braille Trail was developed in the mid-1970's by the Casper Mountain Lions Club, Wyoming Field Science Foundation, and teachers Ed Strube, Dana Van Burgh, and Mary Katherman. With tremendous community support, the trail has been reconstructed after a number of climatic events that washed away bridges, took down large numbers of trees, and washed out much of the trail. In 1976, the Braille Trail was the first trail in Wyoming added to the National Trail System as a National Recreation Trail.

ACCESS

Located in the Casper Mountain Trail Center, the trail is accessed from a small, five-car dirt pullout along the Strube Loop. Additional parking is available behind a gate. Located in the ecologically and geologically diverse headwaters of Elkhorn Creek, the area is historically known as Skunk Hollow.

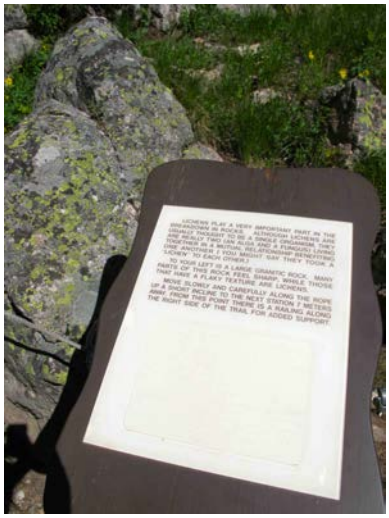
TRAILS

The roughly 1,900 linear foot Braille and English language nature interpretation trail runs along both sides of the Elkhorn Creek valley, crossing the creek in a number of places.

- The trailhead area has a number of kiosks, mostly dedicated to listing and thanking individual and group contributors to the original and numerous reconstructions of the trail. A small handwritten sign states that the trail is currently closed, ostensibly the reason for the closed gate.
- A closed cabinet contains a guest log and trifold brochure that provides a history and photos of the trail development.
- No maps of the trail are present.
- The trail is made accessible to those with visual impairment by use of wood posts spaced at approximately fifteen-foot intervals with a small rope strung between the posts at approximately three feet off the ground.
- Most of the posts are anchored firmly, but a few wobble a few inches if pushed.
- Thirty four interpretive signs are present along the trail, some as close as six linear feet and others separated by more than 150 feet.

BRAILLE TRAIL

- The trail tread is a combination of natural dirt surface with many areas of added aggregate material to maintain tread firmness and stability. A number of rocks protrude one to three inches above the trail tread along its course, especially in steeper trail grades and switchbacks.
- Very little outslope is present to maintain a flat trail tread.
- The tread ranges in width from two to four feet.
- Trail grades range from flat to greater than 20%.
- Near the beginning of the trail a recent tree blow down has led to post/rope break and an approximately six-foot long slough that intrudes a number of inches into the trail tread.



Recommendations:

- Formalize parking area along Strube Loop with a sign and improved delineation of parking or restore area to natural forest cover.
- Add trail map to kiosk area in flat and raised topographic formats.
- Consider removal of extensive “thank you” kiosks and replace with a general kiosk giving thanks, providing history, and explaining park regulations.
- Remove protrusions from trail tread.
- Endeavor to improve trail to modern accessibility standards in width, grade, and level of roughness.
- Consider a reduction in the number of interpretive stations along trail, combining multiple ecological messages in a single sign. Consider the addition of vision impairment and Braille interpretation for sighted trail users.

CASPER MOUNTAIN TRAILS

ACCESS

The Casper Mountain Trail Center is located on Casper Mountain Road, approximately 0.5 miles south of the Hogadon Road split. A second access is located down the hill on the north side of the road at the entrance to the Strube Campground and Strube Road.

TRAILS

The Casper Mountain Trail Center (CMTC) includes approximately 20 miles of Nordic ski routes, including a (1km) lighted loop for night skiing. CMTC is interwoven by campgrounds, including Beartrap, Deer Haven, Tower Hill, Strube, Elkhorn, and Skunk Hollow areas.

An approximately 50-car parking area is located next to a lodge and kiosk with a map of the Nordic trails. There is a small, fenced parking area for snowmobiles is located on the east side of the Trail Center lodge to provide access, but parking of snowmobiles is discouraged in this area because they cannot access the trail system. More often, snowmobile use begins from the large Beartrap Meadows parking area which is connected to signed snowmobile routes. Recently, local mountain bike enthusiasts have begun to develop trails, utilizing portions of the Nordic trails connected to narrow singletrack through the forest. The trails are on both Natrona County property as well as authorized access on adjacent private properties. The development of a biathlon center is planned on private property on the east end of the existing Nordic trails, accessed off East End Road.

CASPER MOUNTAIN TRAILS

Nordic Trails

- The trailhead kiosks that are present at the CMTC and the adjacent trailhead are quite old. Only the Nordic maps are on the kiosk .
- Trail names are not prominently displayed, nor are distances or shortest return routes to the Trail Center.
- 911 markers are installed at 117 locations around the trail system.
- Grooming staff has stated that ski runs are somewhat inconsistent in width and/or turn radius, bringing grooming challenges.
- It is not clear from signage and literature whether a homolugated competition course(s) are present within the trail system.
- Trails have been difficulty rated, but ratings change throughout individual trails.

Singletrack Trails

- Maps for mountain bike trails are not available in paper or kiosk formats. Maps for snowshoe or snowbike routes are not available. However, some snowshoe route signage is present throughout the nordic trails with additional signage requesting that snowshoers and dog walkers keep to the edges of the groomed areas.
- Many fall line, social trail routes are present.
- It is not clear whether equestrian use is allowed on either the nordic or singletrack trails, but both types of trails see regular equestrian use.
- It is not clear whether singletrack trail development is authorized on the private lands where nordic trails are located.
- The trail system is not marked in the forest, making navigation quite difficult for new visitors. The trail intermittently utilizes nordic ski trails, further making navigation choices difficult.
- Trail corridors are often quite narrow, sometimes too narrow for many modern mountain bike handlebars.
- Much of the trail is adequately constructed with trail grades ranging from flat to 15%. However, multiple alignments on the fall line of the hillslope are beginning to show signs of degradation caused by water running down the trail, tires lost traction, or braking forces.
- Mountain biking-specific structures have been erected, log pyramids and berms with a pine and/or plywood foundation. A few of these structures are rapidly degrading due to poor construction techniques.
- The trails provide an enjoyable riding experience, but the sinuous nature and sometimes very short loops detracts from a quality pedestrian experience.

CASPER MOUNTAIN TRAILS

RECOMMENDATIONS

Nordic Trails

- Increase Nordic trail corridors to widths and turning radii that can accommodate a more modern, faster grooming machine to decrease necessary grooming time.
- Add living or wooden snow fences to better maintain snow cover where regular wind scour exists.
- Where terrain allows, consider corridor redevelopment to provide consistent moderate and difficult skiing experiences.
- Consider homolugation of course(s). Combined with a high level training- and competition-focused biathlon center, this could position the trail system for high-level competitions on a national and international scale.

Singletrack Trails

- Redevelop, sign, and map the snowshoe/singletrack trail system to minimize intersections with the nordic trail system to eliminate shared-use issues related to grooming and trail quality in the winter and navigation and hiking experiential quality in the summer.
- An approximately 5 km trail system of low-gradient, family- and snowbike-focused routes should be developed on the western end of the county properties, connecting the Elkhorn, Skunk Hollow, Beartrap, Deer Haven, and Tower Hill campgrounds with the CMTC. Access should be available to as many campsites as possible to improve access to recreation and minimize the development of fall line, social routes. Developed to a 4-foot wide trail tread and six-foot trail corridor would allow snowmobile-based grooming/rolling in the winter and bidirectional travel in the summer.
- An approximately 10-15 km singletrack trail system should be created in the central and eastern portions of the nordic trail system (radio tower area and Circle T property), redeveloped as narrower (two-foot wide trail tread and four-foot wide corridor) longer, more difficult loops for more experienced snowshoers, mountain bikers, trail runners, and hikers.

CONCEPTUAL PLAN

A FOUR-SEASON PLAYGROUND

On Casper Mountain, Natrona County has the makings of a four-season recreation hub. The mix of County-managed properties have something to offer all manner of residents and visitors, from high-level sporting event venues such as the archery range and CMTC to close-to-town, family-focused, passive enjoyment of the outdoors at the many campgrounds, Rotary, and Crimson Dawn Parks. Certainly, many of these facilities have not seen the amount of maintenance necessary, but the land base is outstanding, the climate complements the City of Casper's during most of the year, and the changing attitude and demographic around outdoor recreation holds huge potential for innovative public support.

The trail system on Casper Mountain is relatively unmanaged, save for the CMTC Nordic trails. Physical, social, and managerial sustainability improvements are necessary to cure some of the current ills (i.e. trespassing, erosion, unsanctioned trail construction) and realize the goal of a successful, manageable, modern trail system. The improvements needed fall into three general focus areas of:

- Trail Diversity and Quality
- Trail Accessibility, and
- Trail Management

Trail Diversity & Quality

The three basic types of trail on Casper Mountain are purpose-developed Nordic ski trails, signed snowmobile routes, and relatively unplanned user-developed paths. The former two trail types are serving the user base quite well, while the latter, in form and function, are not meeting the needs of the County's residents or visitors. Natural surface trail improvements do not have to take a one-size-fits-all approach, but should match the trail facility to its intended user base.

Shorter distance trails, especially those that access nearby destinations like the waterfall, Crimson Dawn's shrines, or the Braille Trail's interpretive sites, should provide maximum utility to the broadest demographic. Meeting this need typically results in more formally developed natural surface trails than are currently present on Casper Mountain. These trails should be wide enough to

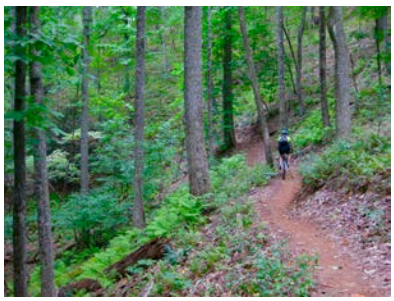
CONCEPTUAL PLAN

allow safe passage of larger numbers of trail users trying to access the trailside destinations without pushing that use outside the trail corridor and initiating vegetation trampling and erosion. These trails should be as barrier-free as possible, with minimal root and rock protrusions, low trail gradients, and a firm tread surface. Structures needed to minimize natural resource impacts, such as stairs, bridges, boardwalks, benches, and overlooks should be constructed in a stout manner out of durable materials with trail user safety in mind.

Campers, families, and those without high levels of stamina or time need trails developed to fit their needs. These trails should be relatively short, aiming for 15 minutes to an hour of recreation, and configured as loops that are directly accessed from a parking area or easily located from a campsite. While this type of trail may have a somewhat rougher tread surface, as these users are looking for a naturalized condition, the width of the trail should accommodate two-way use in these generally more crowded areas. Structures that are necessary may be developed with a rustic look, but should also be wide enough for bidirectional use and considerable loads.

Outdoor athletes, both recreational and competitive, desire longer trail experiences with a multitude of options. Just as “The Maze” alone wouldn't satisfy all the serious skiers, mountain bikers, hikers, and trail runners would like to see a trail system made of more than a single loop or limited mileage. The trails that appeal to these types of recreationists generally have a natural tread surface where protrusions may be large, only require width for one-way traffic, and the least formal type of constructed features.

The common elements to all these trails will be that they are designed with the best practices of trail sustainability, 1) controlling trail grades and placing trails perpendicular to the fall line to mitigate erosion, 2) avoiding wet and flat areas where drainage problems develop, and 3) aligning trail in a rolling contour fashion that mimics the curves of the landscape, minimizes potential water volumes on the trail, and mitigates trail user speeds.

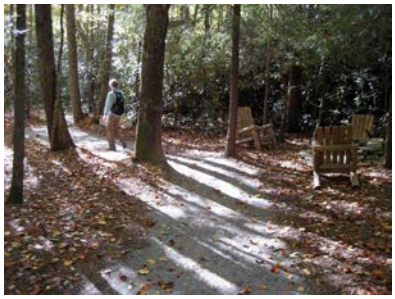


CONCEPTUAL PLAN

TRAIL ACCESSIBILITY

Trails on Casper Mountain should be easily accessed and navigated to maximize the quality of the trail experience and minimize the likelihood and/or severity of incident response. Unlike many popular trail areas, Casper Mountain already has significant parking capacity and facilities in close proximity to its potential trail systems. With existing space for well over 100 vehicles, the CMTC/Beartrap Meadows area and planned parking increases at Rotary Park, these facilities are ready for heavy weekend use and special events once the trail systems are improved. This focused access is much easier to manage than a more dispersed scenario and provides for high levels of visitor interaction with managers.

However, once a visitor is parked at any one of the Natrona County facilities on Casper Mountain, navigation to and throughout the current trails is challenging, at best. While all visitors desire to be outside in nature, very few desire to be lost. With many of the County's facility signs on the mountain in disrepair, it is the perfect time to develop an integrated and comprehensive signage system. With a common aesthetic and information layout, roadside navigation signs, trailhead kiosks, maps, and trail junction signposts can work together to inform, educate, navigate, and regulate trail users. With multiple groups supporting different trails and the likelihood of that situation only increasing in the future, it is very important that Natrona County takes the lead on a comprehensive signage plan so that each group does not recreate its own wheel and create confusion in the process.



From a legal standpoint of trail accessibility, rather than vehicular access to and navigation through trails, relatively new federal regulations require trails and attendant facilities to be brought up to an accessibility standard. While these rules only apply on federal lands when new facilities are developed or existing facilities, including trails, are altered, the Access Board is currently working on developing similar new regulations for non-federal lands through the Americans with Disabilities Act (ADA). With maintenance needed on trails in locations where higher levels of accessibility would benefit more individuals, such as trail access at campgrounds, practice target range, the Braille Trail, and Crimson Dawn, it would be wise to plan improvements with this changing regulatory situation on the horizon.

CONCEPTUAL PLAN

TRAIL MANAGEMENT

Trail management in the 21st Century looks very different from even a few decades ago, when even county-level park systems had numerous park rangers, full maintenance staffs, and extensive equipment to many trails and recreation. Today, the reality is that trail management funding is not nearly as extensive. Volunteers and partnerships have taken the forefront of effective recreation management- a tactic that has already reaped significant benefits for Natrona County in the ongoing management of its Casper Mountain holdings.

Looking into the future, the presence of these partnerships and an active volunteer force will have to be more robust, developing partnerships that are more formalized, have mutually approved annual work plans/priorities, and develop funding streams to realize the improvements conceptualized in this plan. While county staff will be responsible for much of the day-to-day maintenance of the parks (i.e. trash, general upkeep, law enforcement, etc.), much of the trail and related recreation development and ongoing management will have to be completed through partnerships, and those tasks will require a common point of management contact to drive the process, cooperatively develop priorities, and manage work flow and outcomes, coordinate with and oversee staff-led maintenance, and outreach to the broader community. This staff position will function as more of a mid-level project manager than a maintenance supervisor, for which there is already a significant load of work on Casper Mountain.

A broad and deep base of outdoor recreation/trail development, management, trends and best practices, and public organization/interaction are the core skill sets for this type of Outdoor Recreation/Trail Manager position. Experience in funding development and management would be very helpful. Ample time to interface with decision makers, funders, and volunteers would facilitate the strongest outcomes for project implementation.

While the current staffing situation does not have the capacity to undertake the improvements outlined in this plan, the focus should be on building volunteer capacity through training and outreach and looking to external sources for specialized work, such as large amounts of trail design and construction.

CONCEPTUAL PLAN

With numerous, full-time professional trail contractors in the Mountain West that are members of the Professional Trailbuilders Association, Natrona County should have have no trouble finding qualified contractors.

Natrona County has a history of utilizing Wyoming Conservation Corps, Boy Scouts, and other semi-organized labor in its park system. This tactic should continue, but as with all volunteers, be very closely managed to assure labor outcomes are in alignment with best practices. Direct oversight is often the best method of management, which requires planning and available time.

It is highly recommended that the County develop a Volunteer Crew Leader training program, to assure that common best practices are utilized throughout its many partnerships. With Crew Leader certification and presence in ample numbers for its volunteer turnout (typically 1 leader for 10 volunteers), project plans can be effectively implemented, volunteer safety maintained, and quality volunteer experiences provided. The State of Colorado's Outdoor Stewardship Initiative is a good model to start with and professional trail educators provide services ranging from staff training in trail management to mechanized equipment instruction and everything in between.

Finally, partnerships with nearby land managing agencies and private land owners on Casper Mountain will need to be enhanced. This is an interpersonal communication, give-and-take, and collaborative process that may reap significant benefits to general land management on Casper Mountain, connectivity between County holdings and to other public agency properties, and the overall quality of the recreation system on the mountain. From the Federal Lands Access Program to the State of Wyoming's Recreational Trails Program, as well as funding sources that assist in the restoration of natural landscapes, Casper Mountain is a very compelling grantee, provided strong support can be generated from multiple parties.

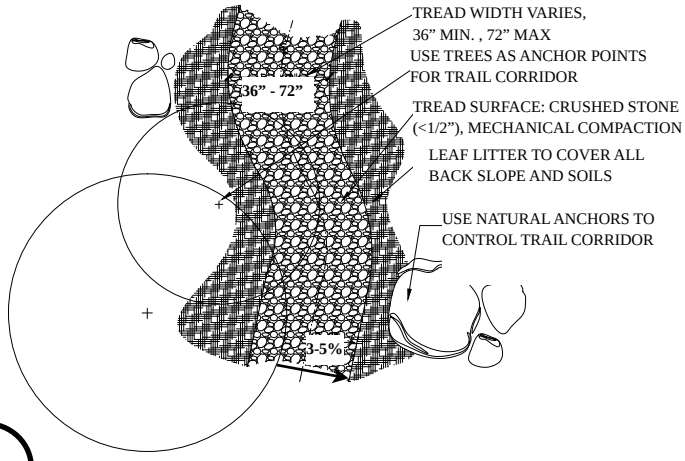
TRAIL SPECIFICATIONS

Trail Type Name: Frontcountry- Barrier Free (FCBF)
Difficulty Rating: Easy
Difficulty Symbol: Green Circle

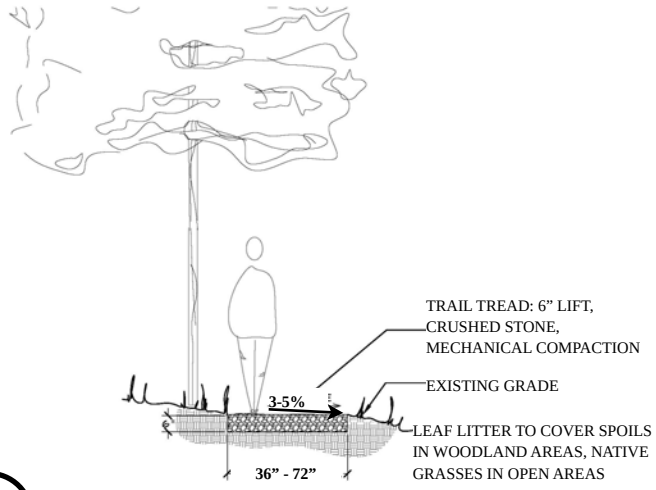
Typical Tread Width: 36”-72” (Sufficient clearance for mobility devices 36” wide)
Typical Corridor Width: 60”-96”
Tread Rugosity: Smooth and even

Average Gradient: <5%
Maximum Sustained Grade: 7%
Maximum Grade: 8%
Typical Tread Materials: Cut and fill at grade compacted crushed stone (6” lift of 1/2”-) with sub-base, as needed.
Sideslope Steepness: Flat to 50%, may need retaining walls on backslope if slope is greater

Turn Radius: Wide and open
Trail/Structure Formality: Formal, 90” minimum width
Wet Area Crossing Formality: Formal bridges for minor/major crossings
Duty of Care: High



1.1 **PLAN DETAIL: GREENWAY TRAIL TYP.**



1.2 **SECTION DETAIL: GREENWAY TRAIL TYP.**

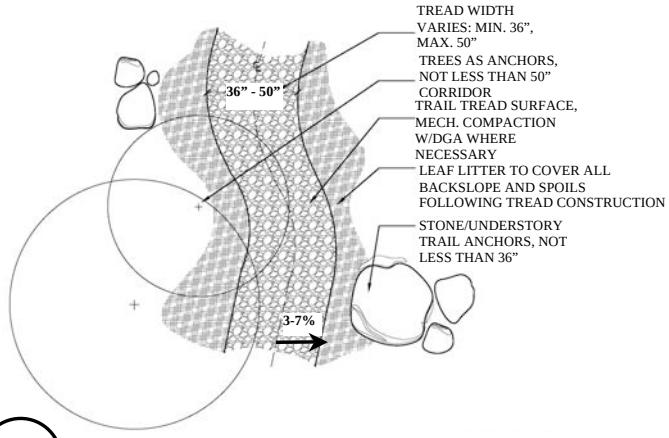
TRAIL SPECIFICATIONS

Trail Type Name: Frontcountry- Natural Surface (FCNS)
Difficulty Rating: Moderate
Difficulty Symbol: Blue Square

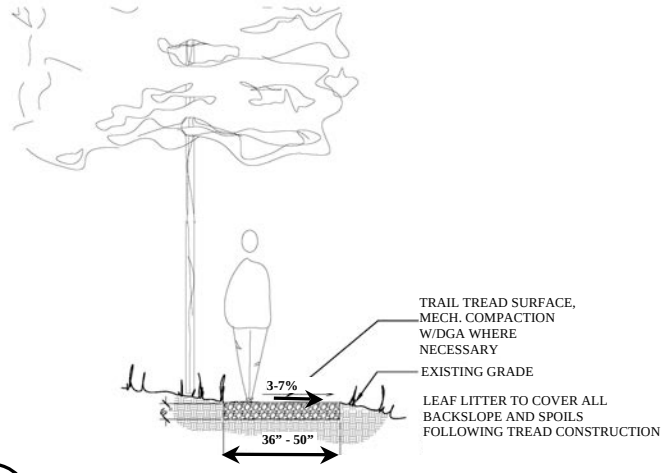
Typical Tread Width: 36”-50”
Typical Corridor Width: 48”-60”
Tread Rugosity: Relatively smooth, some roots or rocks, protrusions <3” above trail tread

Average Gradient: <10%
Maximum Sustained Grade: 15%
Maximum Grade: 20% with surface treatment
Typical Tread Materials: Natural surface with surfacing amendments where necessary
Sideslope Steepness: Flat to 75%

Turn Radius: Wide and open
Trail/Structure Formality: Formal, 48” width
Wet Area Crossing Formality: Formal bridges for minor/major crossings, 60” minimum width
Duty of Care: Moderate



2.1 N.T.S
PLAN DETAIL: FRONTCOUNTRY TRAIL- TYP.



2.2 N.T.S
SECTION DETAIL: FRONTCOUNTRY TRAIL- TYP.

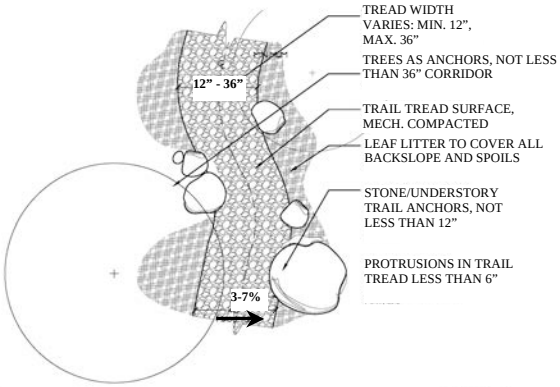
TRAIL SPECIFICATIONS

Trail Type Name: Backcountry (BCM or BCD)
Difficulty Rating: Moderate /Difficult
Difficulty Symbol: Blue Square/Black Diamond

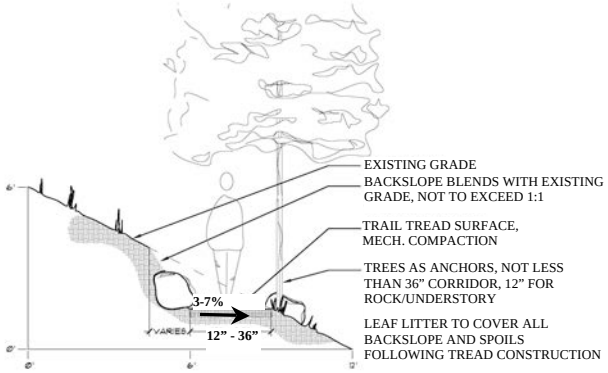
Typical Tread Width: 12” - 36”
Typical Corridor Width: 36”-48”
Tread Rugosity: Uneven, with regular rock and root protrusions above trail tread

Average Gradient: < 10%
Maximum Sustained Grade: 15%
Maximum Grade: 30%, with armored tread and/or steps
Typical Tread Materials: Mostly natural surface (native soils) with some rock armoring
Sideslope Steepness: Flat to 75%

Turn Radius: Tight turns with possible switchbacks
Trail/Structure Formality: Low formality, 36 minimum width
Wet Area Crossing Formality: Armored crossings at grade where possible, bridges less formal with low level engineering
Duty of Care: Low



3.1 N.T.S
PLAN DETAIL: BACKCOUNTRY TRAIL TYP.



3.2 N.T.S
SECTION DETAIL: BACKCOUNTRY TRAIL- TYP.

BRIDLE TRAILS

SUSTAINABILITY ASSESSMENT FINDINGS

TRAIL	PHYSICAL	SOCIAL	MANAGERIAL
Picnic Loop	Lack of outslope, backslope, and insufficient drainage require attention	Trail has a rather road-like feel and lack of developed stream access has resulted in eroding, socially created routes	Does not adhere to accessibility guidelines, but could be retrofit.
Waterfall Trail	Insloped trail tread and steep grade exacerbating erosion conditions.	A spectacular location very close to parking that appeals to many senses. However, trail is not well-designed for the intended users and the active erosion will worsen matters.	Lack of functional water management threatens the condition and enjoyment. Signage and interpretation could improve off-trail use.
Lower Cutoff Trail	Far steeper over most of its length than the maximum sustainable gradient the soil can handle. Trail does not look like it was constructed, but just widened from an existing social path on west side and old road on east side.	Provides great views of the waterfall and a nice length for a short walk. Lack of developed overlooks and trail user knowledge on where the trail goes has led to numerous, steep, eroding social routes back to the Waterfall Trail.	Needs intensive formalization. Lack of functional water management threatens the condition and enjoyment. Trail structures are failing in many locations. Formal steps are necessary on grades steeper than 15%. Signage and interpretation could improve off-trail use.
Upper Trails	Incredible feats of trailbuilding placed this trail in a very challenging and spectacular landscape. However, it is steeper than is sustainable without significant water management.	A premier, challenging hiking/ trail running experience. Steep grades, loose soil conditions, and extreme exposure limit utility to mountain bikes and horses. Connection to Mountain Road not recommended due to private property concerns, vehicle travel patterns, and lack of potential for wide, paved shoulder.	Lack of functional water management threatens the condition and enjoyment. Improved signage and interpretation could improve off-trail use. Destination amenities would improve experience

BRIDLE TRAILS

PROJECT PRIORITIZATION & COST OPINION

High Priorities

- Improved trail corridor closure and vegetation restoration at all private property crossings that are not part of the formal trail system. Estimated Cost: $500/location.
- Intensive maintenance on the Lower Cutoff and Upper Trails to bring trails to BC/MD (see Specifications) standard. Estimated Cost: $50,000/mile.
- Formalization and intensive maintenance on Waterfall Trail to bring trails to FC/BF standard. Estimated Cost: $100,000/mile.

Intermediate Priorities

- Picnic Loop water management and stream crossing formalization to bring to FC/BF standard. Estimated Cost: $50,000/mile.
- Redevelop eastern portion of Lower Cutoff Trail with park expansion to FC/NS standard. Estimated Cost: $35,000/mile.
- Develop overlook as a picnic and resting location. Estimated cost: $5,000

CRIMSON DAWN

SUSTAINABILITY ASSESSMENT FINDINGS

TRAIL	PHYSICAL	SOCIAL	MANAGERIAL
Cemetery/ Bonfire Loop	Fall line alignments on east and west ends eroding/entrenching. Position at top of hill on south end and old roadbed do not allow for proper drainage	Significant destinations and views of Muddy Mountain, but length and connectivity limit recreational use.	Lack of navigation signage, property upkeep and active trail maintenance/ management contribute to a run-down feel in the park.
Woodland Trail	Log curbs and trail width prevent optimal drainage	Shrines and outdoor theater are quite degraded and dated in presentation of interpretive information.	Lack of navigation signage, property upkeep and active trail maintenance/ management contribute to a run-down feel in the park.

PROJECT PRIORITIZATION & COST OPINION

Highest Priorities

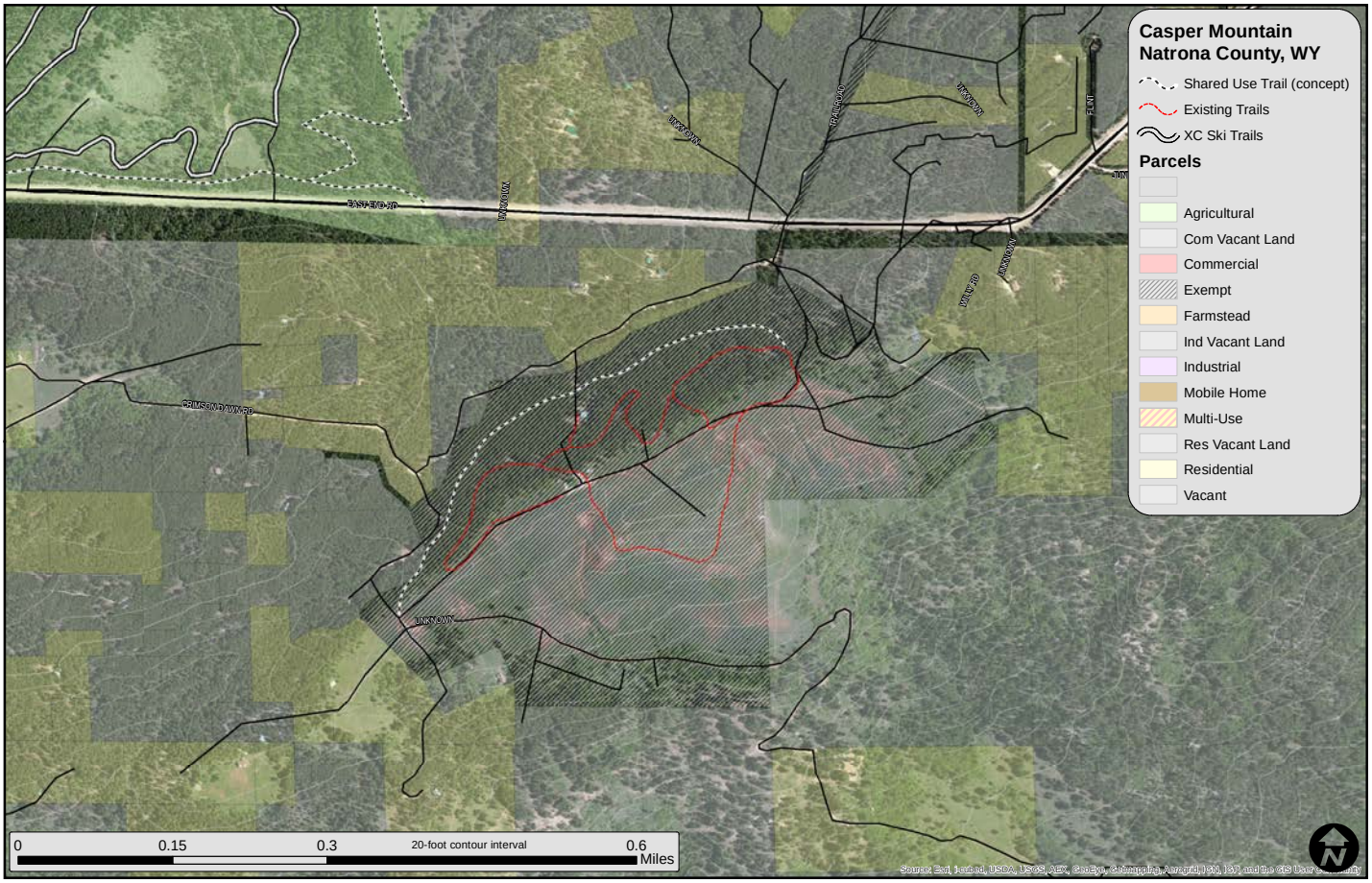
- Development of a park-encircling loop trail that ties into the Cemetery/Bonfire Loop relocation improvements and meets FC/NS specification. Estimated Cost: $25,000/mile

Intermediate Priorities

- Redevelop Woodland Trail to FC/BF specifications. Estimated Cost: $75,000/mile.
- Redevelop interpretive shrines to modern thematic and material standards. Estimated Cost: $1,000/site.

CRIMSON DAWN

CONCEPTUAL TRAIL SYSTEM



ARCHERY RANGE

SUSTAINABILITY ASSESSMENT FINDINGS

TRAIL	PHYSICAL	SOCIAL	MANAGERIAL
Target Loop	Acceptable trail alignments in most locations for this type of facility. Entrance to trail requires maintenance and management of parking lot stormwater flows.	Very well-developed course with variety in shooting angles and distances. Shaded and generally wind-blocked location improves shooting experience. Wildlife interpretation signs are degraded. Very narrow shooting corridors and vegetation behind targets create an advanced experience, even at shorter distance markers.	Target sites are well maintained, but safety signage, parking area and practice range could benefit from modernization. Kiosk tucked behind pavilion limits utility. Additional short course, created for beginners, could be added on the southern portion of the property and include skills development and hunting safety interpretation.
Animal Loop	Acceptable trail alignments in most locations for this type of facility. Trails generally need more definition than is provided by the small, ground-level green arrows.	A well-developed course with ample shooting variety. A more appropriate course for wildlife and ecological interpretation.	Target sites are well maintained, but safety signage, parking area and practice range could benefit from modernization. Kiosk tucked behind pavilion limits utility.

PROJECT PRIORITIZATION & COST OPINION

Highest Priorities

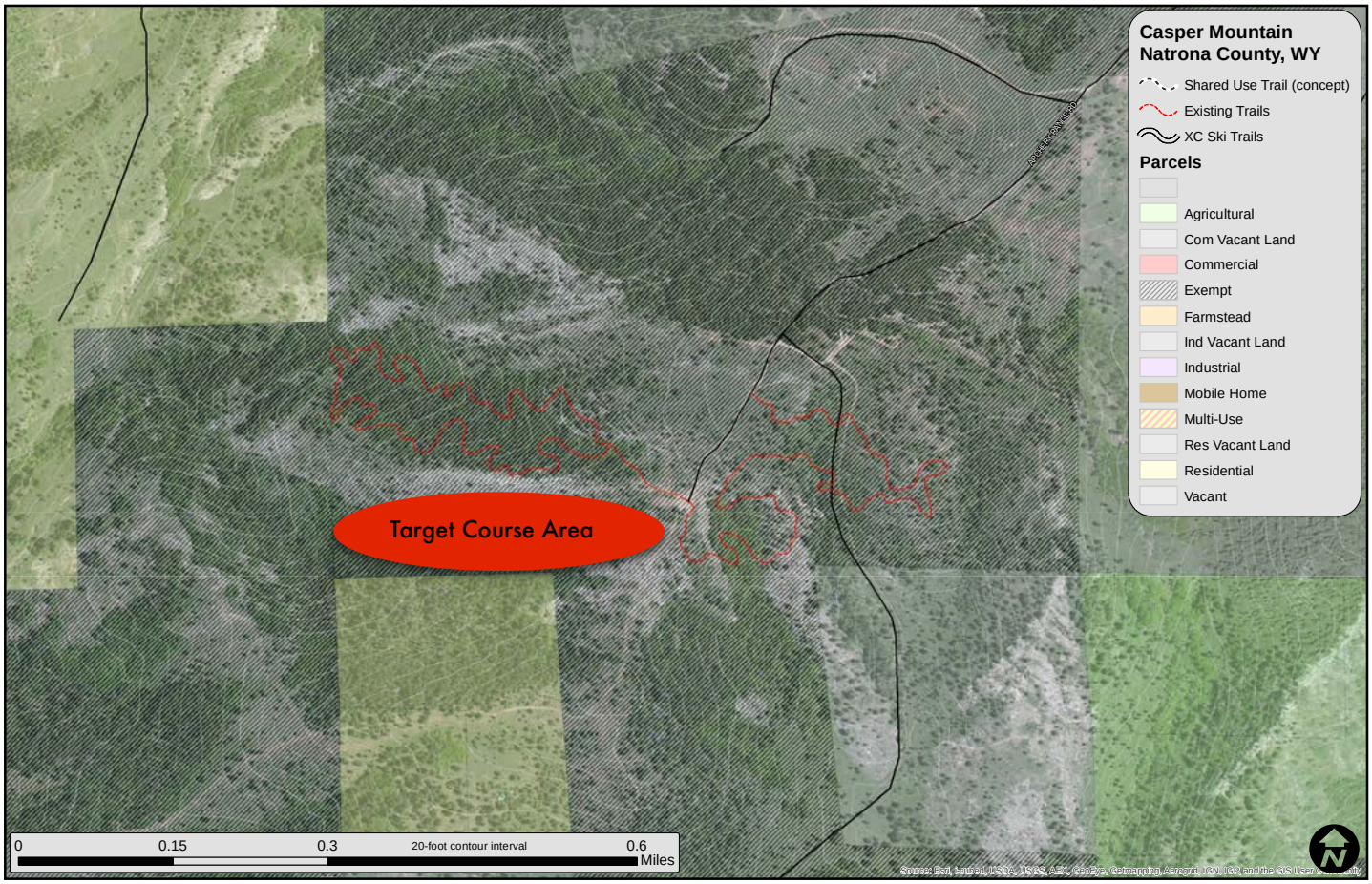
1. Improve safety signage, access to practice range to FC/BF specification, and entrance trail to FC/NS specification. Estimated Cost: $25,000

Intermediate Priorities

2. Develop beginner's short course and skills/safety interpretive information on southern portion of property with shorter target distances, wider shooting corridors, and some vegetation clearing behind targets. Estimated Cost: TBD

ARCHERY RANGE

CONCEPTUAL RECREATION IMPROVEMENT- ADDITIONAL TARGET COURSE



BRAILLE TRAIL

SUSTAINABILITY ASSESSMENT FINDINGS

TRAIL	PHYSICAL	SOCIAL	MANAGERIAL
Braille Trail	Well-developed trail, but lack of drainage management causing erosion that is reducing the trail's accessibility. Does not meet modern accessibility guidelines.	Lots of large signs, but lost opportunity in developing basic trailhead kiosk information. Brochures "hidden" in box at terminus of trail. Social shortcutting beginning to occur.	When trail is closed, access should be denied at existing gate and/or bridges at beginning and end of trail. Some posts loosening and ropes hung where trip hazards are within the active trail tread.

PROJECT PRIORITIZATION & COST OPINION

Highest Priorities

- Implement improvements to accessibility related to trail tread width, rock and root protrusions, and tripping hazards within the roped corridor. Estimated cost: $5,000

Intermediate Priorities

- Redevelop trailhead kiosk and Strube Road parking area. Estimated cost: $10,000
- Implement accessibility improvements related to trail gradient, boardwalk, and resulting changes to interpretive panels. Estimated cost: $20,000

CASPER MOUNTAIN TRAILS

SUSTAINABILITY ASSESSMENT FINDINGS

TRAIL	PHYSICAL	SOCIAL	MANAGERIAL
Nordic Trails	Some windblown locations that have difficulty holding snow. Dense network may require significant changes for homolugation.	Snowshoe and snow bike use reduces grooming quality and experiential quality for these uses is relatively low. Alteration of difficulty mid-trail can reduce trail system utility to less experienced skiers.	System not optimized for grooming management, which then cascades to reduce availability of County staff for other required duties.
Singletrack Trails	Many small trail sections too steep and beginning to erode, corridors are often too narrow for bidirectional use, and wooden features have low construction quality.	System is difficult to navigate and new routes are being developed. Utilizing nordic trails for summer use decreases experiential quality	Trail development is not being driven or managed by Natrona County, maps are not present at the trailheads, and trails are not connected well to campgrounds, limiting ease of access to recreation.

PROJECT PRIORITIZATION & COST OPINION

Highest Priorities

- Design and construction of campground/CMTC four-season, shared-use trail system to FC/NS specification to begin to move snowshoe and snow bike use off nordic trails while redeveloping recreation access from campground areas. Estimated cost: $25,000/mile
- Develop an optimized nordic grooming arrangement that provides sustainable funding stream and/or more efficient grooming schedule. Estimated cost: Not Applicable

Intermediate Priorities

- Design and construction of four-season, shared-use trail system to BC/NS specification. In order to keep trail intersections to a minimum for experiential and navigation needs, design should be in concert with nordic homolugation/biathlon planning and design process. Estimated cost; $20,000/mile

CASPER MOUNTAIN TRAILS

CONCEPTUAL TRAIL SYSTEM

Trail System Components:

- Two major existing parking area/trailheads- CMTC and Beartrap Meadows
- Secondary trailheads with trailhead kiosk only (no additional parking) to be developed at campground interface locations
- Minimized intersections with the existing Nordic trail network
- Frontcountry trail system of approximately 5 miles that provides short loops with multiple route options and trail access from CMTC and all area campgrounds. Potential for expansion if area landowners are amenable.
- Backcountry trail system of approximately 7 miles made of larger loops with multiple route options, with access to the planned biathlon center. Potential for expansion if area landowners are amenable.
- Recommendation for new trails to be managed as mountain bike-optimized, shared-use in Summer and snowshoe/snow bike/dog walking trails in the Winter

PONDEROSA TRAILS

SUSTAINABILITY ASSESSMENT FINDINGS

TRAIL	PHYSICAL	SOCIAL	MANAGERIAL
Winter Season Trails	Large property with significant meadow is very conducive to high-quality snowmobile experience.	Nearby private property concerns are significant, especially with use as loud as open terrain snowmobile activity.	Significant infrastructure repair to the county road, park entrance road loop, warming hut, and restroom facilities are necessary prior to public use. At this point, risk management concerns need to keep the property closed.
Summer Season Trails	A great location for a backcountry singletrack trail system that skirts the edges of steep topography, through the aspens, and adjacent to rock outcrops	Soils are not suitable- far too sandy and erodible- for summer motorized use.	A great location for the mountain bike community to "scratch" in an extensive trail system and scout a few backcountry camping locations with views toward Muddy Mountain.

PROJECT PRIORITIZATION & COST OPINION

Highest Priorities

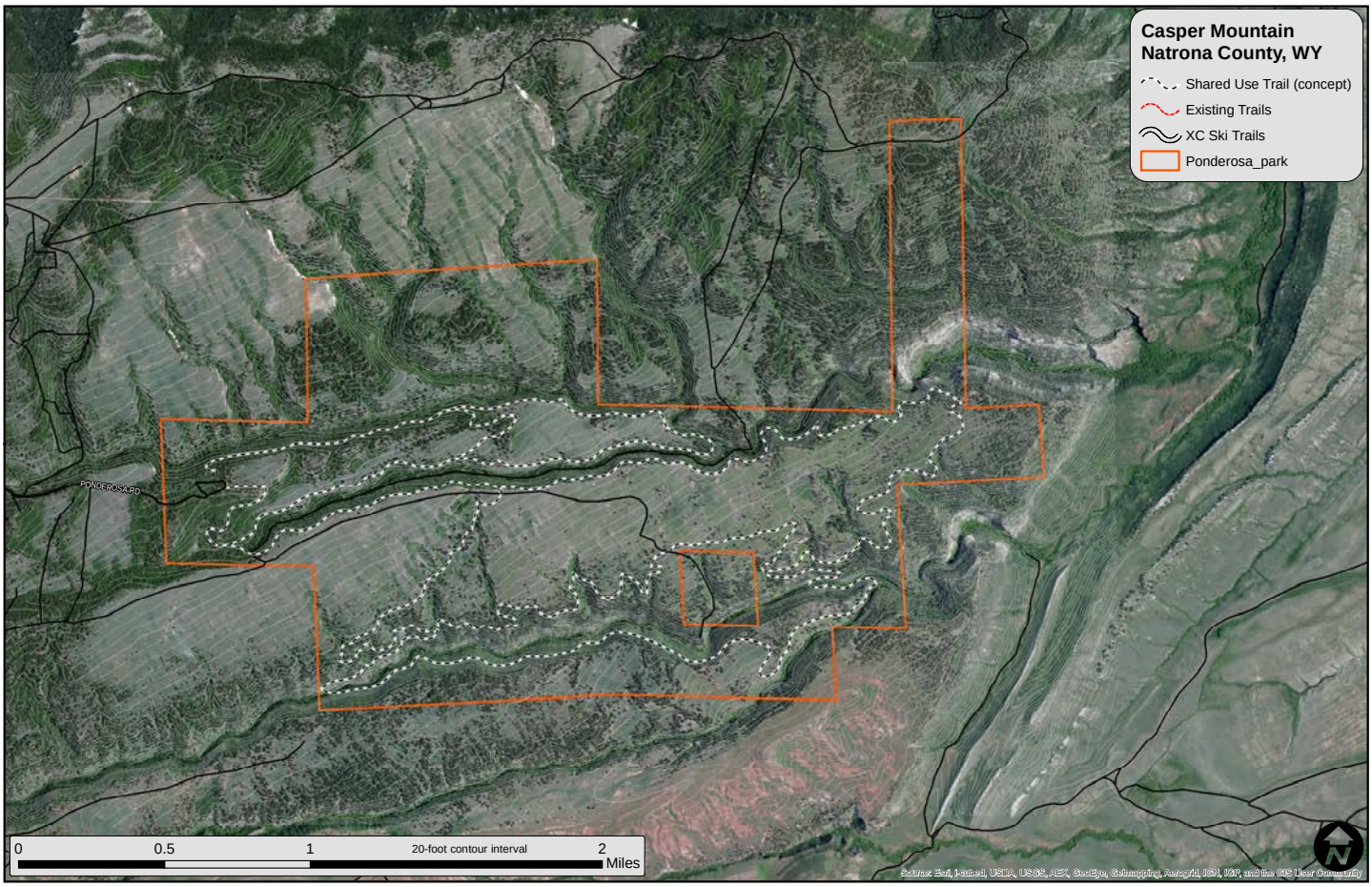
- Rebuild County Road to park and park entrance road. Estimated cost: covered by KLJ plan
- Mitigate facility hazards. Estimated cost: covered by KLJ plan

Intermediate Priorities

- Following infrastructure improvements, work with local volunteers to establish an extensive BCM trail system with alternate BCD challenge areas on the rock outcrops and sign backcountry camping areas Estimated cost; $5,000/mile, mainly for challenging construction on steeper terrain that should be accomplished by a trail contractor.

PONDEROSA TRAILS

CONCEPTUAL TRAIL SYSTEM



Trail System Components:

- Parking area/trailhead at existing road/loop location
- Backcountry trail system of approximately 17 miles of narrow singletrack (12-24”) made of 4 loops with multiple route options
- Recommendation for new trails to be managed as mountain bike-optimized, shared-use in Summer and snowshoe/snow bike/backcountry ski trails in the Winter
- Potential for improved surface road or OHV trail connectivity to Muddy Mountain

CONNECTIVITY

The team undertook a preliminary connectivity assessment between public landowners, utilizing existing maps and GIS information, and where legal, by vehicle. Casper Mountain could provide vast connectivity to City of Casper lands in the north and BLM lands primarily in the south and west. Such an interconnected trail system, very much like the existing signed snowmobile routes, would provide a stunning array of recreational opportunities. However, the public-private land matrix on Casper Mountain combined with long-term disputes over trespassing make that vision a daunting task. As trail system sustainability and management improves on County lands, realizing such a vision may become easier.

At this juncture, connectivity between most public lands with natural surface trail systems (Hogadon, CMTC, and BLM-Muddy Mountain) is best accomplished utilizing the existing public roads. Without appropriate public road access, the Bridle Trails do not currently provide similar connectivity possibilities. It would be prudent to sign these roads as recreational cycling routes and provide some “share the road” or similar signage to alert motorists of the potential for recreational use. Dependent upon road easement width and layout, landscape grades, and drainage, there may be potential along these routes for an off-road trail that parallels the road. This would have to be moderately engineered and somewhat costly related to other natural surface trails in this plan.

There are numerous examples of very successful, public, shared-use trail systems that are situated largely on private property. The vast majority of Park City, Utah’s 500-mile trail system is located on private land. Stowe Vermont has only approximately 10 miles of its 200-mile trail system on public land. Knoxville, Tennessee, led by the non-profit Legacy Parks Foundation, and Louisville, Kentucky, led by the non-profit 21st Century Parks, have recently begun privately developed parks and trail systems where the public agencies have not had the wherewithal or political support to purchase additional land, develop facilities and increased public recreation access.

For private landowners who support additional recreational trail development on the mountain, the possibility exists to develop recreation easements for trails. Generally, maintenance of such routes is then the responsibility of the easement holder. This may be an attractive option for some private institutional landowners, such as churches, camps, etc. that would benefit from improved facilities for their visitors, connectivity without vehicle use to improved public trail systems. Similarly, where a private landowner may be interested in putting a portion of their land into long-term conservation for tax or personal reasons, the opportunity exists to work with that owner to craft the easement in a manner that allows natural surface recreational trail development.

In the end, the creation of high-quality trail systems that attract recreational use to the public lands on Casper Mountain provides the best opportunity to begin to alter public perceptions, improve the prospects for trail system growth and interconnectivity, and the development of a world-class recreational area.

APPENDICES

APPENDIX A

TRAIL IMPACTS: LITERATURE REVIEW

APPENDICES

Introduction
Much research has been conducted to analyze recreational impacts to public lands; some of this research has focused on understanding impacts of different types of recreational use on trails, trail systems and the natural settings in which trails exist.

Trails are generally regarded as essential facilities in parks and forests. They provide access to remote areas, accommodate a diverse array of recreational activities, and protect resources by concentrating visitor trampling on narrow and resistant tread surfaces. Formal or designated trails are generally designed and constructed, which involves vegetation removal and soil excavation. These changes may be considered "unavoidable," in contrast to "avoidable" post-construction degradation from their subsequent use (e.g., trail widening, erosion, muddiness), or from the development and degradation of informal visitor-created trails.

Common environmental impacts associated with recreational use of trails include:

- Vegetation loss and compositional changes
- Soil compaction
- Erosion
- Muddiness
- Degraded water quality
- Disruption of wildlife

This review is organized into four broad categories: impacts to vegetation, soil, water, and wildlife.

Impacts to Vegetation: General Research
On formal trails, most vegetation is typically removed by construction, maintenance, and visitor use. This impact is necessary and "unavoidable" in order to provide a clear route for trail users. One goal of trail construction and maintenance is to provide a trail only wide enough to accommodate the intended use. Trails made wider than this through visitor use or erosion represent a form of "avoidable" impact. For example, a doubling of trail width represents a doubling of the area of intensive trampling disturbance. Wider trails also expose substantially greater amounts of soil to erosion by wind or water.

The creation and maintenance of trail corridors also removes shrubs and trees, allowing greater sunlight exposure that favors a different set of groundcover plants within trail corridors. Occasional trailside trampling within trail corridors also favors the replacement of fragile plants with those more resistant to trampling traffic. For example, shade-tolerant but fragile broadleaved herbs are frequently replaced by grasses and sedges that are trampling-resistant and require more sunlight to survive. Trail construction, use, and maintenance can also be harmful when trails divide sensitive or rare plant communities.

APPENDICES

Trampling - the action of crushing or treading upon vegetation, either by foot, hoof, or tire - contributes to a wide range of vegetation impacts, including damage to plant leaves, stems, and roots, reduction in vegetation height, change in the composition of species, and loss of plants and vegetative cover (Leung & Marion, 1996; Thurston & Reader, 2001). Trampling associated with "avoidable" off-trail traffic can quickly break down vegetation cover and create a visible route that attracts additional use. Complete loss of vegetation cover occurs quickly in shady forested areas, less quickly in open areas with resistant grassy vegetation. Regardless, studies have consistently revealed that most impact occurs with initial or low use, with a diminishing increase in impact associated with increasing levels of traffic (Hammit & Cole, 1998; Leung & Marion, 1996). Furthermore, once trampling occurs, vegetative recovery is a very slow process.

Compositional changes in the vegetation along trail corridors* can have both beneficial and adverse effects. Trampling-resistant plants provide a durable groundcover that reduces soil loss by wind and water runoff, and root systems that stabilize soils against displacement by heavy traffic. The ecological impacts of such compositional changes are not fully known, except when non-native vegetation is introduced to and spreads along trail corridors. Many of these species are disturbance-associated and are naturally limited to areas where the vegetation is routinely trampled or cut back. However, a few non-native species, once introduced to trail corridors, are able to out-compete native plants and spread away from the trail corridor in undisturbed habitats. Some of these species form dense cover that crowd out or displace native plants. These "invasive" species are particularly undesirable and land managers actively seek to prevent their introduction and spread. Unfortunately their removal is difficult and expensive.

*See Wells and Lauenroth 2007 for a case study examining horse and pack stock as dispersal mechanism for plants along recreational trails.

Impacts to Vegetation: Management Implications

Trail managers can either avoid or minimize impacts to vegetation through careful trail design, construction, maintenance, and management of visitor use. Here are some recommendations to reduce vegetation impacts:

Design trails that provide the experience that trail users seek to reduce their desire to venture off-trail.

Locate trails away from rare plants and animals and from sensitive or critical habitats of other species. Involve resource professionals in designing and approving new trail alignments.

Keep trails narrow to reduce the total area of intensive tread disturbance, slow trail users, and minimize vegetation and soil impacts.

Limit vegetation disturbance outside the corridor when constructing trails. Hand construction is least disruptive; mechanized construction with small equipment is less disruptive than full-sized equipment; skilled operators do less damage than those with limited experience.

Locate trails on side-hills where possible. Constructing a side-hill trail requires greater initial vegetation and soil disturbance but sloping topography above and below the trail bench will clearly define the tread and

concentrate traffic on it. Trails in flatter terrain or along the fall line may involve less initial disturbance but allow excessive future tread widening and off-tread trampling, which favor non-native plants.
Construct and formalize meet-up and “tie-up” areas in a fashion that contains and concentrates visitor use to durable surfaces
Use construction techniques that save and redistribute topsoil and excavated plants.

There are also important considerations for maintaining and managing trails to avoid unnecessary ongoing impacts to vegetation:

While it is necessary to keep the trail corridor free of obstructing vegetation, such work should seek to avoid "day-lighting" the trail corridor when possible. Excessive opening of the overstory allows greater sunlight penetration that permits greater vegetation compositional change and colonization by non-native plants.
An active maintenance program that removes tree falls and maintains a stable and predictable tread also encourages visitors to remain on the intended narrow tread. A variety of maintenance actions can discourage trail widening, such as only cutting a narrow section out of trees that fall across the trail, limiting the width of vegetation trimming, and defining trail borders with logs, rocks, or other objects that won't impede drainage.
Use education to discourage off-trail travel, which can quickly lead to the establishment of informal visitor-created trails that unnecessarily remove vegetation cover and spread non-native plants. Such routes often degrade rapidly and are abandoned in favor of adjacent new routes, which unnecessarily magnify the extent and severity of trampling damage.
Educate visitors to be aware of their ability to carry non-native plant seeds on their bikes or clothing, and encourage them to remove seeds by washing mud from bikes, tires, shoes, and clothing. Preventing the introduction of non-natives is key, as their subsequent removal is difficult and costly.
Educate visitors about low impact riding practices, such as those contained in the IMBA-approved Leave No Trace Skills & Ethics: Mountain Biking booklet (www.LNT.org).

For further reading see: Pickering et al 2010, Cessford 1995; Gruttz and Hollingshead 1995; Thurston and Reader 200l.

Impacts to Soils: General Research
The creation and use of trails also results in soil disturbance. Some loss of soil may be considered an acceptable and unavoidable form of impact on trails. As with vegetation loss, much soil disturbance occurs in the initial construction and use of the trail. During trail construction, surface organic materials (e.g., twigs, leaves, and needles) and organic soils are removed from treads; trails built on sidehill locations require even more extensive excavation. In addition, the underlying mineral soils are compacted during construction and initial use to form a durable tread substrate that supports trail traffic.

APPENDICES

In contrast, post-construction soil displacement, erosion, and muddiness represent core forms of avoidable trail impact that require sustained management attention to avoid long-lasting resource degradation. This degradation can reduce the utility of trails as recreation facilities and diminish the quality of visitor experiences. For example, soil erosion exposes rocks and plant roots, creating a rutted and uneven tread surface. Erosion can also be self-perpetuating when treads erode below the surrounding soil level, hindering efforts to divert water from the trail and causing accelerated erosion and muddiness. Similarly, excessive muddiness renders trails less usable and aggravates tread widening and associated vegetation loss as visitors seek to circumvent mud holes and wet soils (Marion, 2006).

Research has shown that visitors notice obvious forms of trail impact, such as excessive muddiness and eroded ruts and tree roots, and that such impacts can degrade the quality of visitor experiences (Roggenbuck and others., 1993; Vaske and others., 1993). Such conditions also increase the difficulty of travel and may threaten visitor safety. Remedying these soil impacts can also require substantial rehabilitation costs. Clearly, one primary trail management objective should be the prevention of excessive soil impacts.

The Four Common Forms of Soil Degradation on Trails:

- Compaction
- Muddiness
- Displacement
- Erosion

Compaction

Soil compaction is caused by the weight of trail users and their equipment, which passes through feet, hooves, or tires to the tread surface. Compacted soils are denser and less permeable to water, which increases water runoff. However, compacted soils also resist erosion and soil displacement and provide durable treads that support traffic. From this perspective, soil compaction is considered beneficial, and it is an unavoidable form of trail impact. Furthermore, a primary resource protection goal is to limit trailside impacts by concentrating traffic on a narrow tread. Success in achieving this objective will necessarily result in higher levels of soil compaction.

The process of compacting the soil can present a difficult challenge, especially on new trails. Unless soils are mechanically compacted during tread construction, initial use compacts the portions of the tread that receive the greatest traffic, generally the center. The associated lowering of the tread surface creates a cupped cross-section that intercepts and collects surface water. In flat terrain this water can pool or form muddy sections; in sloping terrain the water is channeled down the trail, gaining in volume, speed, and erosive potential.

Displacement

Trail users can also push soil laterally, causing displacement and development of ruts, berms, or cupped treads. Soil displacement is particularly evident when soils are damp or loose and when users are moving at

higher rates of speed, turning, braking, or other movements that create more lateral force. Soil can also be caught in hooves, footwear, or tire treads, flicked to the side or carried some distance and dropped. Regardless of the mechanism, soil is generally displaced from the tread center to the sides, elevating inslopes or berms, and compounding drainage problems.

Muddiness
When trails are located in areas of poor drainage or across highly organic soils that hold moisture, tread muddiness can become a persistent problem. Muddiness is most commonly associated with locations where water flows across or becomes trapped within flat or low-lying areas. Soil compaction, displacement, and erosion can exacerbate or create problems with muddiness by causing cupped treads that collect water during rainfall or snowmelt. Thus, muddiness can occur even along trails where there is sufficient natural drainage. Subsequent traffic skirts these problem spots, compacting soils along the edges, widening mud holes and tread width, and sometimes creating braided trails that circumvent muddy sections.

Erosion
Soil erosion is an indirect and largely avoidable impact of trails and trail use. Soil can be eroded by wind, but generally, erosion is caused by flowing water. To avoid erosion, sustainable trails are generally constructed with a slightly crowned (flat terrain) or outsloped (sloping terrain) tread. However, subsequent use compacts and/or displaces soils over time to create a cupped or insloped tread surface that intercepts and carries water. The concentrated run-off picks up and carries soil particles downhill, eroding the tread surface.

Loose, uncompacted soil particles are most prone to soil erosion, so trail uses that loosen or detach soils contribute to higher erosion rates. Erosion potential is closely related to trail grade because water becomes substantially more erosive with increasing slope. The size of the watershed draining to a section of trail is also influential - larger volumes of water are substantially more erosive.

Water and the sediment it carries will continue down the trail until a natural or constructed feature diverts it off the tread. Such features include a natural or constructed reversal in grade, an outsloped tread, rocks or tree roots, or a constructed drainage dip or water bar. Once the water slows, it drops its sediment load, filling in tread drainage features and causing them to fail if not periodically maintained. Sediment can also be carried directly into watercourses, creating secondary impacts to aquatic systems. Properly designed drainage features are designed to divert water from the trail at a speed sufficient to carry the sediment load well below the tread, where vegetation and organic litter can filter out sediments. A well-designed trail should have little to no cumulative soil loss, for example, less than an average of one-quarter inch (6.3 mm) per year.

Impacts to Soils
Many studies have evaluated the soil impacts of different types of recreational uses. The general consensus of this research has shown that motorized and equestrian use are significantly more impacting to soils than human powered recreation (hiking, trail running, cycling). The trail system at Cave Run Lake is showing

APPENDICES

significant signs of degraded soils as a result of heavy use, poor design and a general lack of appropriate maintenance.

Several key studies comparing the impacts to soils by user-type are reviewed below:
Wilson and Seney (1994) evaluated tread erosion from horses, hikers, mountain bikes, and motorcycles on two trails in the Gallatin National Forest, Montana. They applied one hundred passes of each use-type on four sets of 12 trail segments, followed by simulated rainfalls and collection of water runoff to assess sediment yield at the base of each segment. Control sites that received no passes were also assessed for comparison. Results indicated that horses made significantly more sediment available for erosion than the other uses, which did not significantly vary from the control sites. Traffic on pre-wetted soils generated significantly greater amounts of soil runoff than on dry soils for all uses.

Marion (2006) studied 78 miles (125 km) of trail (47 segments) in the Big South Fork National River and Recreation Area, Tennessee and Kentucky, measuring soil loss along transects across the trail to evaluate the influence of use-related, environmental, and management factors.

Sidehill-aligned trails were significantly less eroded than trails in valley bottom positions, in part due to the influence of periodic floods. Trail grade and trail alignment angle were also significant predictors of tread erosion. Erosion rates on trails with 0-6 percent and 7-15 percent grades were similar, while erosion on trails with grades greater than 16 percent were significantly higher. And there was significantly greater erosion on fall line trails (alignment angles of 0-22 degrees) than those with alignments closer to the contour.

This study also provided an opportunity to examine the relative contribution of different use types, including horse, hiking, mountain biking, and ATV. Trails predominantly used for mountain biking had the least erosion of the use types investigated. Trails receiving equestrian use had significantly less erosion when rock content was high and grades were minimized.

Cessford (1995) provides a comprehensive, though dated, summary of trail impacts with a focus on mountain biking. Of particular interest is his summary of the two types of forces exerted by bike tires on soil surfaces: The downward compaction force from the weight of the rider and bike, and the rotational shearing force from the turning rear wheel. Mountain bikers generate the greatest torque, with potential tread abrasion due to slippage, during uphill travel. However, the torque possible from muscle power is far less than that from a motorcycle, so wheel slippage and abrasion occur only on wet or loose surfaces. Tread impact associated with downhill travel is generally minimal due to the lack of torque and lower ground pressures. Exceptions include when riders brake hard enough to cause skidding, which displaces soil downslope, or bank at higher speeds around turns, which displaces soil to the outside of the turn. Impacts in flatter terrain are also generally minimal, except when soils are wet or uncompacted and rutting occurs.

APPENDICES

Impacts to Soils: Management Implications
Soil loss is among the most enduring forms of trail impact, and minimizing erosion and muddiness are the most important objectives for achieving a sustainable trail. Soil cannot easily be replaced on trails, and where soil disappears, it leaves ruts that make travel and water drainage more difficult, prompting further impacts, such as trail widening.

Existing studies indicate that motorized and equestrian use have far greater impacts to soils than human powered recreation. Other factors, particularly trail grade, trail/slope alignment angle, soil type/wetness, and trail maintenance, are more influential determinants of tread erosion or wetness.

There are a number of tactics for avoiding the worst soil-related impacts to trails:

- Discourage or prohibit off-trail travel. Informal trails created by off-trail travel frequently have steep grades and fall-line alignments that quickly erode, particularly in the absence of tread maintenance. Exceptions include areas of solid rock or non-vegetated cobble.
- Design trails with sustainable grades and avoid fall-line alignments. Where equestrian or motorized use is allowed, minimize trail grades and import rock material to form a durable substrate should the native soils not have substaintial rock content.
- When possible, build trails in dry, cohesive soils that easily compact and contain a larger percentage of coarse material or rocks. These soils better resist erosion by wind and water or displacement by feet, hooves and tires.
- Minimize tread muddiness by avoiding flat terrain, wet soils, and drainage-bottom locations.
- Use grade reversals to remove water from trail treads. Grade reversals are permanent and sustainable - when designed into a trail's alignment they remain 100 percent effective and rarely require maintenance.

Other strategies are more temporary in nature and will require periodic maintenance to keep them effective:

- While the use of a substantial outslope (e.g., 5 percent) helps remove water from treads, it is rarely a long-term solution. Tread cupping and berm development will generally occur within a few years after tread construction. If it is not possible to install additional grade reversals, reshape the tread to reestablish an outsloped tread surface periodically, and install wheel-friendly drainage dips or other drainage structures to help water flow off the trail.
- If it is not possible to install proper drainage on a trail, consider rerouting trail sections that are most problematic, or possibly hardening the tread with the addition of local or imported material (rocks).
- In flatter areas, elevate and crown treads to prevent muddiness, or add a gravel/soil mixture in low spots.
- Finally, it is important to realize that visitor use of any type on trails when soils are wet contributes substantially greater soil impact than the same activities when soils are dry. Thus, discouraging or

prohibiting the use of trails that are prone to muddiness during rainy seasons or snowmelt is another effective measure. Generally such use can be redirected to trails that have design or environmental attributes that allow them to better sustain wet season uses.

For further reading see: Pickering et al 2010, Cessford 1995, Thurston and Reader 2001, Newsome et al 2004.

Impacts to Water Resources: General Research

Trails and their use can also affect water quality. Trail-related impacts to water resources can include the introduction of soils, nutrients, and pathogenic organisms (e.g., Giardia), and alter the patterns of surface water drainage. However, in practice, these impacts are avoidable, and properly designed and maintained trails should not degrade water quality. Unfortunately there is very little research to draw from on these topics, and none that is specific to different modes of trail use.

Poorly sited and/or maintained trails can be eroded by water, with tread sediments carried off by runoff. Generally, if water control features such as grade reversals and outsloped treads are used to divert runoff from trails, the water drops its sediment close to trails, where it is trapped and held by organic litter and vegetation. Soils eroded from trails rarely enter water bodies, unless trails cross streams or run close to stream or lake shorelines and lack adequate tread drainage features. Since many recreational activities, such as fishing, swimming, boating, and viewing scenery (e.g., waterfalls) draw visitors and trails to the vicinity of water resources, it is often necessary to route trails to water resources or visitors will simply create their own informal trails.

Trails that are close to water resources require special consideration in their design and management to prevent the introduction of suspended sediments into bodies of water. Eroded soil that enters water bodies increase water turbidity and cause sedimentation that can affect aquatic organisms (Fritz and others 1993). Trout and other fish lay their eggs in gravels on the bottom of streams and lakes, and sediments can smother those eggs, reducing reproductive success. Sedimentation can also hurt invertebrate organisms, which serve as food for fish and other creatures. In addition, some sediment may contain nutrients that can contribute to algal blooms that deplete the dissolved oxygen in water bodies when they die off.

Poorly designed trails can also alter hydrologic functions - for instance, trails can intercept and divert water from seeps or springs, which serve important ecological functions. In those situations, water can flow along the tread, leading to muddiness or erosion and, in the case of cupped and eroded treads, the water may flow some distance before it is diverted off the trail, changing the ecology of small wetland or riparian areas.

Trail users may also pollute water with pathogenic organisms, particularly those related to improperly disposed human waste. Potential pathogenic organisms found through surveys of backcountry water sources include Cryptosporidium spp., Giardia spp., and Campylobacter jejuni (LeChevallier and others, 1999; Suk and others, 1987; Taylor and others, 1983). This is rarely a significant concern where trail use is

predominantly day-oriented, and waste issues can be avoided by installing toilet facilities or following Leave No Trace practices (i.e., digging cat-holes for waste away from water resources).

Impacts to Water Resources: Management Implications
The same trail design, construction, and maintenance measures that help minimize vegetation and soil impacts also apply to water. But there are also some additional efforts needed to protect water resources:

- Trails should avoid close proximity to water resources. For example, it is better to build a trail on a sidehill along a lower valley wall than to align it through flat terrain along a stream edge, where trail runoff will drain directly into the stream.
- It is best to minimize the number of stream crossings. Where crossings are necessary, scout the stream carefully to select the most resistant location for the crossing. Look for rocky banks and soils that provide durable surfaces.
- Design water crossings so the trail descends into and climbs out of the steam crossing, preventing stream water from flowing down the trail.
- Armor trails at stream crossings with rock, gravel or concrete to prevent erosion.
- Include grade reversals, regularly maintained outsloped treads, and/or drainage features to divert water off the trail near stream crossings. This prevents water and sediment from flowing down the trail into the stream, and allows trailside organic litter, vegetation, and soils to slow and filter water.
- On some heavily used trails, a bridge may be needed to provide a sustainable crossing.
- Where permanent or intermittent stream channels cross trails, use armoring, open rock culverts or properly sized buried drainage culverts to allow water to cross properly, without flowing down the trail.

Impacts to Wildlife: General Research
Trails and trail users can also affect wildlife. Trails may degrade or fragment wildlife habitat, and can also alter the activities of nearby animals, causing avoidance behavior in some and food-related attraction behavior in others (Hellmund, 1998; Knight & Cole, 1991). While most forms of trail impact are limited to a narrow trail corridor, disturbance of wildlife can extend considerably further into natural landscapes (Kasworm & Monley, 1990; Tyser & Worley, 1992). Even very localized disturbance can harm rare or endangered species.

Different animals respond differently to the presence of trail users. Most wildlife species readily adapt or become "habituated" to consistent and non-threatening recreational activities. For example, animals may notice but not move away from humans on a frequently used trail. This is fortunate, as it can allow high quality wildlife viewing experiences for visitors and cause little or no impact to wildlife.

APPENDICES

Other forms of habituation, however, are less desirable. Visitors who feed wildlife, intentionally or from dropped food, can contribute to the development of food-related attraction behavior that can turn wild animals and birds into beggars. In places where visitors stop to eat snacks or lunches, wildlife quickly learn to associate people with food, losing their innate fear of humans and returning frequently to beg, search for food scraps, or even raid unprotected packs containing food. Feeding wild creatures also endangers their health and well-being. For instance, after food-attracted deer in Grand Canyon National Park became sickly and dangerously aggressive, researchers found up to six pounds of plastic and foil wrappers obstructing intestinal passages of some individuals.

The opposite conduct in wildlife - avoidance behavior - can be equally problematic. Avoidance behavior is generally an innate response that is magnified by visitor behaviors perceived as threatening, such as loud sounds, off-trail travel, travel in the direction of wildlife, and sudden movements. When animals flee from disturbance by trail users, they often expend precious energy, which is particularly dangerous for them in winter months when food is scarce. When animals move away from a disturbance, they leave preferred or prime habitat and move, either permanently or temporarily, to secondary habitat that may not meet their needs for food, water, or cover. Visitors and land managers, however, are often unaware of such impacts, because animals often flee before humans are aware of the presence of wildlife.

Two studies of possible interest are summarized below:
A study of the Boise River in Idaho examined flushing distances of bald eagles when exposed to actual and simulated walkers, joggers, fishermen, bicyclists, and vehicles (Spahr 1990). The highest frequency of eagle flushing was associated with walkers (46 percent), followed by fishermen (34 percent), bicyclists (15 percent), joggers (13 percent), and vehicles (6 percent). However, bicyclists caused eagles to flush at the greatest distances (mean = 148 meters), followed by vehicles (107m), walkers (87m), fishermen (64m), and joggers (50m). Eagles were most likely to flush when recreationists approached slowly or stopped to observe them, and were less alarmed when bicyclists or vehicles passed quickly at constant speeds. Similar findings have been reported by other authors, who attribute the difference in flushing frequency between walkers and bikers/vehicles either to the shorter time of disturbance and/or the additional time an eagle has to "decide" to fly (Van der Zande and others. 1984).

Impacts to Wildlife: Management Implications
Many potential impacts to wildlife can be avoided by ensuring that trails avoid the most sensitive or critical wildlife habitats, including those of rare and non-rare species. There are a number of tactics for doing this:
Route trails to avoid riparian or wetland areas, particularly in environments where they are uncommon.
Consult with fish and wildlife specialists early in the trail planning phase.
For existing trails, consider discouraging or restricting access during sensitive times/seasons (e.g., mating or birthing seasons) to protect wildlife from undue stress.

APPENDICES

The education of trail users is also an important and potentially highly effective management option for protecting wildlife. Organizations should encourage Leave No Trace practices and teach appropriate behaviors in areas where wildlife are found:

- Store food safely and leave no crumbs behind - fed animals too often become dead animals.
- It's OK for wildlife to notice you but you are "too close" or "too loud" if an animal stops what it's doing and/or moves away from you.
- It's best to view wildlife through binoculars, spotting scopes, and telephoto lenses.
- All wildlife can be dangerous - be aware of the possible presence of animals and keep your distance to ensure your safety and theirs.

Conclusion

Scientific studies have examined the impacts of recreational use on trails and public lands. These studies provide an objective lens to view and understand how to better manage recreational use while minimizing impacts to natural resources and other users. The body of research has shown that motorized and equestrian use have significantly greater impacts to the natural resources than human powered trail uses. Studies present data that suggest ways to minimize impacts associated with trails, through proper design and construction (shallower grades, frequent grade reversals or water control features, more durable substrates with higher rock content).

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APPENDICES

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APPENDICES

APPENDIX B

SIGNAGE, WAYFINDING, AND MAPPING RECOMMENDATIONS

APPENDICES

A well-developed signage system is vital management tool in the 21st century land management context. Especially with large, diverse trail systems such as the Casper Mountain, a human management presence such as park rangers and law enforcement officers will be dispersed. Consistent, clear, well-placed signs often must take the place of humans in providing 1) information and directional assistance, 2) regulations and hazard warnings, and 3) educational and interpretive information.

Informational And Directional Signs

Roadside Signs

A positive experience on a trail begins by easily finding the desired location, be it a developed trailhead, boat launch, or brick and mortar facility. This gross level navigation requires roadside signage prior to the developed facility. With a suite of facilities as broad and diverse as those present on the Casper Mountain, a universal symbol should be combined with short verbiage and mileage to provide information that can be recognized and comprehended at driving speeds. These clear, roadside signs help encourage trail use and dissuade visitors from creating unauthorized access routes.

Trailhead Signs

Upon entering a developed trailhead facility, large signs with a complete map and description of all the nearby trails and facilities, local regulations, emergency contact information, and educational messages should be located to funnel visitors to the developed facilities such as rest rooms, trails, launch, etc. This main trailhead kiosk is an ideal place to describe trail length and relative difficulty, allowing visitors to make informed decisions about their recreational experience. Trailhead kiosks can incorporate interpretive, programming, volunteer, and printed information such as maps. The total amount of information provided should mesh with the level of facility development. Major trailheads with significant parking should creatively incorporate most information, while striving not to reach “information overload”, while smaller trailheads may only require a map board (with location), emergency contact, and basic regulations.

APPENDICES

Trailside Signs

Signs at trail intersections should provide clear, concise directions for how to stay on the trail or return to a trailhead. This navigation assistance is best provided on wooden or fiberglass posts at heights easily read by trail users, typically 60 – 84 inches from ground level, with standard iconography for allowed uses and difficulty level. Intersection signs can post location identification information to aid in emergencies. Outside of trail intersections, little signage is required on trails. Longer trails may necessitate waymarking, "confidence" signage, also placed on posts with location information.

Regulatory And Warning Signs

Human management of delineated rules will be difficult except in spot locations. While it is simple to list dozens of prohibited activities, the success of regulatory signage is usually dictated by its practicality, ease of comprehension, and attitude. Fewer, more practical rules and explanations about why regulations are present almost always achieve higher compliance rates. Images and short phrases are much easier for a broader segment of the public to take note and understand. Positive phrasing of rules engenders a spirit of cooperative management with the public.

Warning Signs

Signs play a vital role in managing risk. These signs alert the public to known hazards and the potential hazards of changing environmental conditions. When appropriate, warning signs should be used to mark known hazards. Position them well in advance of the hazard or risk so that visitors have enough time to read the sign and react. Also consider adding signs before unexpected challenging technical trail features, like drop-offs, narrow bridges, or other elements of increased risk. Where human-vehicle interactions will occur, traditional yield signs, painted crosswalks, stop signs and traffic signals are necessary. Along the trail approaching a road crossing, both "slow" and "stop" signs should be considered. Additionally, consider placing information signs, such as trail name and allowed uses, on either side of a road crossing, as these are trail-system access points.

APPENDICES

Emergency Signs

No matter how well-signed and maintained, there are likely to be incidents that require immediate maintenance or emergency response. With the duty to warn the public of potential hazards upheld, the ability of signs to help direct a timely incident response helps to demonstrate an ability to minimize the severity of incidents. To facilitate emergency services access, each trailhead or access point could be assigned a physical address by an appropriate local agency and mapped by GPS. This physical address and GPS coordinates should be included on trailhead and intersection signs along with emergency contact information. Emergency management and park maintenance personnel should have complete map sets and sufficient training to mobilize to any site on the Greenway in the most efficient manner practical.

Educational Signs

Effective outreach signage that provides educational and interpretive messaging is vital to effect a positive trail experience, regulatory compliance, and visitor safety, perhaps more than any other management technique. These types of messages are essentially the auto-rangers of modern, extensive trail systems. Educational signs provide guidelines for responsible recreation and trail etiquette. Interpretive signs describe natural or cultural resources and agency or volunteer-led programming.

APPENDICES

Responsible Use

It is always necessary in urban interface trail systems to provide guidance on trail etiquette, preparedness, and good stewardship of resources. Again, stated with positive phrasing and reinforced through targeted agency-led or peer-to-peer programming (such as citizen/park ambassador patrols or trailhead presence) attains the highest levels of compliance.

Interpretive Signs

Interpretive signs provide information about points of interest along the trail, helping to make an experience interactive for visitors. Often keying on natural, cultural, or historical facets, these signs help frame a larger context for a recreational experience. Recently, interpretive signs have expanded in scope to include skill development contexts that promote safer use or are integrated into self-paced park programming such as play areas, scavenger hunts, seasonal changes, or art-based activities. The keys for types of signs and their density in placement revolve around matching the development level of nearby facilities with the signage. Additionally, in areas where higher speed differentials are expected such as paved trails, interpretive signs and associated activities should be removed from the immediate trail corridor and proper ingress/egress planned.

APPENDICES

APPENDIX C

USE CONFLICTS: KEYS TO SUCCESSFUL TRAIL MANAGEMENT

APPENDICES

Humans congregate to trails for a multitude of reasons. Relaxation, exercise, nature contemplation, social time with friends all bring people out to our selected paths through nature. But one concept unites every trail user- the desire for an experience idealized within their mind. More simply, they want to have a good time. When this experience suffers, it is human nature to attempt to assign blame. And it's also human nature to assign that blame, whether justified or not, to those seen as different or not having the same values. This natural human tendency has driven the idea of trail user conflicts, especially on shared-use trails.

Trail professionals have the ability to detect potential conflict situations and address them during the design and construction phases of a project. Thoughtful development of trails drastically reduces the potential for conflicts between different types of trail users; designs that help to minimize speed differentials, improve sight lines, and reduce the potential for startling, routes that take visitors to desired destinations and keep them away from sensitive areas or non-compatible situations, trails and trailheads that help frame the trail experience and basic etiquette expected.

At the core of this etiquette is the trail user's responsibility to leave the land as it was found. Many trail managers find that this foundation can be used to encourage volunteers to assist in the maintenance and management of the trails. This has been found to be most effective, especially in smaller communities, when the trails are shared by different types of modalities of users (i.e. hikers, runners, bikers, wildlife watchers and equestrians or motorized users where trails can be designed, constructed, and maintained to sustain this "heavier" use) share the trails. Shared-use trails are also the most cost and land effective way for managers to conserve natural resource values on lands employed for recreation.

The following is an excerpt from Dr. Roger Moore's (NCSU) *"Conflicts On Multiple-Use Trails: Synthesis Of The Literature And State Of The Practice"* (1994)

The challenges faced by shared-use trail managers can be broadly summarized as maintaining user safety, protecting natural resources, and providing high quality user experiences. These challenges are interrelated and cannot be effectively addressed in isolation. To address these challenges, managers can employ a wide array of physical and management options such as trail design, information and education, user involvement, and regulations and enforcement. Past research has consistently found that most outdoor recreationists are satisfied with their recreation experiences. Likewise, most trail experiences on multiple-use trails are probably enjoyable and satisfying. Conflicts among trail users do exist, however, and these conflicts can have serious consequences.

Conflict in outdoor recreation settings (such as trails) can best be defined as "goal interference attributed to another's behavior" (Jacob and Schreyer 1980, 369). As such, trail conflicts can and do occur among different user groups, among different users within the same user group, and as a result of factors not related to users' trail activities at all. In fact, no actual contact among users need occur for conflict to be felt. Conflict has been

APPENDICES

found to be related to activity style (mode of travel, level of technology, environmental dominance, etc.), focus of trip, expectations, attitudes toward and perceptions of the environment, level of tolerance for others, and different norms held by different users. Conflict is often asymmetrical (i.e., one group resents another, but the reverse is not true).

The existing literature and practice were synthesized into the following 12 principles for minimizing conflicts on multiple-use trails. Adherence to these principles should help improve sharing and cooperation on multiple-use trails.

1. Recognize Conflict as Goal Interference -- Do not treat conflict as an inherent incompatibility among different trail activities, but goal interference attributed to another's behavior.

2. Provide Adequate Trail Opportunities -- Offer adequate trail mileage and provide opportunities for a variety of trail experiences. This will help reduce congestion and allow users to choose the conditions that are best suited to the experiences they desire.

3. Minimize Number of Contacts in Problem Areas -- Each contact among trail users (as well as contact with evidence of others) has the potential to result in conflict. So, as a general rule, reduce the number of user contacts whenever possible. This is especially true in congested areas and at trailheads. Disperse use and provide separate trails where necessary after careful consideration of the additional environmental impact and lost opportunities for positive interactions this may cause.

4. Involve Users as Early as Possible -- Identify the present and likely future users of each trail and involve them in the process of avoiding and resolving conflicts as early as possible, preferably before conflicts occur. For proposed trails, possible conflicts and their solutions should be addressed during the planning and design stage with the involvement of prospective users. New and emerging uses should be anticipated and addressed as early as possible with the involvement of participants. Likewise, existing and developing conflicts on present trails need to be faced quickly and addressed with the participation of those affected.

5. Understand User Needs -- Determine the motivations, desired experiences, norms, setting preferences, and other needs of the present and likely future users of each trail. This "customer" information is critical for anticipating and managing conflicts.

6. Identify the Actual Sources of Conflict -- Help users to identify the specific tangible causes of any conflicts they are experiencing. In other words, get beyond emotions and stereotypes as quickly as possible, and get to the roots of any problems that exist.

APPENDICES

7. Work with Affected Users -- Work with all parties involved to reach mutually agreeable solutions to these specific issues. Users who are not involved as part of the solution are more likely to be part of the problem now and in the future.

8. Promote Trail Etiquette -- Minimize the possibility that any particular trail contact will result in conflict by actively and aggressively promoting responsible trail behavior. Use existing educational materials or modify them to better meet local needs. Target these educational efforts, get the information into users' hands as early as possible, and present it in interesting and understandable ways (Roggenbuck and Ham 1986).

9. Encourage Positive Interaction Among Different Users -- Trail users are usually not as different from one another as they believe. Providing positive interactions both on and off the trail will help break down barriers and stereotypes, and build understanding, good will, and cooperation. This can be accomplished through a variety of strategies such as sponsoring "user swaps," joint trail-building or maintenance projects, filming trail-sharing videos, and forming Trail Advisory Councils.

10. Favor "Light-Handed Management" -- Use the most "light-handed approaches" that will achieve area objectives. This is essential in order to provide the freedom of choice and natural environments that are so important to trail-based recreation. Intrusive design and coercive management are not compatible with high-quality trail experiences.

11. Plan and Act Locally -- Whenever possible, address issues regarding multiple-use trails at the local level. This allows greater sensitivity to local needs and provides better flexibility for addressing difficult issues on a case-by-case basis. Local action also facilitates involvement of the people who will be most affected by the decisions and most able to assist in their successful implementation.

12. Monitor Progress -- Monitor the ongoing effectiveness of the decisions made and programs implemented.

Conscious and deliberate monitoring is the only way to determine if conflicts are indeed being reduced and what changes in programs might be needed. This is only possible within the context of clearly understood and agreed upon objectives for each trail area. The available research on recreational conflict is helpful for understanding and managing conflicts on trails. There is a great deal we do not know, however. This report concludes by identifying many conflict-related research topics that have not been adequately explored. Some of this suggested research is theoretical in nature, and some is suggested for applied experimentation by managers in the field. Trail managers recognize trail conflicts as a potentially serious threat. Many are optimistic, however, and feel that when trail conflict situations are tackled head on and openly they can become an opportunity to build and strengthen trail constituencies and enhance outdoor recreation opportunities for all users.